GEMINI 105M

PERFORMANCE CRUISING, INC.
7364 Edgewood Road • Annapolis, Maryland 21403 • Telephone 410-626-2720 • Fax 410-626-2726

GEMINI OWNERS' ASSOCIATION

The Gemini Owners' Association is an association of owners and those interested in Gemini cruising catamarans. It is independent of Performance Cruising, the manufacturer. The Association publishes a quarterly newsletter of 16 to 20 pages each, devoted to articles by owners, for owners, and interested parties. Articles generated are about modifications, problems encountered, adventures, questions, anything of interest to owners. There is also a directory published with the April issue listing all members and known owners.

Dues are $16 per year. Individual back issues are $3 each. A computer disk of issues from Volume 27 to 63 is also available at a cost of $1 per issue. However, the format is DOS WPS.1, and is text only without pictures. Check should be made payable to GEMINI GEMS and forwarded to the address below.

For those on the Internet, there is a listserv. Send a request to 'gemini-list-owner@rachel.net' to receive the postings to the listserv. To send items to the listserv the address is 'gemini@rachel.org'.

If you have purchased a used Gemini, please send the year of the boat, year of sale, some general information about extra equipment, and/or condition and sales price. This general information is published with the Directory so there is a source of actual sales prices for reference when planning to sell or for financing purposes. GEMS does not publish any names or addresses to preserve privacy.

The editor's address is

Dee and Dave Lovett
Gemini Gems
13028 Thunderhead Drive
Germantown, MD 20874
(301) 916-6745
geminigems@hotmail.com

When joining, please supply the following information with your check:

Name:
Address:
Telephone:
Fax:
E-mail:
Boat Name:
Aux. Power:
Berth:

GEMINI GEMS is only as informative as its members' contributions. Looking forward to your membership and input.

Jjm -- Editor

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QUICK START

BATTERY AND MAIN SWITCH

The batteries are under the navigation table in the port hull with the main battery switch just above them.

Turn switch to '1'. Everything on the boat will go through battery '1' including engine start. On '2' everything goes through '2'. Never use both because that way there is no reserve. When switching from '1' to '2' go through 'both'. Try to alternate use of '1' and '2'

DIESEL ENGINE

Turn on cooling water stopcock under starboard aft bunk. Make sure water filter is full.
Make sure gear lever is horizontal and in neutral. To start a cold engine it helps to have the throttle advanced. With the lever horizontal, use both hands, and with the left hand pull out lever 1/4" while the right hand lifts the lever to an angle of 45 Deg. In this way the throttle is advanced without the gears being engaged

Turn key to run, buzzer will sound. Press preheat first for a while then, while still pressing preheat, press start. Check that cooling water is coming out of the exhaust on the transom beside the outdrive leg. Drop the gear lever back to horizontal and the lever is now set to operate the gears. Lifting for forward and lowering for reverse.

In the back of the engine compartment are the valves to select the fuel from either the port or starboard 18-gal tank. There are two valves, which must point the same way. One is fuel feed, the other is return. These valves simply point to starboard or port.

The sonic drive leg is lowered by turning the red stop cock lever in the starboard cockpit locker, and then opening the black valve. When the sonic drive is down and locked there will be a loud click.

To raise the leg close the black valve. Pull out the chrome knob in the back of the locker to release the reverse lock, and then pump red handle. The first pump will be hard and then it should be possible to feel the leg slip out of reverse lock and start to come up. At that point let the chrome knob go and continue pumping. (if the lever and pump are hard to operate, that probably indicates a lack of lubrication. If it is important to raise the unit keep the chrome plunger out and push down on the back of claw that goes around the shaft and hooks over the 3/8" horizontal thrust bar which has a small spring holding it up. At the same time pump the red handle. This is a two-person operation). Once the unit is up, turn the red stopcock vertical, to stop any fluid loss through the pump so that the leg will stay up.

With the leg down the boat can be moved by operating the gear and throttle lever. The leg is connected to the steering so will be steered by the wheel.

ELECTRIC PANEL

The 12-volt electric panel has 7 circuit breakers:
compass
running lights: Nav light on pulpit, pushpit, front of mast for under engine
Masthead light: Nav light at top of mast for under sail
anchor light
cabin lights: Each light or fan is individually switched
shower pump: Pressure water and power to shower sump pump, which is separately switched.
instruments: Autohelm, tridata, wind and autopilot

The VHF goes direct to the battery.
The cigarette lighter goes to the cabin light circuit breaker
There is a 25-amp fuse with a spare protecting the switch panel down by the battery

SHORE POWER

The shore power is 30 amp.
The switches on the panel are all circuit breakers.
The top two are linked together as the main breaker.
Under these are circuit breakers for port, starboard, refrigerator and spare.
The battery charger is plugged into the port outlets.
There is a green light to indicate power in.
There is a red light to indicate a badly wired marina.

WATER

There are two translucent 30-gal tanks under the port and starboard aft bunks.
The tanks are filled individually from behind the main sheet track.
There is a 'Y' valve to select water draw from either the port or starboard tank.
There is an electric 12-volt pump to pressure water to each sink and the hot water heater.
There is a tip toe foot pump in the galley to manually pump water from the tank selected if the pressure water pump is not on.

PROPANE

In the port aft cockpit locker there are two, 20 lb. vertical propane tanks with overfill protection.
Only one at a time are hooked to the system.
The propane comes from the tank via a regulator and rubber hose to a junction box.
From the back of the junction box are 2 copper hoses going to each appliance.
From the rubber hose the propane can either go through the solenoid or through the by pass.
The solenoid is switched on at the switch panel and can be heard to click on.
The by-pass is intended for use when sailing. The 3/4 amp drain on the batteries to keep the solenoid open is too much. The by-pass valve is open when the lever is in line with the copper pipe.
The solenoid must be used when the shore power is on.

STOVE
Two burners, broiler and oven.
To operate burners on top of unit, as well as in broiler and oven, push knobs in to override flame failure safety cut off device. Turn to 'on' position, and apply a light. Hold knob in for a few seconds then set knob to desired setting.
The oven has a thermostat. Turning the knob on the front of the unit sets thermostat up to 250 Deg

FRIDGE
To light the fridge on propane, first select 'gas' on fuel selector.
On the left of the fridge at the bottom are two buttons. Press in the button on the right to operate flame failure cut out. Press left button intermittently. This operates the piezo lighter.
There is a prism on the left that will allow the operator to see if the burner is on.
(All the time the flame failure button is held, keep operating the piezo lighter, otherwise propane could flow without being lit)
The only way to tell if the fridge is working, is if the top starts to get warm after 20 min. There is no noise.

HOT WATER HEATER
The hot water heater is a six-gallon tank stored in front of the water tank under the bunk in the port aft cabin.

When the engine is running, the water in the heater tank is heated by a heat exchanger coil coming from the engine. There is a red handled valve in the front end of the engine compartment which is used to shut off the hot water going to the water heater tank. When the handle is pointing down, the engine is not heating the water. When the handle is horizontal, the water in the tank is being heated.

When on shore power, a switch on the main 110V panel turns on a 110V electric element in the tank, which heats the water.

CAUTION: Do not turn on the electric element unless water is in the tank. To fill the tank, run a hot water faucet until water comes out. This indicates that the tank is full – at which point it is safe to turn on the electric element and let the water in the tank heat up.

CAUTION: Make sure you do not run out of water from your 30 gallon tanks allowing your hot water heater to run dry with the electric element on.

TOILET
3\4 inlet and 1 1\2 outlet seacocks are behind and below the toilet, with the handle in line with the hose the seacock is open. At right angles it is closed.
On the 3\4 inlet line there is an Earth Safe sanitation device. The pellets in the device need to be changed depending upon amount of use. (pellets obtained from West Marine)
The Y valve behind the toilet directs the toilet water either overboard or into the holding tank. (the long end of the handle points to the hose in use; i.e. pointing right pumps overboard and pointing left pumps into the holding tank)
Turn dial on top of toilet counterclockwise to flush the toilet or clockwise to close the incoming water and pump the toilet dry.
WARNING: when sailing in rough weather, close this dial to stop water from flooding back into the toilet and flooding the boat.
The deck pumpout is on the side of the foredeck next to the sail locker.

CENTERBOARDS

There is a centerboard in each hull.
The centerboard is operated by a winch handle in the socket.
The centerboard is locked into position with a wing nut going over the 3/4" nut.
Releasing the wing nut and turning the socket approximately two turns counterclockwise, will fully lower the centerboard (it cannot be lowered too much). Tightening the wing nut will lock the board down.
Raising the board is simply reversing the procedure. Turn clockwise two turns until the board clonks on the top of the case.
The board will float up. If left unlocked. the back of the board will be 9" down.
The boards will push up if run aground.
The boards are only necessary for windward work or when close maneuvering in a marina. Only the leeward board is necessary but it does not hurt if they are both used. If in doubt put both down 1 1/4 turns.

RUDDERS

The rudders will operate at any depth.
To raise the rudders simply pull the control lines that are on the transom.
One line pulls the rudder up the other pulls the rudder down.
The sheet stopper that holds the rudder down must not be pushed down hard because the rudder will stick and something will break if grounded.
The engine is connected to the tillers on the top of the rudders and will steer whatever the depth of the rudder.

SAILS

Reduce sails when heeled to 7 Deg.
Reduce sails when winds reach to following strengths:

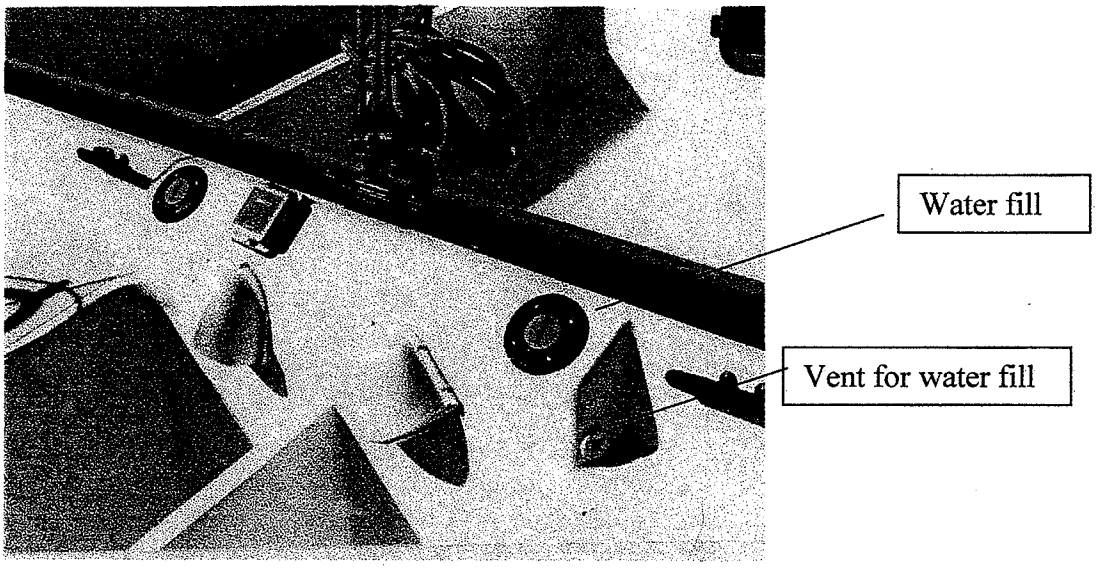
Main and full genoa	18 knots
Main and jib or reefed genoas	22 knots
1st reef in main and jib	26 knots
1st reef in main and storm jib	30 knots
2nd reef in main and storm jib	gale
1st reef in main alone is good above	30 knots

Reefing the genoa first is important because the genoa puts max load in mast and rig particularly when pounding to windward. The Genoa is 350 sq. ft. The jib is 220 sq. ft. The main is 260 sq. ft.

PLUMBING AND HEAD

WATER FILL

The water tanks are filled individually from inlets on the combing behind the mainsheet track. The tanks are vented just under the waterfills. There are two water tanks, each of 30 gallons situated under the aft cabin bunks.



SELECTION

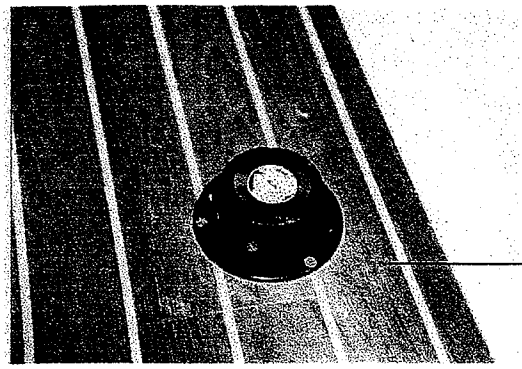
There is a Y valve under the port aft bunk. The short end of the 1/2 inch Y valve handle points to the hose that comes from the tank that is closed. It is easy to trace the hose from the bottom of the port tank. The other hoses from the Y valve go to the other tank or the pressure pump.

PRESSURE PUMP

The water pressure pump is also situated under the port aft bunk. Gemini comes with a Flojet pressure pump for fresh water. The main reason for pressure water is to use the shower. A foot pump is also standard. The pressure pump has a non-return valve that keeps the pressure in the line. The pump has a pressure switch that switches the pump on when the pressure drops to 15 psi and off when the pressure reaches 25 psi. If the pressure pump cycles on and off every few seconds, first check for a leak in the system. Then disassemble the pump and clean the debris out of the valves. It also could be that for some reason the non-return valve in the pump is not holding pressure. An accumulator just after the pressure pump can be installed which traps a volume of air that evens out the pressure fluctuations as the faucets are turned on and off. This would stop the pump coming on and off so often. The pressure pump should be turned off when not needed because even in a perfect system it will come on and off periodically.

FOOT PUMP

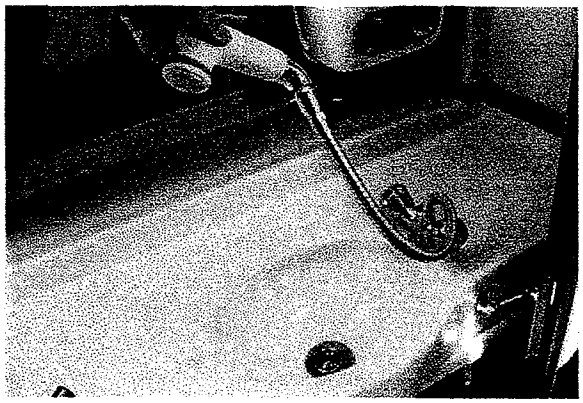
There is a whale foot pump in the floor beside the galley. This pump does not have a diaphragm but is like a bicycle type pump that can take pressure. This pump is in the line direct from the pressure pump to the cold faucet in the galley. This pump can only be used when the pressure pump is not in use. The purpose of this pump is to conserve battery power and water and to be able to get water from the tanks if the pump does not work.



Foot pump in galley when up. To keep it down, press and turn 90 deg. clockwise

SHOWER

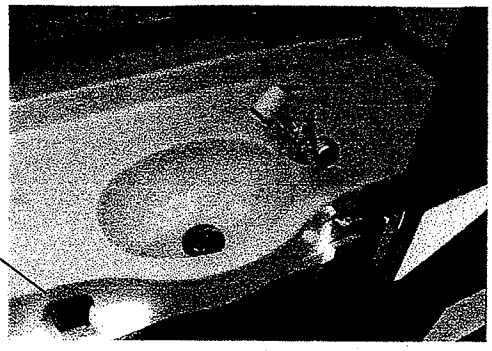
In the bathroom there is a combination faucet/shower. When the lever on the end of the spout is raised, and the spout is in the normal position, the faucet acts as normal. With the spout pulled out of its base this is then a hand held shower with a cut off lever to stop the flow of water without readjusting the hot and cold valves.



SHOWER SUMP

After showering, the shower water will collect in the sump. To empty the sump press the brown switch on the wall below the sink. This will activate the sump pump for as long as the switch is pressed. The pump is a small in line pump under the floor of the nav station. This pump is not self-priming, it must be air-lock free and below the level of the water in the shower sump. Every effort must be made to keep hair out of the pump. This is a low cost, low current, powerful pump that is the most functional. Replacing it if it fails is easy and still the most cost effective.

Shower sump: keep pressed until dry



HOSES
The water hoses used are reinforced plastic, suitable for drinking water and to take hot water.

CLAMPS
The hoses are secured with clamps to the various attachments. These clamps may need tightening periodically particularly if the boat was built in the winter when the hoses were stiff. They can be tightened with a screw driver or 5/16 wrench.

COCKPIT SHOWER
It is possible to tap into the cold water hose just after the pressure pump and run a hose to the aft deck for a shower.

MAINS ADAPTER
It is possible to fit a mains water adapter on the aft deck and run a hose to just after the pressure pump. However, if this is done the mains pressure must be reduced to prevent damage to the ships hoses.

WATER MAKER
Provision has been made for the installation of a modular water maker around the starboard aft water tank under the starboard aft bed. The water intake can be easily installed under the aft bed.

SALT WATER PUMP
A flipper-type pump that is compatible with salt water can be installed in the galley counter. A 1/2" through hull can be installed below the starboard aft bunk.

TOILET
The toilet is a Raritan ph2, which practical sailor recommended. This is a marine toilet with a lever handle that gives a mechanical advantage making pumping the toilet easier. An electric motor can be added to pump the toilet.

The pump is a dial, which is turned counterclockwise to flush the toilet and clockwise to close the incoming water to pump the toilet dry. **WARNING:** When sailing and pitching in rough water, always close this dial on the top of the toilet pump to stop water flooding back into the toilet and flooding the boat.

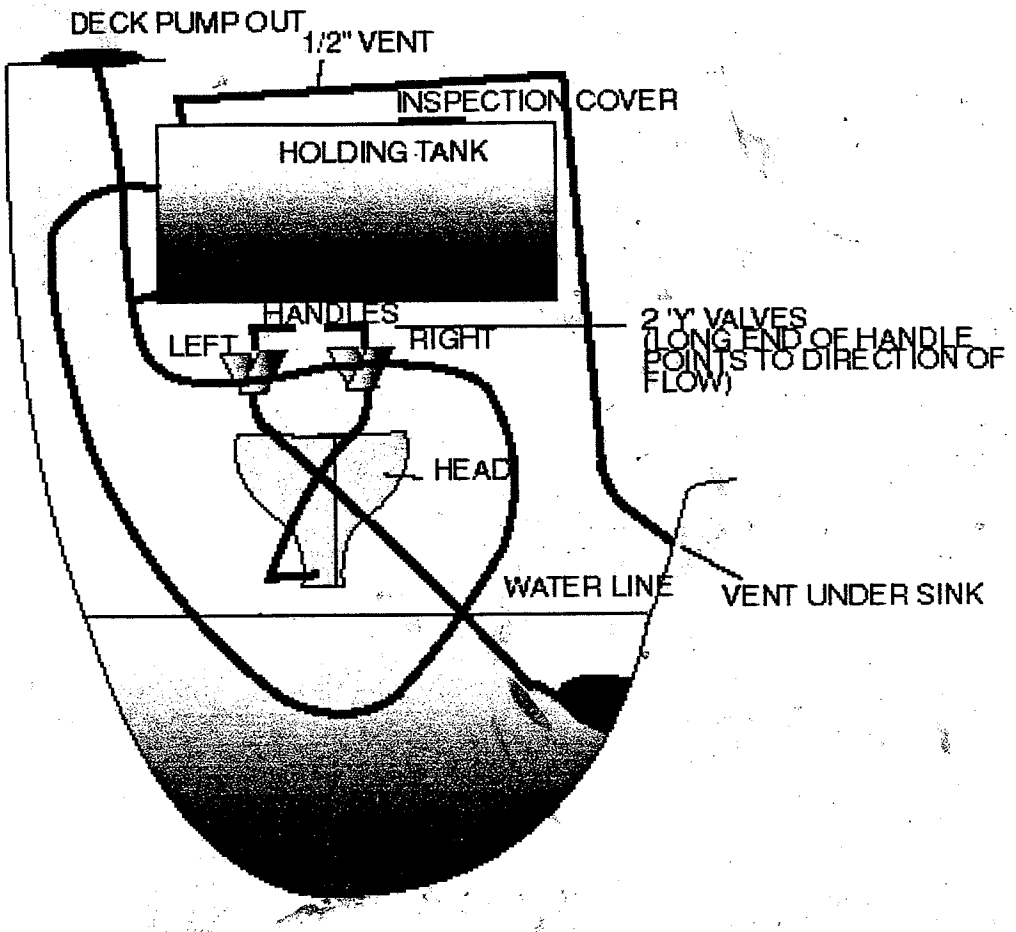
SEACOCKS
Behind and below the toilet on the left side is a 3/4" inlet seacock. On the right is a 1 1/2" outlet seacock. These fittings are plastic from Forespar.

BUOYANCY TANK
Forward of the seacocks is a vertical wall, which is the back of a buoyancy tank. The top of the buoyancy tank is the base of the sail locker. There is a 6" inspection cover in the vertical wall of the buoyancy tank.

HOLDING TANK

The holding tank is on the same level as the sail locker base. The holding tank is 18 gal with a 1 1/2" inlet at the top against the outside of the hull. The 1 1/2" outlet is at the bottom against the outside hull. The vent is on the same side with a 1/2" hose going across the tank to a through hull fitting under the sink. The holding tank can be inspected visually through the plexiglass bulkhead in the sail locker. It may be necessary to shine a flashlight behind the toilet from the other side of the tank to illuminate the fluid at the same time.

In the top of the tank is a 4" inspection cover. The tank can be inspected by unscrewing the top shelf in the sail locker. The tank can be removed through the sail locker by cutting the marine sealant tabing that holds the vertical plexiglass wall below the shelf in the sail locker.



DIRECTION OF LONG END OF HANDLE

OPERATION	LEFT HANDLE	RIGHT HANDLE
1. PUMP OVERBOARD	POINT RIGHT	POINT LEFT
2. INTO HOLDING TANK	POINT RIGHT	POINT RIGHT
3. GRAVITY DRAIN	POINT LEFT	POINT RIGHT
4. PUMP OUT HOLDINGTANK	POINT RIGHT	POINT RIGHT

Y VALVE

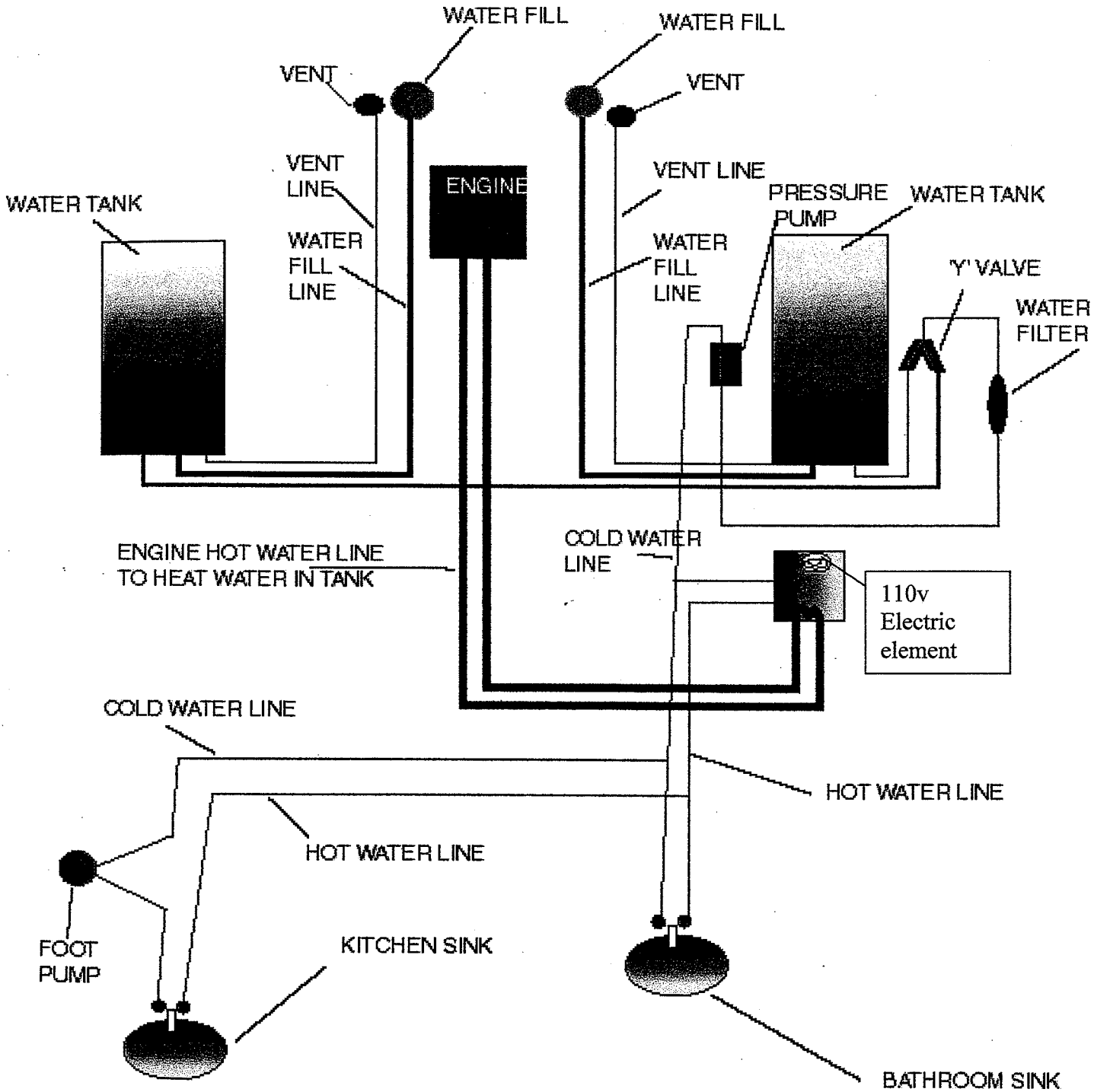
There are two Y valves behind the toilet that directs the toilet water outlet either directly overboard or into the holding tank. The second Y valve enables the holding tank to be gravity drained. The long end of the Y valve handle points to the direction of flow. When two handles point together, the toilet is pumped overboard. When both Y valve handles point right, the toilet pumps to the holding tank. When both handles point away from each other, the holding tank is gravity drained. When both handles point to the right, the holding tank can be emptied through the deck pumpout.

The Y valve used has a teflon seal so that it will not seize up or allow odor through. The hoses used are special odor free hoses.

EARTH SAFE SYSTEM

On the inlet side of the toilet is an earth safe system that passes the inlet seawater through a pellet that deodorizes and sanitizes the toilet. These pellets last one month of heavy use and six months of light use. Replacement pellets can be obtained from West Marine.

Water System



PROPANE

Propane is recognized by most yachtsmen and the Coast Guard as the best fuel for use on boats. It is the easiest to obtain, very economical and has more heat per lb. than natural gas. Propane will only explode if there is a ratio of between 12,000 and 65,000 parts per million of propane and air. At propane levels of below 600 ppm, propane smells are overwhelming. Each propane bottle contains 20 lbs. of propane and takes a long time to escape from a bottle in the event of a broken pipe. This is unlike gasoline which, with a small spillage instantly evaporates to an explosive mixture.

When leaving the boat always TURN OFF THE PROPANE AT THE BOTTLE.

SAFETY

In order to have a safe installation there are the following safety procedures:

The propane bottles are in a cockpit locker on the bridge deck with vents down through the bridge deck.

There is a separate copper line from the propane junction to each appliance with no joints in each line except at the appliance.

Each appliance has a flame failure cut out

There is a Xintec propane detector in each hull, hooked up to an alarm and a solenoid in the cockpit locker. The Solenoid will cut off the propane in the event the sensors detect propane at 25% of the lower explosion point of propane.

The fridge, once lit, has a continuous running pilot light that is in a box sealed from the cabin and vented to the outside.

TANKS

There are 2 x 20 lb. vertical bottles with a 5 year rust protection and overfill protection. **Note:** New, unfilled tanks are delivered with compressed air and must be purged the first time they are used.

There is a rubber tube connected to the fitting that has a pressure regulator. This regulator reduces the pressure of the propane down from bottle pressure to 11". There is a special left-hand thread that is first screwed into the bottle to connect the tube and regulator. A pressure gauge at the regulator is used to test for propane leaks. With all the units off and the bottle turned off there should be no pressure drop for at least 10 minutes.

JUNCTION AND SOLENOID

The rubber hose is then connected to the junction that has the solenoid and the various copper tubes going to each appliance. There is a bypass to the solenoid so that when sailing with no method of charging the batteries, the solenoid, which takes .8 amps to keep open, can be turned off. The logic to this approach is that the solenoid can be used when the boat is on shore power when there is the likelihood that the boat may be unattended. If the propane is turned on, which would be the case for a liveaboard, and there were to be a leak, the solenoid would be shut off by the propane detector. When sailing, the boat is obviously attended and therefore if there is a leak, detected by either smell or the Xintec alarm, the bottle can be turned off manually. The by pass is opened by turning the lever in line with pipe that is bypassing the solenoid. To test which works, light the stove, and see what stops the flow of propane.

XINTEC CONTROL PANEL

The Xintec control panel is mounted on the switch panel. When the 12 volt Guest switch is first turned on, the propane detector goes through a checking system and stabilizes with a green light over the number of each sensor on the control panel. The Xintec detector is wired directly to the battery and requires 200 mil., amps to operate. Pressing the left hand, end button on the Xintec control panel marked 'Solenoid', switches the solenoid open. There is a loud click in the propane locker when the solenoid opens.

CARBON MONOXIDE

When propane burns with a blue flame, there is only carbon dioxide produced and water vapor. **However, when the flame burns yellow, it means carbon monoxide is produced.** Carbon monoxide can also be produced if there is a 5% depletion of oxygen in the cabin while propane is burning.

All internal combustion engines produce carbon monoxide. A gas engine being worse than a diesel engine. The largest cause of carbon monoxide poisoning is from gasoline powered generators because they are left running for long periods of time.

Propane units, if properly maintained, will not produce carbon monoxide. In other words, keep them clean and always have good airflow around them. If you are at all nervous, you can try a carbon monoxide detector, but unfortunately they are not too reliable and can be affected by atmospheric conditions. They also have to measure the time exposure as well as the amount of carbon monoxide. Basically good ventilation is the only safeguard.

COPPER AND FITTINGS

The copper in use is 3/8", K type. Most of the copper fittings are connected to the various appliances with 3/8" flare fittings.

CHECKING LEAKS

To check for propane leaks all the connections should be tested. With the propane on, use a small paintbrush and liberally coat the joints with a mixture of dishwashing soap and water. If there is a leak, the escaping propane will blow bubbles in the soapy liquid.

STOVE

The stove is an English unit with 2 burners, broiler and oven. There is a flame failure device to each burner so that if the flame were to blow out, after about 10 seconds the probe beside each burner would cool down and the propane would be cut off. That also means that turning the burner on will not result in propane flowing. To light each unit there is a flame failure override procedure. This procedure is different on each unit. In the case of the stove turning the knob counterclockwise to full on and pressing in, allows propane to flow. Light the propane and hold the knob in for a few seconds. This warms up the heat sensor and the unit will continue to run. Completely turning the knob counterclockwise turns the flame up. To turn the flame down or off turn the knob clockwise.

The broiler is lit by holding a flame under the burner moving left to right and front to back. The broiler also has a flame failure.

The oven is lit by holding a flame to the burner at the back of the oven. There is a thermostat that controls the flame in the oven. The thermostat is controlled by the position of the knob. 8 is the highest temperature which is 250 degrees Centigrade, 482 degrees Fahrenheit.

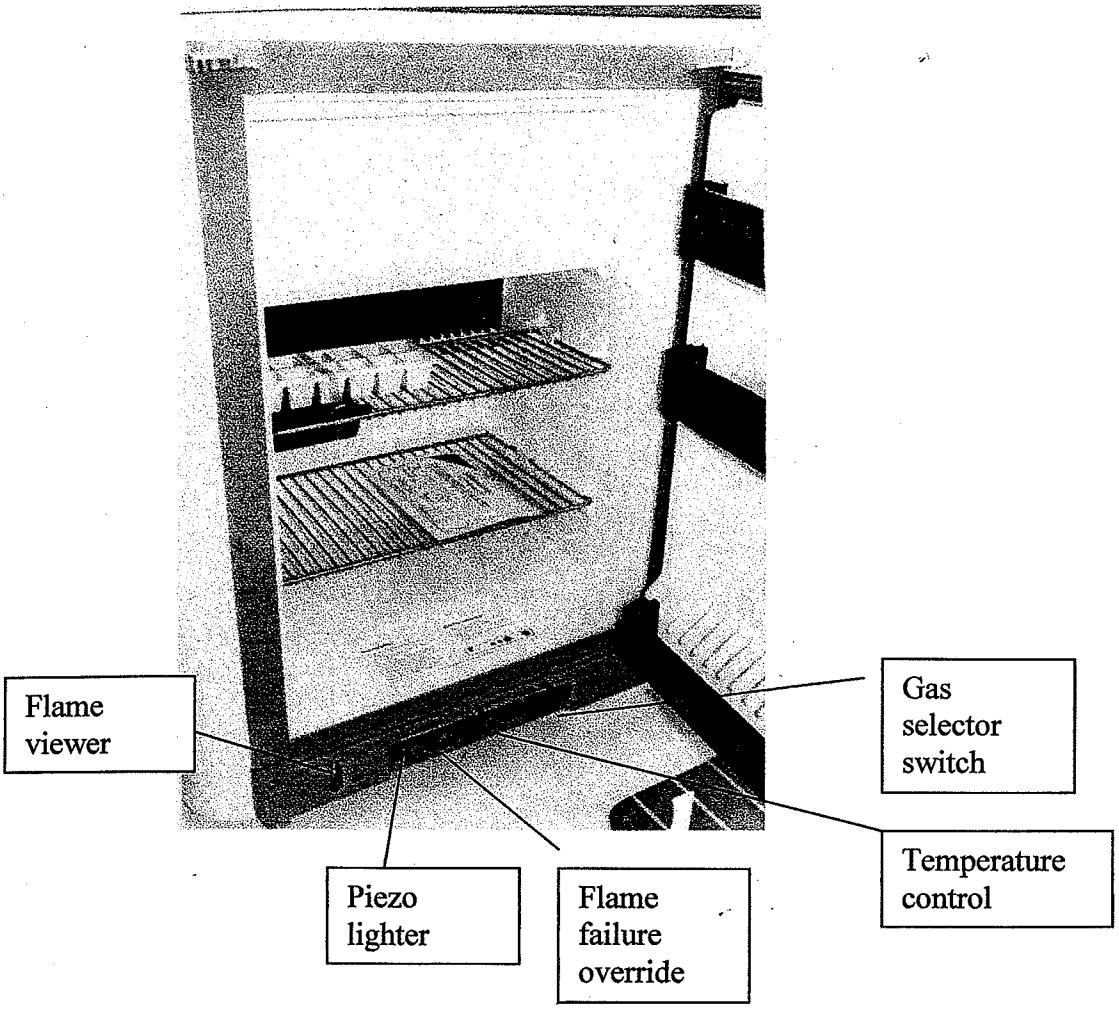
FRIDGE

The fridge is 3.5 cu. ft. and has a freezer compartment in the top. The fridge is totally silent when operating. The refrigerant is ammonia, water and hydrogen. The method of operation is called an absorption. The application of heat acts like a pump and starts the process. Heat applied by a small propane flame or an electric heating probe boils ammonia out of the solution of ammonia and water. This ammonia gas then rises and is cooled by the fins at the top back of the fridge. After taking heat from the fridge, the ammonia returns to the reservoir near the bottom of the fridge, remixing with the water. The reason this unit is sensitive to heeling and, therefore, is not suitable for monohulls is because the reservoir must be at the same level as the point where the ammonia is boiled out of the solution so that the water can go back to the reservoir. This type of unit is very reliable and efficient. Any failure is normally the switches or the thermostat. The fuel selector switch is sensitive to position, so make sure it is in the right position when turning to 110 volt.

To light the fridge on propane, select 'gas' on the fuel selector switch. Press in the flame failure override button and then press the piezo lighter button. Once the fridge lights it will take a few seconds to heat up the safety probe so that the safety button can be released. All the time the flame failure button is pressed, keep operating the piezo button every few seconds. The reason for this is if propane flows without lighting there could be a build up of propane. There is a prism on the left of the fridge down by the buttons through which it is possible to see the blue flame once the unit is lit. The only way it is possible to tell if the unit is working after 20 minutes, is to feel the top tube behind the fridge. This tube should be hot to touch.

To switch over to 110 volt, simply turn the fuel selector switch, making sure it is accurately in line with 'elec.'. When leaving the boat and turning the propane off at the bottle, first turn the fridge off. Letting the fridge burn out the propane in the line when the propane bottle is turned of will make it harder to light next time.

The fridge is vented from the cockpit. Fresh air comes in through the hatch near the cockpit floor. The hot air is then vented out through openings above the steering wheel. The 24x16 Bomar hatch should always be propped open when the fridge is running.



AIR CONDITIONING

In the past we installed a 12,000 BTU Cruisair with reciprocating pump and adjustable fan control. This unit when operating on shorepower could be reversed to produce heat. This unit draws 34 amps to start and 17 amps when running.

In 1998 we began installing the Mermaid 16,000 BTU air conditioner also with reverse cycle. This unit uses 24 amps to start and runs at 15 amps from 110V. However, the Mermaid's fan speed cannot be adjusted.

It is also now possible to have a 6500 BTU Mermaid air conditioner with a rotary compressor that only draws 6 amps from 100V. This small unit can run from a 1500-watt inverter and will draw 55 amps from a 12V battery. With this set-up, extra batteries and a larger alternator with a smart regulator, this air conditioner can be run when the engine is running without stressing the system. The 6500 BTU is on the small side; therefore, in order for it to be effective, great attention must be paid to keep heat from the sun, refrigerator, and engine out of the boat. One of the biggest sources of heat is the sun through the pilot house window -- blocking sun from entering the pilot house window should assist in keeping the 6500 BTU air conditioner effective.

SHOREPOWER

The boat comes standard with 110-volt shorepower, and the current rating is 30 amp. The female plug on the combing behind the mainsheet traveler is 30 amp.
The color codes of the wires are:

black live
white neutral
green ground

There is a circuit panel with breaker just inside the main door to port. The top of the panel has a green light that shows power is coming into the boat. Below this light is a red light that will only come on if the external power source is incorrectly wired. The top 2 switches are the main inlet switches rated to 30 amp.
The switches under the main switches have different ratings up to 20 amp.:

Port outlets
Starboard outlets
Fridge
Air conditioner
Spare

There are duplex outlets in the Head, Master cabin, Galley, Fridge area (close to main door), and Navigation area. The outlet by the navigation area is in the recess above the battery box, and is ideally suited to plug in a battery charger.

In the event an inverter/battery charger is used, it is important to make sure that the inverter cannot be on when the shore power is connected. Today's inverter is designed to take the shore power into it so that it can sense if the shore power is on. Today's inverter is so quick that if there were to be a failure on the incoming shorepower the inverter would switch over to battery without a computer failing. If a high demand shore power item is installed such as air conditioning that would take more power than the inverter is capable of supplying., then a separate line from the inlet should go to that appliance by-passing the inverter. This is because the inverter would try and supply the power necessary to run that appliance if there were to be a shore power failure and would keep over heating and shutting down.

Care should be taken with shore power hook ups because stray currents in the water will cause corrosion in rudder shafts, etc.

When testing electronic equipment, be careful that stray fields from the shorepower cables do not influence sensitive equipment.

The wire used is 3 core, 12 gauge, 600 Deg stranded boat cable.

12 VOLT

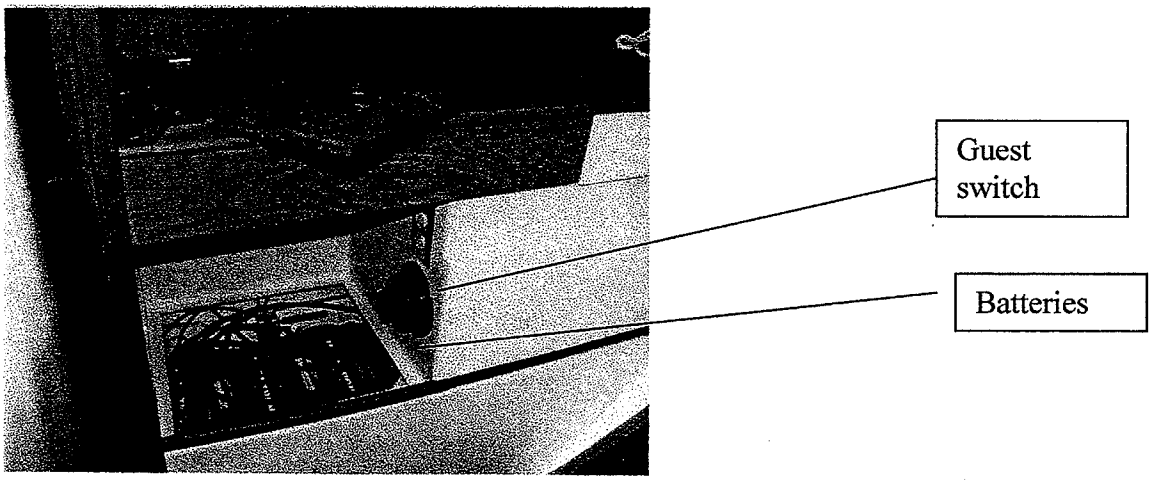
BATTERIES

There are 2 batteries installed as standard with room for more.
The batteries are number 24, deep cycle with a capacity of 85 amp each.
Deep cycle batteries, unlike conventional car batteries hold a charge better and retain an almost constant voltage until just before the battery dies. That is one reason why it is difficult to tell how much charge is left in the battery. The only accurate way is with the use of a hydrometer to check the acidity of the battery fluid. Battery managers that measure the flow of current into and out of the battery are good for continuous use but do not work well if the boat is left for long periods of time without use. Batteries lose charge by internal degradation at the rate of as much as 1/8 amp. an hour. As batteries are used, the distilled water changes to sulfuric acid and eventually the formation of sulfate crystals coats the plates in the battery and the capacity of the battery is reduced. If the battery is left at 60 % charge for long periods this will become the new 100 % and so on until the battery is dead. It is possible to tell when the battery is near dead when it can be fully charged in a short time.

Solar power is a great way to keep batteries in good condition because solar power puts out low current at high voltage. The solar panels we provide as options charge at 3 amps.

A battery can be brought to 80 % charge very easily but the last 20% requires a lot of time so that the battery is not overheated. That is why running the engine to charge the batteries is not efficient no matter what capacity alternator is in use.

The new smart chargers require a thermometer on the battery.
Gel cell batteries are expensive and can be damaged by over heating and theoretically can only be charged and discharged one quarter as many times as deep cycle batteries.



BATTERY MONITORS

A battery monitor can cost $200 and up. They measure everything that goes in and out of a battery through the negative side. This is a highly effective way of keeping track of available power. A voltmeter is not accurate enough, because it will not tell you what state of charge your battery is in.

SWITCH

There is a Guest switch down beside the batteries that go OFF, BAT1, BAT2, BOTH. If BAT1 is selected then everything in use on the ship goes through battery one. The engine is started by battery 1 and the charging from the alternator goes back into battery 1. Battery 2 is not in use. When BAT2 is selected then battery 2 is the only battery in use, battery 1 is not in use.

If battery 1 is used and left fully charged before switching to battery 2, then there will always be a full spare battery and vice versa.

We do not use a designated engine starter battery because we use small engines that do not use large currents to start them. If a designated starter battery is used then an automatic switch has to be used that, once the engine is started, first the engine battery is fully charged and once it reaches 13.8 volts then the other ship's batteries are charged. The problem, with this system as discussed earlier, is that it is easier to charge a flat battery than a fully charged battery so that the yachtsman that does not use his engine much, may perhaps never put any charge into the ships battery and of course there are some inefficiencies in the switch. **Refer to photo above.**

25 AMP FUSE

There is a 25 amp fuse between the live red 8 gauge wire going up to the switch panel and the battery. This fuse with a spare is down beside the battery.

There is no fuse between the battery and the engine because in the event of a short at the engine the battery cables are so large that the battery will quickly die before the cables over heat and cause a fire.

CODE

The normal code for 12-volt is red positive and black negative. Unfortunately the boat cable supplied sometimes comes red and black and sometimes white and black. We have chosen:

BLACK NEGATIVE
RED OR WHITE POSITIVE
This is different to shore power where black is live and white neutral.

The European system is different and electronic equipment that comes from Europe has the code:

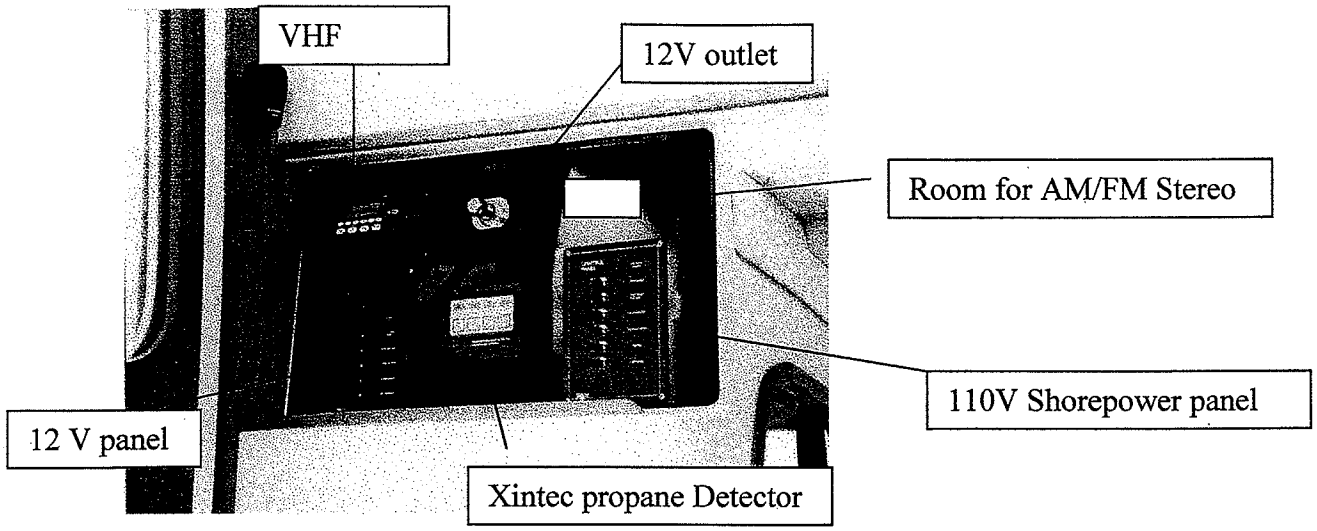
Brown positive
blue negative

SWITCH PANEL.

The switches on the panel are also circuit breakers and vary from 5-amp to 20-amp.:
Compass -- red light to illuminate compass.
running lights -- running at night under engine-red/green on pulpit-white on pushpit-white up mast, each 10-watt
mast light -- sailing at night- tricolor light at top mast 25 watt
anchor -- anchoring at night-all round white-10 watt
shower pump -- switches on pressure water pump and supplies power to shower sump pump that has its own switch beside sink in bathroom

cabin -- supplies power to cabin lights, all lights have their own switch.
If fans are used, they also come off this circuit breaker and have their own switch.
The cigarette lighter is also on this circuit.

Instruments -- supplies power to the electronic equipment



VHF
If VHF is installed it is recessed into the switch panel above the 12-volt panel. The VHF is wired separately to the battery

AM FM STEREO
There is room to recess a stereo in the switch panel above the shore power switch panel. The speakers are best located on the main bulkhead either side of the dinette.

LIGHTS
There are 3 fluorescent lights in the main cabin over the galley, navigation station, and saloon table
There are 12-volt dome lights in the head, master bedroom, each aft cabin and over the refrigerator.

BULBS
Do not know each bulb's specifications – take old bulb with you when you need to buy a replacement.
dome lights
mast head tricolor
anchor
steaming light up mast
bicolor on pulpit
stern light on pushpit

MAST WIRES

When the mast is being erected, the wires in the mast are pushed down through a 1-inch tube, 4 inches high in the center of the mast base. These wires come out in the roof of the master cabin under a removable panel. The wires that come down the mast are connected to the rest of the ship in the following way.

The coax for the VHF is simply screwed to the coax that goes to the switch panel.
The wire from the electronic equipment is connected color to color either side of the connecting block supplied.
The ground wire is a few unshielded strands of wire that should not be ignored, but attached to connecting block as shown in the illustration.

There are 2 twin core wires coming from the switch panel one labeled 'steaming' and the other labeled 'tricolor'. These are attached to the connecting strip.

The twin core wire labeled 'steaming' has its individual wires labeled :

white -steaming
black -ground or negative

The twin core wire labeled tricolor has its individual wires labeled :

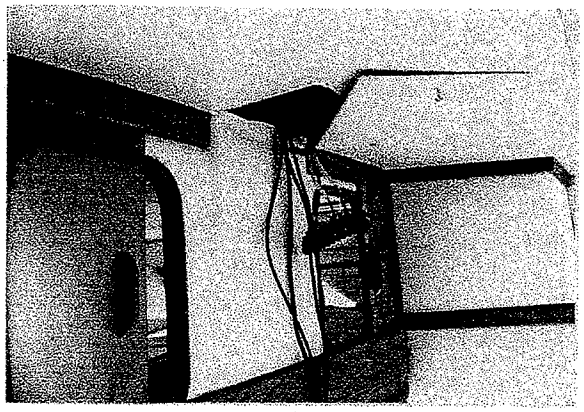
white -tricolor
black -anchor (this is the only time a black wire is live supplying power to the anchor light)

From the mast there are two sets of wire:

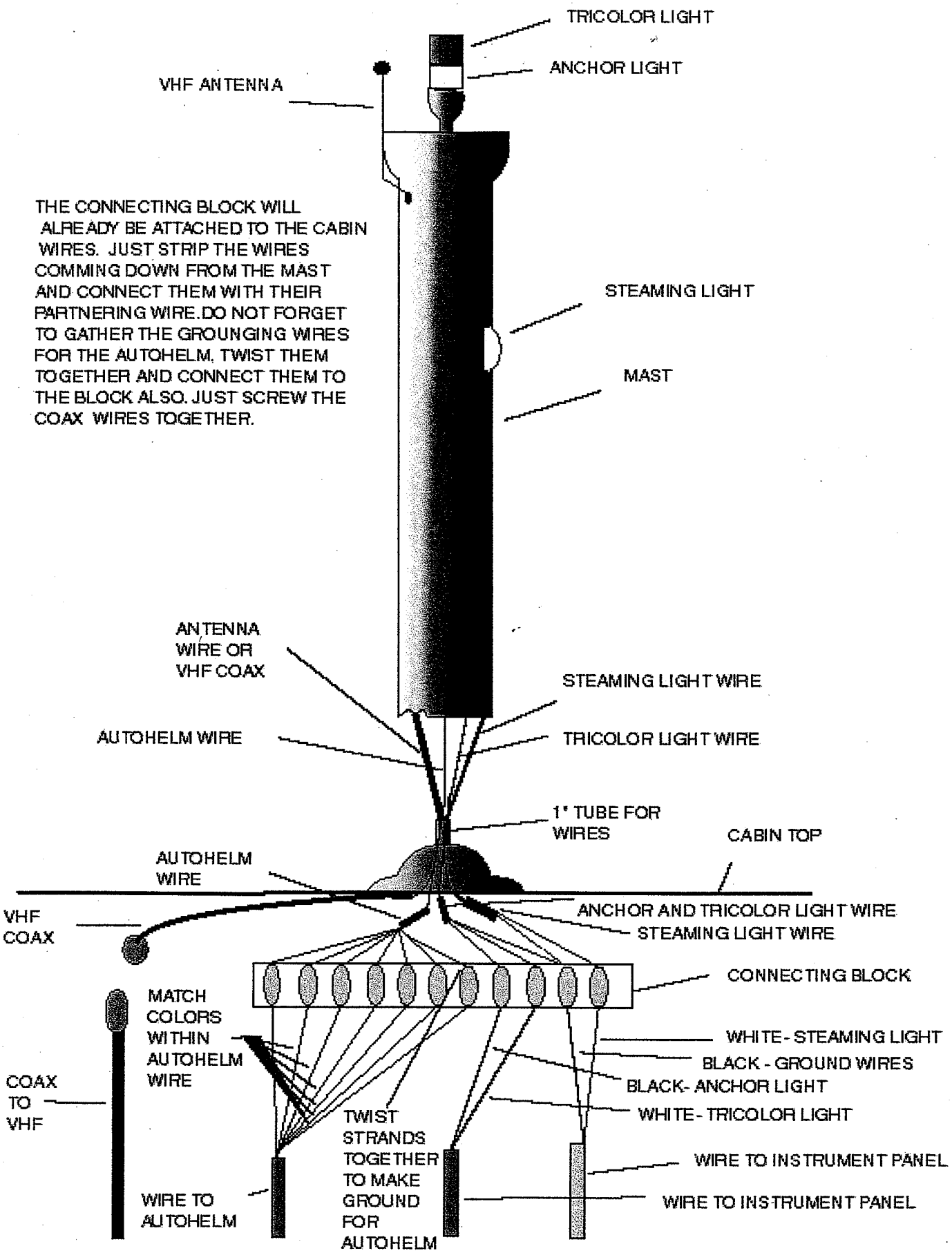
1. Brown and blue from the steaming light part way up the mast. The brown is the positive to the steaming light and the blue is the negative.
2. Brown, blue and strip yellow from the combination tricolor and anchor light at the top of the mast. The blue is the negative to both anchor and tricolor, with the brown being the positive to the anchor and the yellow being the positive to the tricolor.

The wires from the mast are connected to the instruments through the connecting block. First connect the two blue wires together and connect both of them to the matching blue wire in the block. Then match the rest of the wires to their partners based on color through the connecting block. Do not forget to group together and connect the ground wire strands. There is a wiring diagram drawn on the underside of the removable panel in the master bedroom.

Most of the 12-volt wires in the coax are under the roof molding. There is little chance of failure with the wiring except for the connections to the various pieces of equipment. All the connections are accessible.
The 12-volt wire used is 16 gauge 600 Deg boat cable wire.
(The 110 volt wires are 3 core and mainly under the dinette)



View from master cabin with panel removed


TRICOLOR LIGHT
ANCHOR LIGHT
VHF ANTENNA
THE CONNECTING BLOCK WILL ALREADY BE ATTACHED TO THE CABIN WIRES. JUST STRIP THE WIRES COMMING DOWN FROM THE MAST AND CONNECT THEM WITH THEIR PARTNERING WIRE.DO NOT FORGET TO GATHER THE GROUNGING WIRES FOR THE AUTOHELM, TWIST THEM TOGETHER AND CONNECT THEM TO THE BLOCK ALSO. JUST SCREW THE COAX WIRES TOGETHER.
STEAMING LIGHT
MAST
ANTENNA WIRE OR VHF COAX
STEAMING LIGHT WIRE
AUTOHELM WIRE
TRICOLOR LIGHT WIRE
1" TUBE FOR WIRES
CABIN TOP
AUTOHELM WIRE
VHF COAX
ANCHOR AND TRICOLOR LIGHT WIRE
STEAMING LIGHT WIRE
CONNECTING BLOCK
MATCH COLORS WITHIN AUTOHELM WIRE
WHITE - STEAMING LIGHT
BLACK - GROUND WIRES
BLACK - ANCHOR LIGHT
COAX TO VHF
WHITE - TRICOLOR LIGHT
TWIST STRANDS TOGETHER TO MAKE GROUND FOR AUTOHELM
WIRE TO INSTRUMENT PANEL
WIRE TO AUTOHELM
WIRE TO INSTRUMENT PANEL

MAST

The mast is 38 ft. off the deck. The bridge clearance is 45 ft. The boom is 14 ft. long.

The mast is deck stepped and sits on the main bulkhead. The main bulkhead is 3/4" teak ply, doubled to 1 1/2" thick under the mast. The mast is a double spreader rig with the shrouds coming down to the main bulkhead. The chain plates are slotted through the deck and bolted to the main bulkhead. There is a steel strap that transmits the load down to the bridge-deck. The slotting of the chain plates through the deck is the strongest system but needs maintenance. As the chain plates take load they stretch and break the seal. There is a stainless cap that is loaded with 3M 5200 sealant. Simply recaulking the chain plate will solve the leak problems.

Like most modern sail boats, the mast chosen is relatively light to reduce pitching and improve performance. When a light section is used it is necessary to use double or triple spreaders. Most race boats will use running backstays to keep the mast straight. With Gemini, in place of running backstays there are permanently mounted checkstays and a babystay to the lower spreaders. For offshore racing, removable checkstays to the upper spreader are recommended. Even the standard checkstays can be removed for efficient down-wind work.

The headstay, intermediate stay and lower shroud are 1/4".
The cap shroud is 9/32" to eliminate any chance of stretch over the upper spreader.
The backstay and checkstays are 7/32" because there are two of them, (a single backstay would be 1/4").

The halyards are low stretch ropes with spliced shackles. The rope is 3/8" or 7/16". The halyards are internal for the main, jib and topping lift. There is provision for a second internal jib halyard and a crane for an external spinnaker halyard. To use a spinnaker there needs to be lower halyard to support the spinnaker, and a pad eye to fix the spinnaker to the mast approximately 2' up from the base.

The masts are delivered with a combination anchor \ tricolor light on the top of the mast, a streaming light 2/3 of the way up the mast, coax for a VHF antenna and an aluminum tube in the mast with a feeder line to pull through the wires for the mast head instruments. The mast head unit of the wind instruments has to be drilled and tapped to the top plate, facing forward.

On the side of the mast at the base are pads at the right angle and position for us to bolt on two single speed winches, one for main and the other for the jib.

The gooseneck is riveted to the mast 24" up, with hooks on either side for slab reefing.

When setting up the rigging, the only important point is for the mast to be straight with all the side shrouds being the same tension. The best way to test for equal tension is to pull the shroud 6' up. With about 40 lbs. of pull the shrouds should move about 2". The headstay should be set to the right length and secured to the front hole on the stem plate. Tension is obtained from the backstays. Because there are two backstays they only need to be about half of the tension of the side shrouds. The checkstays and babystay do not need to be tight at all because they only serve to stop the mast from pumping when beating to windward. For racing, the clevis pin securing the turnbuckle to the pad eye can be replaced with a quick release 3/8 pin, for down wind disconnection.

The mast is normally set vertical. Moving the mast does not seem to affect the helm.

BOOM

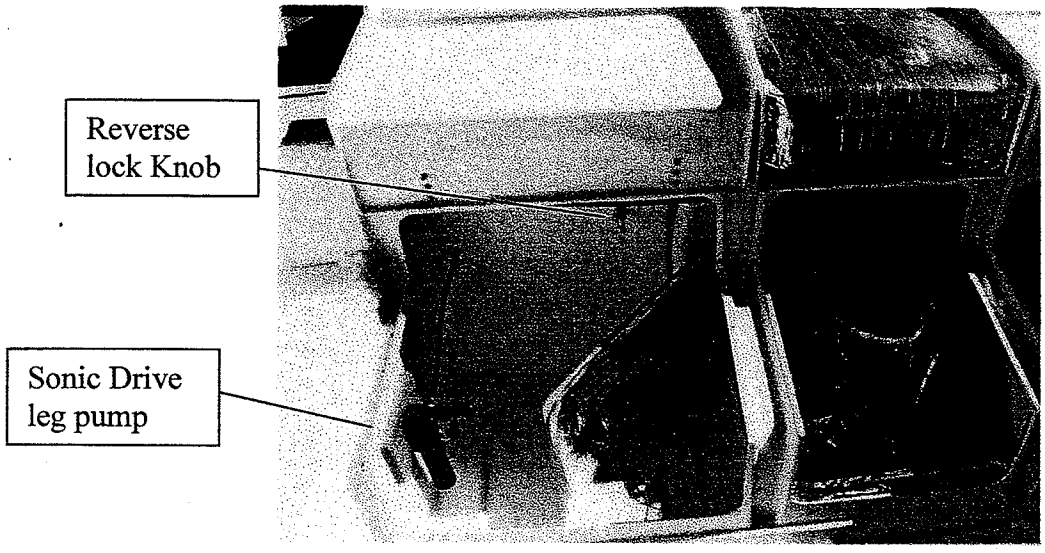
The boom is secured to the mast at the gooseneck with a clevis pin. The boom has four pulleys at the outboard end and four jam cleats at the underside of the boom at the gooseneck end. The starboard pulley and jam is for the first slab reef. The second is for the out-haul. The third is a spare and the fourth is for the second reef. The spare can be for a third reef. On the underside of the boom are 3 sliding pad eyes for either the attachment of the slab reefing lines or to be riveted in place for attaching preventers or boom vang. The sail that comes with Gemini has slides on the foot so that the end of the slab reefing line can be tied around the boom. The first slab reef is between the second and third slider from the end while the second slab reef is between the fourth and fifth slider from the end.

The main sheet goes to a triple block shackled to the under side of the boom. On the mainsheet track on the combing is a slider with a triple block, becket and jammer. Because the main sheet is a triple block with the becket and jammer on the center pulley, there is no good way to feed the lines without them crossing.

ENGINE

The standard Gemini engine is the Westerbeke 27 horsepower, Model 30B. The 27-hp diesel linked to a sonic outdrive leg gives good fuel economy and battery charging from its 55-amp alternator. The use of diesel is safe and can be used for other appliances on the boat such as heaters and generators. This engine weighs about 400 lbs. The fuel economy will range from 6 to 12 miles to the gallon depending on speed and conditions.

The Westerbeke engine is mounted on the bridge deck under the center cockpit hatch. The gearbox at the back of the engine is connected through a flexible coupling to the English built sonic out- drive leg. Access to the engine is through the cockpit and aft deck hatches. Side access on the starboard side which is where the oil dipstick, oil filter and water pump are situated is through an easily removable panel. Access to the port side is by unscrewing the side panel. *Please refer to your Westerbeke manual for oil change information and specific operating instructions.*



SONIC DRIVE LEG

The sonic drive leg has a claw that goes over the thrust bar. The claw is held down by an inverted "L" shaped lever, this allows the engine to reverse without coming up. The "L" lever is pulled forward by a knob in the starboard cockpit locker. Once this lever is moved forward the claw can move up off the thrust bar and the whole drive leg can be raised out of the water. As the leg drops back down to prepare for use, the claw pushes the spring loaded inverted "L" lever out of the way so that the claw can go over the 7/16" thrust bar. The spring loaded "L" then goes over the claw preventing the sonic drive leg from raising.

TO RAISE THE LEG: refer to photo

1: Small red lever next to pump handle in locker must be horizontal
2: Black knob must be tightened or closed
3: Pull out reverse lock knob at back of locker
4: Pump handle to raise leg
5: Turn red lever vertical - this will lock the leg up in case of a leak in the pump seal.

TO LOWER THE LEG:
1: Turn the small red lever horizontal
2: Loosen or open the black knob - the leg will drop and you should hear it lock into place.

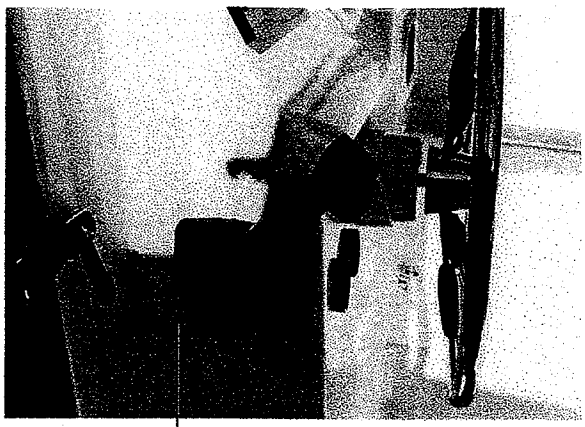
STEERING DRIVE LEG
When the drive leg is in position lines from the 8-inch tiller on the rudders go tight to the pad eye on the top of the drive leg and the drive leg is then steered when the rudders are steered.

COOLING WATER
The cooling water for the engine comes into the ship through a seacock under the starboard aft bed. There is a water filter by this seacock. The engine is a freshwater-cooled engine with salt water cooling the freshwater in a heat exchanger. There is a fresh water header tank on the wall above the engine.

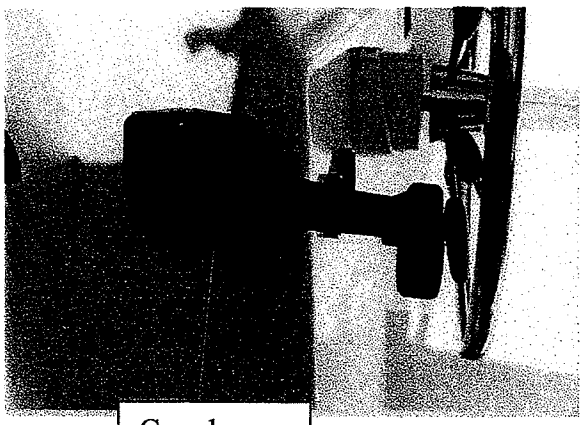
FUEL
There is one 18-gal fuel tank either side of the engine under the aft deck with fuel gauges by the switch panel. On the aft wall of the engine compartment are two fuel selector valves. One is fuel supply to the engine. The other is the return valve returning the unused fuel back to the tank. The valves simply point to the tank in use. Both valves should point to the same tank.

After the fuel valves there is a Racor fuel and water filter on the rear wall. After the fuel filter the fuel goes to the engine electric pump and then to another filter. Because the Westerbeke uses an electric pump the engine is self-priming.

GEAR LEVER
On the port side of the wheel is the single lever throttle and gear control. With the lever in neutral it can be pulled out 1/4". This disengages the gears so the throttle can be operated without moving the boat. Once the lever drops back to the neutral position, which is horizontal, the gears are engaged. Lifting the lever up 45 Deg. engages forward. The rest of the movement increases the engine speed. Moving the lever down engages reverse.



Gear lever shown in forward. If it is pulled away from the steering wheel ¼" the gears are disengaged



Gear lever in neutral

CONTROL PANEL

The control panel is on the console in front of the wheel. The control panel has a tachometer, oil pressure, temperature and an hour meter. The ignition key switch, preheat button and start button are in the panel.

START

To start the engine the preheat button must be pressed for a few seconds depending on the temperature. While the button is still being held down the start button can be pushed. Immediately after the engine starts make sure there is water coming out with the exhaust. If not, stop the engine and make sure the seacock under the aft bed is open. If it is then there could be a problem with the seawater pump on the starboard side of the engine near the oil dipstick. Changing the impeller is easy.

STOP

The engine can only be stopped by cutting off the fuel. This is done by pulling out the button below the steering wheel. When the engine has stopped and the alarms sound the ignition can be turned off with the key.

MAINTENANCE

Refer to the engine and sonic drive manual for maintenance details. Look for oil change times for the diesel, gearbox and sonic drive. The engine must line up with the flexible coupling. The gap between the bolt heads on the flex coupling should remain the same as the coupling is turned. The discs of the coupling, one on the engine and the other on the sonic drive, should be at the same level as the engine and in line side by side with the engine. The engine is sloped down at the front 5 Deg while the sonic drive mounting is sloped at 7 Deg. The combined angle between the rear-mounting wall and the engine mount base is 12 Deg. To adjust the engine to change the alignment, the engine mounts should be loosened and moved side to side or up and down to achieve the desired result.

ANCHORING

The boat is supplied as standard with a 22-lb. Danforth anchor, with 1600 lb. holding power. There is a stowing anchor roller on the bowsprit and an anchor locker just behind the bowsprit.

The Danforth has the highest straight line holding power, but will not take a wind shift. The anchor can be capsized and released and when loaded with mud can be difficult to reset if the boat is being blown fast. The flukes of the Danforth can be loaded with grass or kelp and then not hold.

The 22 lb. Bruce anchor is the strongest but can develop a ball of mud between the blades that do not hold. The flukes of the Bruce will probably get a hold in rocks and are strong enough not to break.

The 25 lb. CQR or Harbor fast from Simpson Lawrance will plough a circle in the sea bottom in the event of a wind change. The CQR is a strong forged anchor but is expensive, whereas the Harbor fast is fabricated.

There are other anchors similar to the three above with different features: The Aluminum Fortress anchor is like the Danforth but has a high blade area with lightweight. This anchor will hold well, but because of its lightweight will skid across the seabed if the boat is being blown backwards. The lighter 13 lb. Hi-Tensile Danforth has a higher holding power of 2200 lb. This anchor theoretically will hold more than the standard anchor once it gets a grip and digs in, but of course, does not have the weight to hold on a rock or if it gets loaded with weed. This is a good anchor for racing where weight is a consideration when sailing.

The standard boat comes with a short length of chain and 100' of 1/2" nylon rope. This is adequate for normal anchoring in sand or mud. The nylon will stretch to absorb the shock loads of rough sea. The chain helps to keep the stock down to make the anchor plough in. For anchoring in coral where the anchor line can rub across the coral and get cut, it is recommended that all chain be used. Chain will not absorb shock like nylon so it is not recommended for other uses. A compromise is to only use chain that will rub on the seabed.

There are numerous theories on anchoring. I would advise checking into these theories but do not automatically assume that in a bad storm two anchors are better than one. Unfortunately in a storm there will almost certainly be a change in the wind direction, at which point the two anchors will wrap together and pull out. There are several systems for anchoring in confined spaces to prevent the boat moving down onto other boats when there is a change in the wind direction. Anchoring fore and aft is one way. Another way is to set two anchors facing one another 150 ft or so apart, then connecting them together in the center with a swivel on the sea bed. Then, taking a line from the swivel up to the boat. In this system the anchors will not pull out in the case of a wind shear. Unfortunately this system will need considerable skill and time to set and retrieve.

Gemini only draws 18"and therefore can be anchored in much shallower places than any other sailboat. Anchoring in shallow water needs a lot less line and is obviously much easier to raise.

Normally the scope of the anchor is 7 to 1. In other words 10 ft of depth will need 70 ft of anchor line. A useful tip is to thread small colored line through the anchor line at 10-ft intervals.

Because the bridge deck is solid between the hulls it is easy to raise the anchor. Have the helmsman drive the boat slowly towards the anchor with the person raising the anchor giving directions toward the anchor. The person raising the anchor only has to flake the loose line into the anchor locker. As soon as the anchor line goes vertical, cleat the anchor line and let the forward inertia of the boat capsize the anchor releasing it from the

seabed. Then simply raise the anchor. Once the anchor is visible, recleat it and let the forward motion of the boat wash the anchor.

Gemini's are anchored in shallow areas. Anchors are much lighter than they would be if someone owned a large monohull with the same accommodation as Gemini. Therefore an anchor windlass is not necessary. However in the event an anchor windlass is needed, then the simple Power winch is the one we recommend. This has a rope drum with a chain sprocket on the inside. This system needs to have the operator flake the line into the anchor locker whilst standing on the switch. The Power winch uses a lot of current and needs a 40-amp circuit breaker.

CENTERBOARD AND RUDDERS

The centerboard is Gemini's secret weapon. Fixed keels, which are used in most cruising catamarans, are responsible for their lack of windward ability, slow down wind speed, and increased draft (from 18 in to 36 in) which dangerously lowers the center of buoyancy and affects their offshore ability and storm survival. Fixed keels that increase the draft to 3 ft have to be engineered to take striking an unseen rock without sinking the boat. Centerboards with their pivot at the front simply push up when they strike a rock.

Daggerboards are the most efficient, but are not a cruising option because when they hit something they have to break.

The drawbacks to centerboards are that they need a long slot. Because this slot is narrow, the boards must also be narrow, because of this it is difficult to design a board with a shape that does not create turbulence on the low-pressure side of the board. With experienced design, Gemini's' centerboards do not affect the accommodation. They are less accident prone than any other cruising catamarans with vulnerable fixed keels, and because they can be used one at a time, getting rid of the parasitic drag of the windward keel, they are dramatically more efficient than low aspect ratio fixed keels.

Asymmetric centerboards with reduced drag are an option for the racer to reduce the drag at the top of the board when the boards are down. Unfortunately with asymmetric centerboards only the leeward board can be used, necessitating the continuous changing of the board when tacking.

There is a centerboard in each hull. The centerboards are on the outside of each hull 7" off center to give foot room in the hull and to keep the centerboard slot to one side of the keel so that stones are not forced into the slot when grounding. The top of the centerboard case is level with the working surface in the galley and navigation station. The centerboard winch handle socket is in the wall of the galley and navigation station. The centerboards do not affect the accommodation and can not be detected when quickly looking into the cabin

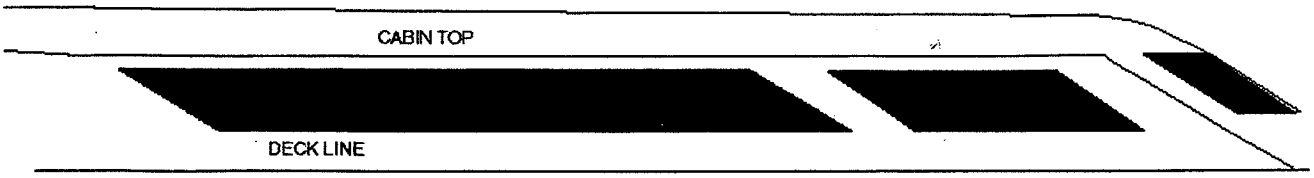
OPERATION

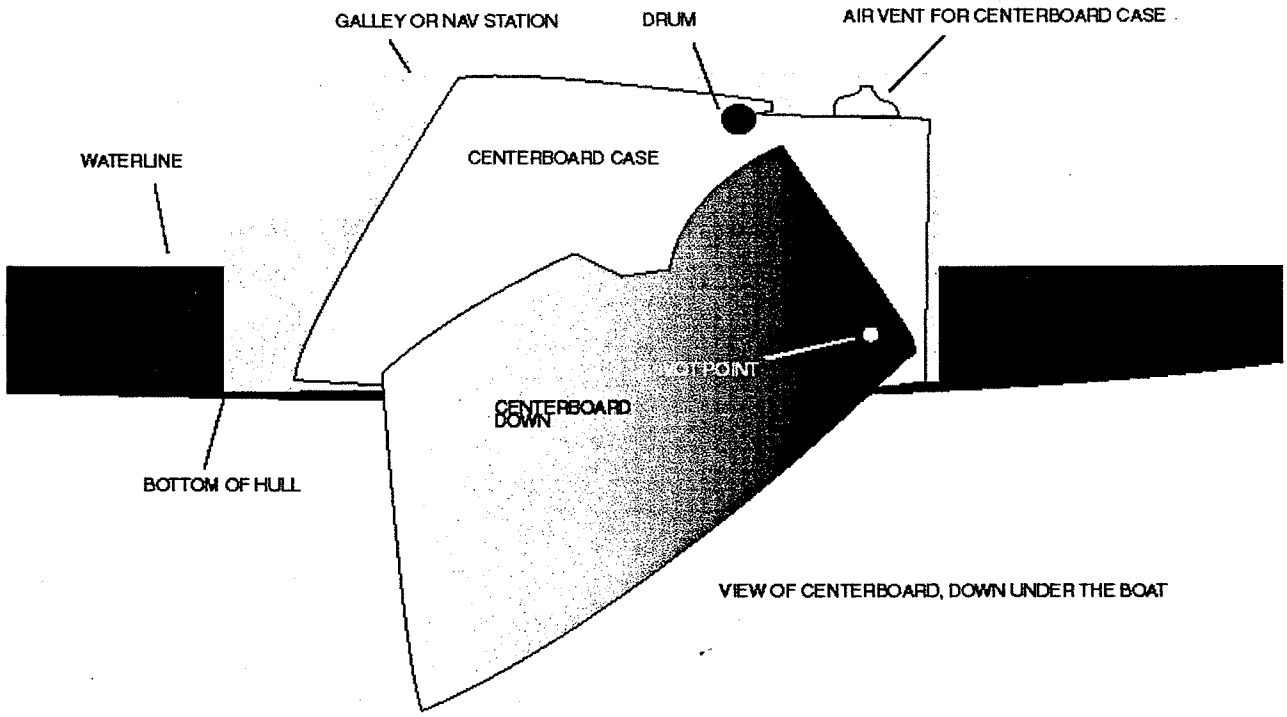
The centerboards are 7' long with the pivot 6" back from the front of the case in line with the main bulkhead and level with the floor. When the centerboards are fully down the leading edge is approximately 45 Deg. back and the exposed centerboard is in the shape of a quadrant or fin coming out of the bottom of the hull. Most of the slot is still filled with centerboard; this prevents turbulence and gives a strong bearing surface. The centerboards go down 4 ft below the keel.

There is a 3 1/2" solid PVC drum inside the case up at the top, 2' back from the front of the case. 3/8 " rope is connected to the top front of the centerboard. The rope then comes back across the top of the centerboard under a bolt and then up to the drum. When the centerboard is up, the rope goes approximately one turn round the drum on the outboard side, through the drum to the inboard side (where it is secured) then round the drum a further 3 turns. From the drum it then goes under the bolt and back to pad eyes on the top of the centerboard.

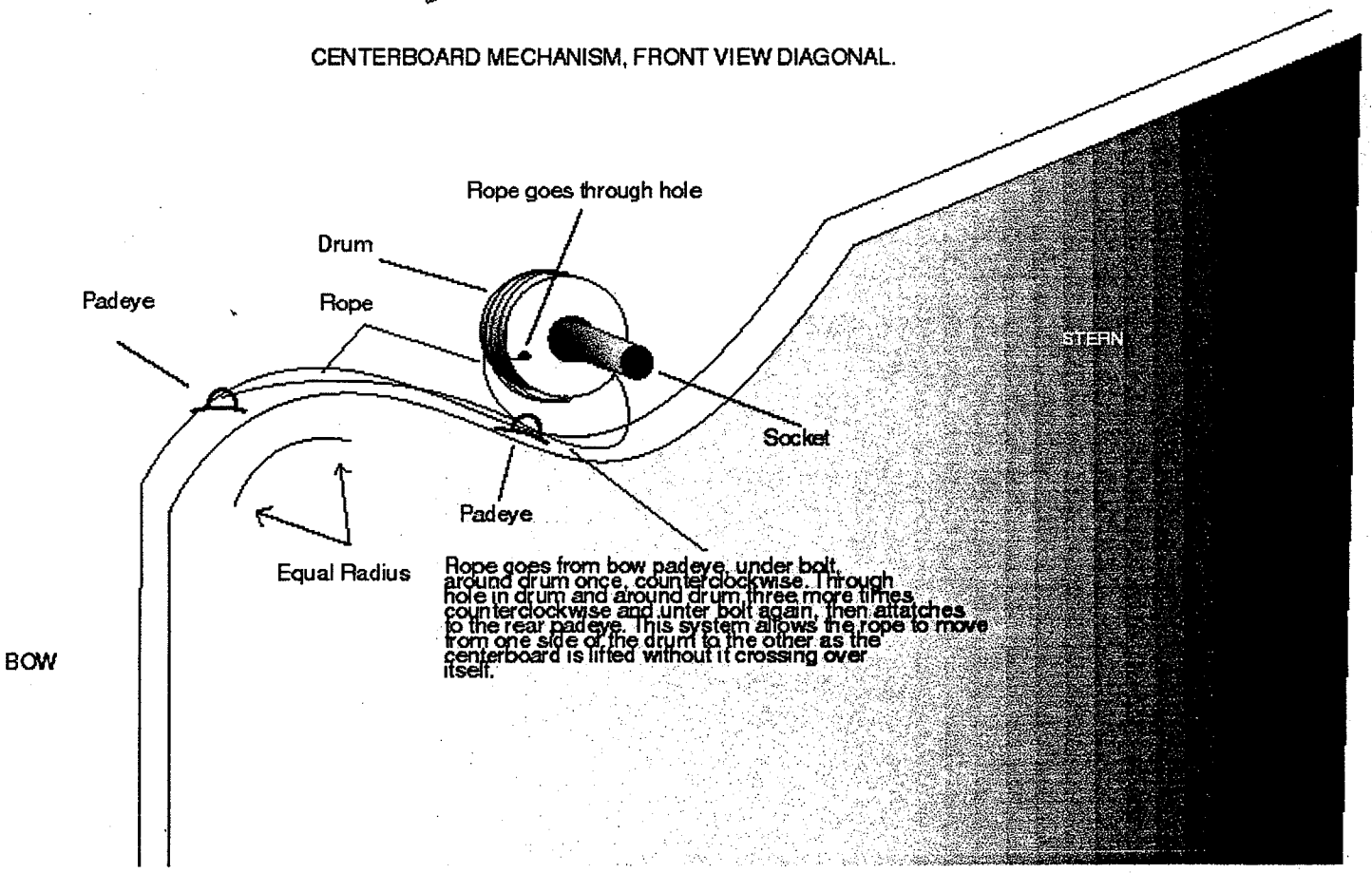
Inserting a winch handle in the socket and turning the drum counterclockwise approximately 1 3/4 turns lowers the centerboard. Turning clockwise raises the centerboard.

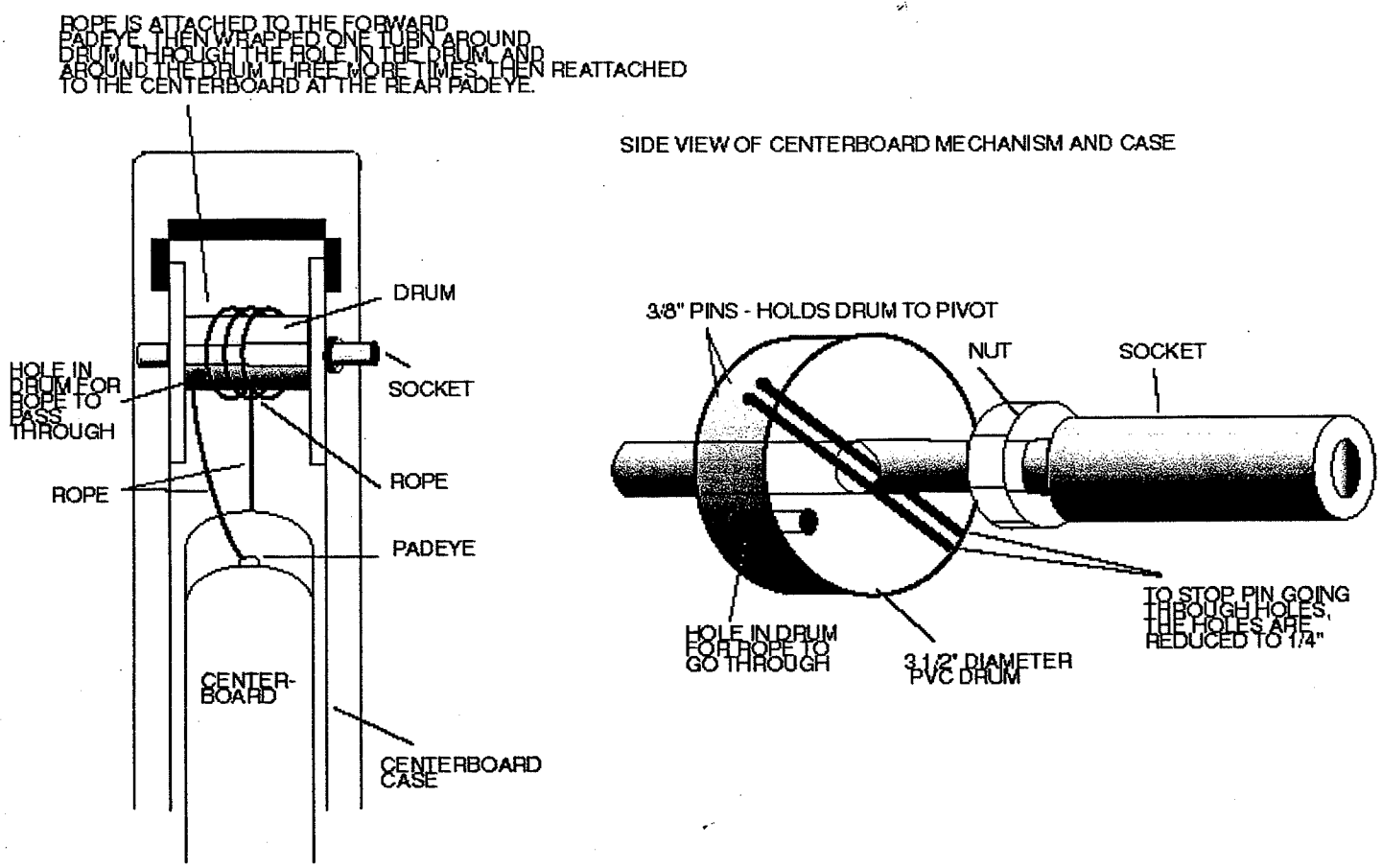
The centerboard is held in position by sliding a 1 1/4" wing nut over a 3/4" nut behind the winch handle socket. Clockwise turning of the wing nut jams the drum to the side and prevents the board from moving. The direction of rotation is such that if the centerboard were down and it struck bottom it would push up and simply undo the locking nut.





CENTERBOARD MECHANISM, FRONT VIEW DIAGONAL.





MAINTENANCE

The pivot is visible on the floor side and reachable behind the case. In the event of a leak the pivot can be tightened a little. 3M 5200 is liberally used to seal around the pivot and at worst can be resealed. The boat should be taken out of the water to do this. In over 400 boats we have found that pivot leaks are rare.

The mechanism in the case at the top can be reached by unscrewing the cap. The rare problems that can happen are for the rope to slip off the drum. This is near impossible because bolts hold the case together and a fiberglass washer covers the edge of the drum leaving no where for the rope to go. There has only been one rope broken. This rope can be changed with the boat in the water. If someone were to break the winch socket or shaft or drum this can also be changed with the boat in the water.

PERFORMANCE AND USE

The centerboards are only needed when sailing to windward with apparent winds closer than 70 Deg. From experience we have found that only the leeward board is necessary. In fact the boat is 1/2 knot faster with only the leeward board down.

For leisurely sailing use both boards 1 1/4 turns down. However, if the boards are down, and they do not need to be, then the lack of side pressure will cause them to rattle in the slot. Simply raise them. The boat will sail at any angle with no boards. However tacking is more difficult and the boat will slip sideways when sailing close to windward. It is more difficult to sail in light airs with no centerboards down. In heavy airs the leeward hull

makes a good keel as it is pushed down into the water. In fact, in rough conditions it is advisable to raise the centerboard a little to take some stress off it when punching to windward.

The technique to changing the boards for max. efficiency when beating is to lower the windward centerboard before the tack when the hull is raised a little, and the leeward centerboard takes the side pressure. After the tack when the sails are set then raise the new windward centerboard.

MOTORING

When motoring, the centerboards are not needed and, in fact will cause drag. When maneuvering at slow speeds centerboards down will make the boat easier to control. In strong cross winds when docking, both boards down will stop the boat being blown around.

STRONG WINDS

When reaching with winds above 25 knots the use of the leeward centerboard 3/4 turn down will steer the boat straight, reducing the load of the rudders. With strong winds there are big seas and it is these seas that cause the problem because the boat tries to broach when the leeward bow digs in. Of course with the boards up on a broad reach the boat will travel perhaps 14 knots, which is also putting stress on the rudders. Lowering the leeward centerboards part way reduces the top speed perhaps to12 knots but the reduction of stress on the helmsman is worth it, in fact, with the centerboard down the autopilot will probably be able to cope.

SURVIVAL AND OFFSHORE

Offshore with larger waves the centerboards seem to be used less. In fact off shore it is possible to sail up to 50 Deg without the use of the centerboards.

In survival conditions raising the centerboards would allow the boat to slip sideways away from breaking waves.

RUDDERS

The rudders are unique to Gemini. Because Gemini has lifting centerboards the rudders must also lift. In order to have transom steps the normal transom hung rudders that lift are not possible. The normal transom hung rudders on a sloping transom are not suitable for offshore use. The rudders on Gemini are a normal spade rudder glassed to a 1 1/2" solid rudder stock, with a permanently fixed 8" tiller that faces aft. There are two split rudder-bearing molds that are riveted around the rudderstock. These bearings are filled and faired, then painted. This sub assembly is complete and ready to go into the rudder recess in the transom of each hull. There is a 3/4" hole in the back top of the rudder bearing and the rudder recess also at the top back. After the rudder and bearing assembly is inserted into the rudder case recess, a 3/4" stainless tube is inserted in the 3/4" hole. This 3/4" tube is part of the Teleflex steering system.

The inner cable of the Teleflex steering cable is 33" long, with the outer cable split 15" from one end and 18" from the other. At the split in the outer cable, the inner cable is inserted into the helm assembly connected to the wheel. The outer ends of the inner cable have a stainless rod that passes through the 3/4" tube at the rudders. The outer cable is secured to the 3/4" rod. The stainless rods are connected to the tiller by means of a link arm. In this way, as the wheel is turned one rod *pushes* one tiller while the other rod *pulls* the other tiller. This is a totally balanced system, better than a single cable going to one rudder that is not very good in compression but good in tension.

The rudders are raised and lowered by a double purchase rope pulley system. The operation of the system is such that the rudders will steer at any position. There is no increase in tiller loads as the rudders are raised, unlike most other systems. The ropes that lower the rudders go through a sheet stopper. The sheet stopper is made inefficient by the addition of another rope so that if the rudder hits an under water obstruction then it will kick up. **NOTE:** When stationary, the rudders will stay down on their own, but when moving forward they want to kick up. The sheet stopper will prevent this, but do not over tension it because the lines could jam and cause something to break if they hit something.

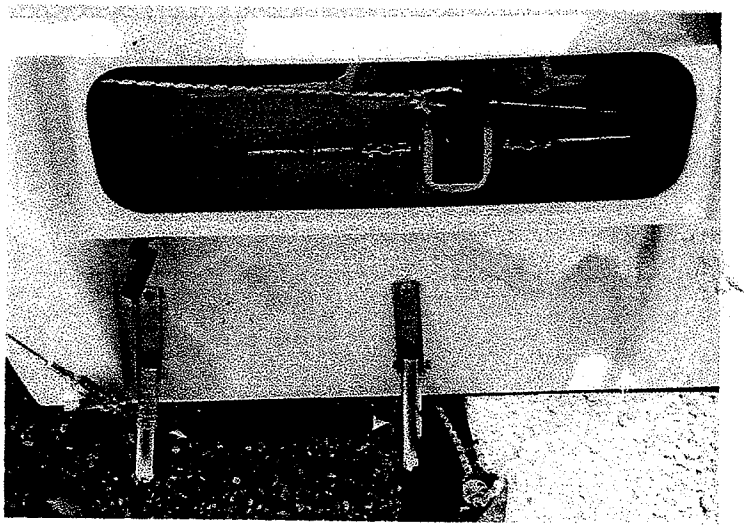
There are no holes drilled below the water line so that even if the whole rudder were to be ripped from the back of the boat there would be no holes in the boat unlike any other system.

Access to the rudder mechanism is through the hatch in the second transom step.

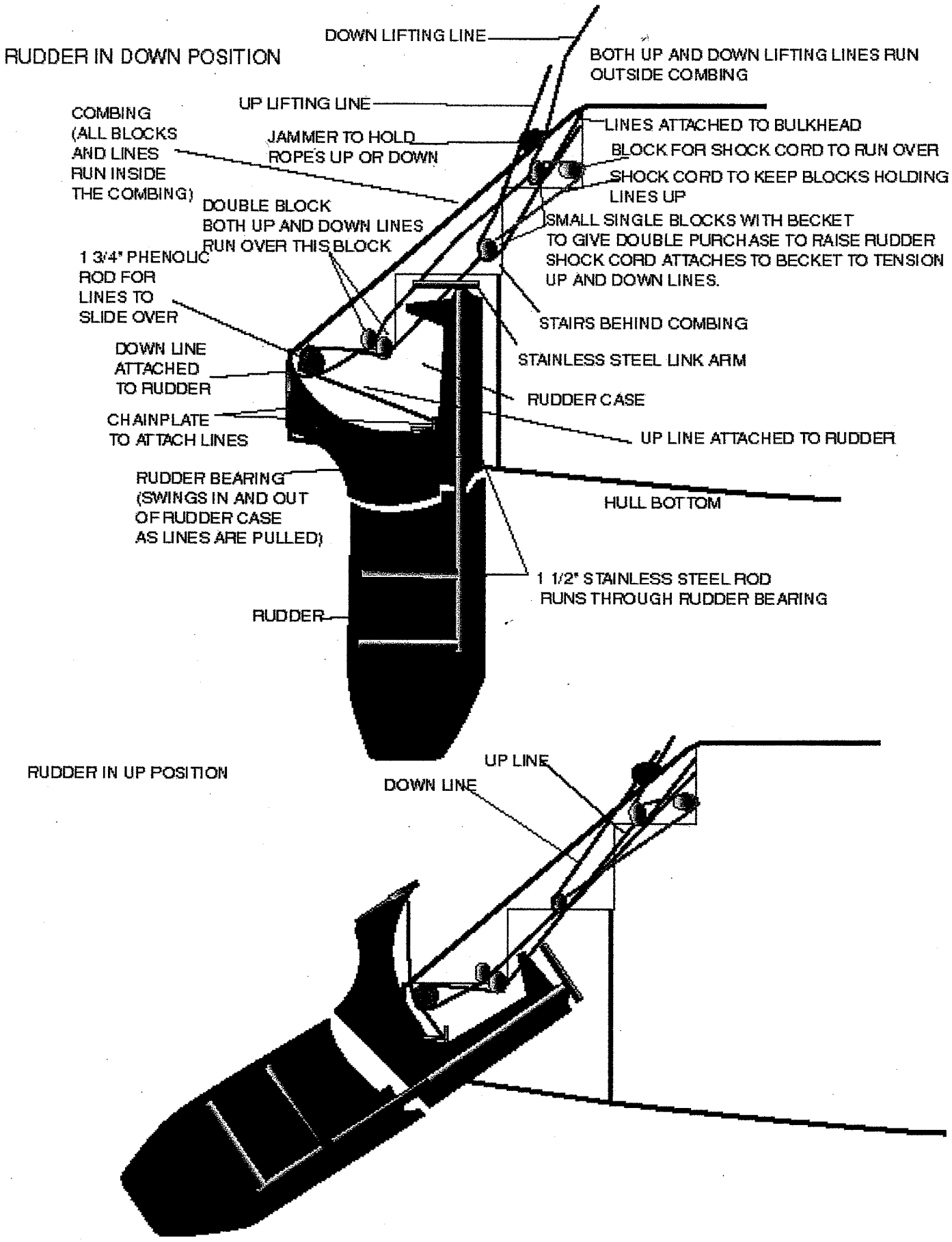
The engine is steered by ropes connected to the end of the tillers that exit the transom by the bridge deck and are then connected to the engine.

For emergency steering another pad eye can be fixed to the outside of the hull. With ropes to each side of the tiller and then the ropes connected together, a tiller can be connected to the two ropes that will steer the boat by moving one rope one way and the other rope the other way.

Shows left rudder all the way up and right rudder ¾ of the way down



View through hatch on middle step. Can see the steering cables, the top of the rudder case and the link arm


RUDDER IN DOWN POSITION
DOWN LIFTING LINE
BOTH UP AND DOWN LIFTING LINES RUN OUTSIDE COMBING
UP LIFTING LINE
COMBING (ALL BLOCKS AND LINES RUN INSIDE THE COMBING)
JAMMER TO HOLD ROPES UP OR DOWN
LINES ATTACHED TO BULKHEAD
BLOCK FOR SHOCK CORD TO RUN OVER
SHOCK CORD TO KEEP BLOCKS HOLDING LINES UP
DOUBLE BLOCK BOTH UP AND DOWN LINES RUN OVER THIS BLOCK
SMALL SINGLE BLOCKS WITH BECKET TO GIVE DOUBLE PURCHASE TO RAISE RUDDER
SHOCK CORD ATTACHES TO BECKET TO TENSION UP AND DOWN LINES.
1 3/4" PHENOLIC ROD FOR LINES TO SLIDE OVER
STAIRS BEHIND COMBING
DOWN LINE ATTACHED TO RUDDER
STAINLESS STEEL LINK ARM
RUDDER CASE
CHAINPLATE TO ATTACH LINES
UP LINE ATTACHED TO RUDDER
RUDDER BEARING (SWINGS IN AND OUT OF RUDDER CASE AS LINES ARE PULLED)
HULL BOTTOM
1 1/2" STAINLESS STEEL ROD RUNS THROUGH RUDDER BEARING
RUDDER
RUDDER IN UP POSITION
UP LINE
DOWN LINE

CONSTRUCTION

The hull of Gemini is a large one-piece molding. The mold that is used to make the deck is also one piece with no removable or add-on parts which would be obvious in the finished product, needing cosmetic rework. The centerboard and rudder cases are all part of the mold and have an elaborate air blowing release system. In this way the centerboard case and rudder case are all molded in at the same time as the hull is molded. This gives a dimensionally accurate, leak free and strong structure.

The hulls have a high quality marine gelcoat with a 20-mm veil and vinylester barrier coat. The main lay-up is all done at once, with no chance of interlaminate bond being a weakness. The main lay-up is comprised of layers of 24 oz stitched bi-directional woven, alternating with high stiffness 1 1/2 oz mat. The layers are in such a way that overlaps increase the strength in strategic places such as the keel. The keel is strong enough to support the boat on a point load, and ends up with fiberglass totaling 5/8" thick with additional wood reinforcing.

The Bridge deck has the same lay-up as the hull but balsa core is also used. The reason for using Balsa is because the bridge deck is flat and subject to heavy pounding loads.
Reinforcing to the hull is by strategic use of bulkheads and interior molds.

STRESS AND MOVEMENT IN CATAMARANS:
A monohull, which is basically a tube, is automatically stiff enough to take the mast and rigging loads. Of course the achilles heel of a monohull is the enormous point loads of the narrow keel which is almost half the weight of the boat. A wide catamaran will need cross arms to connect the hulls together. These cross arms have high point loads at connections, particularly when the boat is subject to twisting. Gemini is a narrow catamaran and can be considered as an upside down channel with the flat of the channel being the bridgedeck and the inside hulls being the walls of the channel. The rest of the outer hulls just keeps the water out. The narrow catamaran with full cabin is like a box and easily resists the twisting forces. As the mast pushes down on the center of the channel, the headstay and backstay pull up the ends. A channel subjected to high loads can only bend if the side walls deflect out. With Gemini the only signs of deflection are the side hulls moving up perhaps 1/4". This movement is impossible to eliminate and is definitely a result of headstay and backstay loads and not side shroud loads. The side shrouds are all connected to the bridgedeck and not the outer hulls. With the centerboard down this movement is only on the windward hull because the side push of the centerboard counteracts the outward movement of the channel side. The windward hull when lifted out of the water should be assumed to bend down, not up. This is further proof that the upward movement of the outer hull is induced by the backstay and headstay loads.

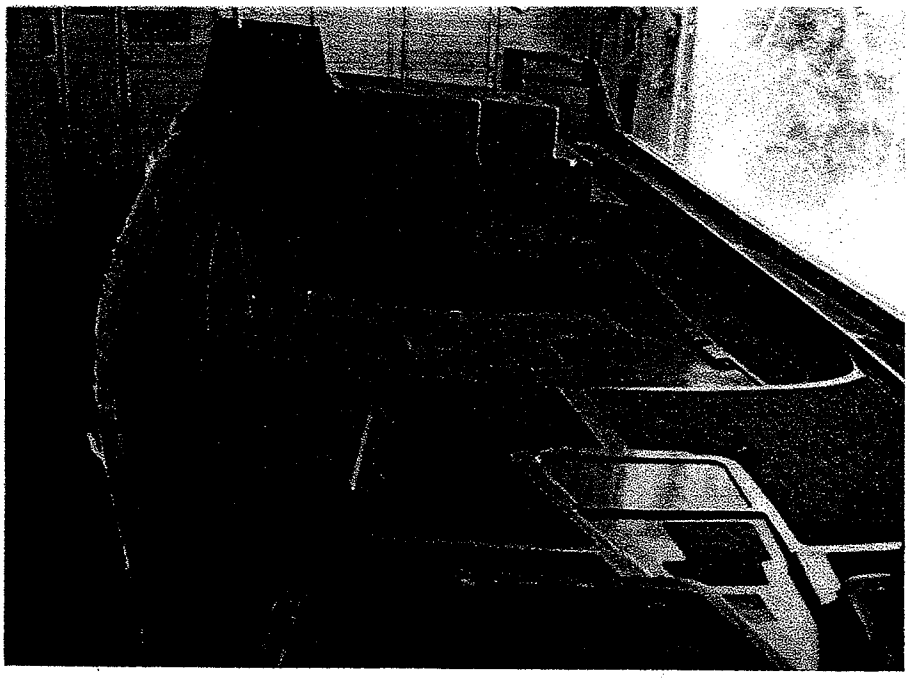
Because of this movement it is not advisable to keep the backstay tight. For racing there does not appear to be any damage if the backstays are tightened to the maximum just for the duration of the windward leg and then released, provided that the upward movement of 1/4" of the hulls does not damage the door jamb of the main bulkhead.

Geminis have been tested statically in the factory by lifting the whole boat on various chain plates with no signs of strain. The reason for racing is to thoroughly test the boat. When the adrenaline is pumping the boat is pushed to the max to win the race. Cruisers will stop to save their boat long before any damage is done.

DECK

The deck is a one-piece mold with all the horizontal surfaces balsa cored and the entire vertical surfaces as light as possible. The reason for Balsa is simply that fiberglass is impossible to walk on until it gets really thick and heavy. Anywhere a deck fitting is to be bolted, to prevent water from getting into the balsa, it is left out and reinforced with extra glass or plywood.

Backing plates are a commonly asked question but are misunderstood by even some boat builders. An item bolted on that takes shear such as a chain plate must not have a backing plate. The most important design consideration is to have the materials of such a thickness that they have the same percentage elongation under the same load so that the bolts are uniformly loaded. A backing plate would change the situation and put the entire load on the first bolt. Most items on the deck of a sailboat are subjected to torsion such as the stanchions. The most important design consideration is to transmit the load over a large area. This is most easily accomplished by molding in plywood; again simply making the fiberglass thick also helps transmit the load. Backing plates are academic because a failure would almost certainly be a large chunk of deck being ripped out, much larger than the actual backing plate. The only time there is a good reason to have a backing plate is for items that are being pulled at right angles to deck or hull, such as rudder gudgeons. A backing plate would stop the bolts pulling through the hull. Unfortunately consideration should be given as to whether it would be better to have, say, four bolt size holes in the event of a sudden unexpected load like running aground or a large hole if backing plates are used. The small holes can be stopped up easily while a large hole might sink the ship.



DECK MOLD HANGING FROM GANTRY SYSTEM AFTER DECK WAS RELEASED

INTERIOR MOLDS

The new Gemini has a lot of interior molds. A complete hull mold that includes the two floors in each hull, the dinette, and the box under the fridge. This mold has110 volt wires, hoses and conduit for electronics glassed in before it is structurally glassed into the hull.

A roof mold: This is a light mold that has 12 volt wire glassed into position before it is glassed to the deck. This mold has cut-outs to facilitate bolting on genoa tracks, winches and cabin lights. This mold also has a glassed in flange to take the main bulkhead.

A shower mold: The shower mold has toilet base, sink, sump for shower water and has accesses for plumbing, seacocks, and the holding tank.

A fridge mold: This is a mold that is 7' wide and high and covers the main cockpit bulkhead. This mold has a box to take the fridge and another box for storage or an air conditioner. This mold is glassed in position to give a box sealed from the interior for the fridge. This mold also has the grooves for the window slider.

The Galley and navigation: These are long molds secured to each hull side, over the centerboard case. They have recesses for teak strips and drawers.

The Aft cabin walls: These are large molds that stand vertical separating the aft cabin. They are bolted into place after the hull and deck have been bonded

The Master cabin mold: This is a unit bolted into place on the hull side in the master cabin.

HOW GEMINI CONSTRUCTION DIFFERS FROM A MONOHULL

A 34-ft monohull has a hull area of 350 square ft and a deck area of 250 square ft. Gemini's hull area is 770 sq. ft and the deck is 600 sq. ft. The monohull has only one bow and transom and is normally molded in a mold that can be tipped for easier rolling out of the fiberglass. With a tipped mold, gravity helps hold the fiberglass to the now horizontal hull side, and the excess resin can easily be squeezed out. The whole main lay-up of a monohull is quicker to apply reducing the places where the fiberglass hardens that can cause air blisters as additional fiberglass is applied over the ridge. Gemini's hull mold is huge and can not be tipped. Not only are there two bows, two transoms, two centerboard cases, and two rudder cases, but also a bridge deck with many corners. The problems associated with a large non-tipping mold, are that the hull sides are molded vertically making it difficult to apply a good quantity of resin without it running down the hull sides into the keel. This excess resin is difficult to remove. Reaching all the places on the bridge deck and around the keels and rudders without air voids and obtaining a perfect resin\glass ratio is difficult.

The deck is large and it would be difficult to apply two tone gelcoat. Gemini's deck has a large non-skid pattern molded in. This pattern not only gives a good non-skid surface but also because of the shadows and texture does the same job as adding another color to the deck.

The molds to build Gemini are also three times more expensive than a monohull of the same size. The extra surface area of Gemini means that if Gemini is built with the same lay-up as the monohull, then Gemini will be a lot heavier than the monohull, even with the keel on the monohull taken into consideration. Fortunately, Gemini does not have to be strong enough to take the high point loads of a keel, so can be of lighter construction. However, the lighter construction and large surface area as well as the flexible nature of the fiberglass make the deck difficult to handle during construction.

A monohull is normally built with most of the interior fitted out before the deck is put on. The deck is also trimmed out with the various fittings installed before it is bonded to the hull. Gemini with large light moldings has to be bonded together first to stabilize the shape. The hull must have numerous interior moldings and bulkheads bonded in before it is released from the mold. This also slows down the process. The unbonded deck is so flexible that it is left in the mold while the entire thing is turned over, then placed in position over the hull

and released. Once the hull and deck are bonded together then the boat is finished. Unfortunately the whole boat has to be finished with workers carrying everything through the main door.

The structure of Gemini is second to none. Any cosmetic problems such as small blisters or stress cracks could be solved with different manufacturing techniques but the structural integrity of the boat would be compromised. For example the hulls could be molded separately like a monohull but then there would be a suspect joint where the parts are joined. Cheap low aspect ratio keels could be bolted on reducing the cost of centerboards and cases. Cheaper fixed rudders could be used. But those are compromises we are not willing to make.

HULL MOLD BEING GELCOATED;
SHOWS MOLDED CENTERBOARD CASES IN THE CENTER OF EACH HULL.

SAILS AND SAILING

There are three types of sailing rigs: Mast head, fractional and rotating.

The rotating rig is the most efficient with the mast being supported by a single large shackle on the front of the mast, with the base sitting on a ball. The mast, which is normally wing shaped, can then rotate in line with the wind. The main sail has a large roach and full battens. The jib is fractional. Because there are no backstays it is not possible to carry a large headsail. The power from this rig comes from the main sail, which can be large. The single side shroud must go to a wide base, which is why it can not be used on a narrow monohull. The wide shroud base and lack of headsail loads gives a low load system but unfortunately the whole mast is supported at only one position. The large fully roached main is very efficient.

The fractional rig is the next most efficient rig. The side supports to this mast can be any system but the headstay presents a problem. A permanent backstay can only be attached to the masthead and will bend the mast when the backstay is tensioned to support the headstay. Monohull fractional rig boats will have a crane at the top of the mast to push the backstay back as much as possible to allow the main to be as big as possible. Running backstays are necessary to support the headstay and to prevent the mast bending. Large Genoas are not possible. Multihulls, with their wide beam, are normally set up like the rotating mast, but fixed. The main sail is large with the genoa small. Fractional rig boats have a high mast failure rate.

The standard Gemini uses the masthead rig. The mast head rig is the strongest because of the amount of shrouds that support the mast. Unfortunately because of the backstays, the main sail cannot have a large roach, however a headsail of any size can be used including spinnakers. The windage of all the shrouds and lack of drive from the small head of the sails, makes this an inefficient rig. The windage at the top of the mast will create more heeling.

For racing there are ways to retain the strength of the masthead rig but reduce the windage and get drive from the top of the sail. Tapering the mast is one way monohulls use. For Gemini, a new technology big head main sail seems to work. The backstays are moved back on a 12" crane at the top of the mast. The main sail has an elaborate headboard and a fully battened main that goes behind the single backstay. This rig gives more power and can be used in higher winds because of the reduced windage and lower heeling moment.

There is a newly promoted type of rig called the Cabospar. This is an unstayed mast with the boom being continuous around the mast, going forward to the tack of the jib. The jib is self tacking, being less than a 100% jib. Without shrouds to keep the mast up, there is a lot of localized forces at cabin top. None of the unstayed mast boats produced to date have been promoted as offshore boats. Boats such as the Nonsuch and the small Freedoms in fact, have all had serious problems. Presumably the Cabospar is well designed, but unfortunately the boat has to be equally well designed. From experience, once there starts to be any movement in an ocean going situation, this small movement rapidly expands to a serious problem. This rig requires the same effort to set and reef as a normal rig. This rig will require the same effort as a normal rig with a self tacking jib when sailing to windward, will be less efficient on a reach (unless the sheets are eased like normal rig with a self tacking jib), but will be easier down wind when the rig can be rotated to be at right angles to the wind easily. Unfortunately, the rig is grossly undercanvased and spinnakers can not be used. The rig has a few unique advantages such as backing up. This rig is ideal for a Pro.

Another rig is the Walker wing sail. Unfortunately, this rig is dramatically undersized in the normal light-airs conditions that exist on the East Coast of America. This rig is also undersize when sailing down wind when the efficiencies of the rig cannot be used.

MAIN

The standard main sail has 4 short battens and two reef points. Full battens are an option but do not increase the size of the sail, they only stop flogging. Lazy jacks or the dutchmen are options, but for every perceived ease-of-handling feature there is a disadvantage. These sails cannot be raised or lowered unless the boat is pointing into the wind. It also takes more effort to fit the sail cover. The reason people think they want these options is so that when the sails are dropped, they are contained on the boom, and do not fall on the helmsman or into the cockpit. Gemini's pilothouse saves the helmsman and the lack of heeling with wide flat decks makes sail handling easy.

MAIN SAIL REEFING

To reef the main, let the mainsheet go and slack off the jib just a little. Leave the rudder turned as if to tack the boat. The boat will then stop and remain at about an apparent wind angle of 50 Deg. Hook the topping lift over the winch and down to the cleat to temporarily raise the boom about 18". Release the main halyard to lower the main sail until the eyelet at the front of the first reef point is in line with the gooseneck. Hook the eyelet over the hook on the gooseneck and retension the main halyard. Pull the green line under the boom until the back of the sail is pulled down to the boom, and cleat. Release the topping lift (the reason for raising the boom is to make it easier to pull the back of the reefing line to the boom)

HEADSAIL

The normal headsails are hanked to the headstay first and then pulled up with the jib halyard. The advantage to this system is lowest cost, simplest and offers the ability to have the right sail in any wind conditions. The disadvantage is that the boat has to be stopped for several minutes to change the sail, in perhaps rough conditions on the foredeck and after every sail they have to be bagged and put away. A roller genoa is a commonly used option that is left on the headstay and protected from the sun by a canvas strip. This option has the advantage of being easy to roll out and reef. The disadvantage is that this one sail has to be made of heavy material to be strong enough for strong wind and therefore is too heavy to take a good shape in light airs, particularly with the added weight of the canvas strip on the leach and foot. The other disadvantage is that when reefed, the sail does not take a good shape and will not allow for close winded work. In a sailing area where light winds are the norm, a large, lightweight drifter is necessary. Unfortunately, this sail cannot be used with a roller genoa.

REEFING THE HEADSAIL

The roller genoa in the full out position has the genoa sheet going down at approximately 45 Deg. to the slider which is near the back of the track. As the sail is rolled in, it is necessary to move the slider forward. The approximate slider position, when the tack of the genoa is in line with the shroud, is with the slider level with the checkstay eye. The reason for the correct position of the slider is to put roughly equal tension on the leach and the foot of the sail. This position will change in different wind strengths. In lighter winds the slider is further aft putting less tension on the leach, allowing the leach to fall away and not rub on the shrouds or close up the slot. In stronger winds the slider is forward to put more tension on the leach which is being blown out with the stronger winds.

With hank on sails the position of the slider has to be changed with the changing of the sails and the changing wind conditions.

The drifter goes to the pad eye on the back of the combing.

WIND STRENGTHS FOR REEFING:
Suggested wind strength before reefing:

Main and Drifter	15 knots apparent wind
Main and Genoa	18 knots apparent wind
Main and Jib	22 knots apparent wind
Jib, 1st reef in Main	25 knots apparent wind
Storm jib, 1st reef main	30 knots apparent wind
Storm jib, 2nd reef main	gale

Another way to decide when to reef is to use an inclinometer and reef as soon as the boat heels to 7 Deg.

To use the above guide, when the boat has a roller genoa, simply reduce the sail as indicated above. The roller genoa is reduced to a jib when the tack is level with the shrouds and then can be further reduced to storm jib

SPINNAKERS or single luff spinnaker
For down wind, a spinnaker is essential for racing. Because of its light weight, shape and pole, it is blown into a position that captures the max. wind. Coupling that with a spinnakers huge size, gives spectacular down-wind speed. On a reach, a spinnaker still works. A single luff spinnaker, which has many names, is designed for use without a pole. It is tacked to the base of the headstay and has just one sheet. This sail has been recently used by racing boats with the tack being secured to a bowsprit several feet in front of the bow and having a large foot measurement. This is a success on a fast sailboat because they never sail directly down wind. A cruising boat goes fastest from 'a' to 'b' in a straight line even if it is dead down wind. The maximum sail area is important. A single luff spinnaker does not work down wind because it is behind the mainsail. The single luff spinnaker works well on a reach. A drifter works equally well on a reach and still works well close to the wind; therefore a drifter is more useable for a cruiser.

SAILING AND SEAMANSHIP

Gemini is a sophisticated boat. Gemini has lifting centerboards, rudders and engines. Gemini is faster, lighter, has less sail area, draws less water and sails more upright, than any other cruising sailboat with the same accommodation. Performance Cruising only builds one type of boat and has built hundreds, constantly refining the product and manufacturing technique. Performance Cruising builds a 34' catamaran more cost effectively than any other sailboat factory can build a sailboat of similar accommodation.

The conventional monohull has a fixed keel, fixed rudders, fixed inboard diesel. This simplicity makes the boat easier to build and should be cheaper. The cheap cast iron keel is the low cost solution to turning a cheap unstable single hull into a sailboat with a mast and sails that are trying to tip it over. The draw back to this keel is deep draft and weight. A heavy boat needs more sail and a larger engine. Most people think the keel is a weight hanging under the boat trying to pull it upright. Unfortunately, with the keel weighing, say 5,000 lbs., and the loaded hull weighing 11,000 lb., the point at which all this weight can be assumed to act to bring the boat upright (the center of gravity), is near the water line and not several feet under the boat. This makes for a boat that will tip easily and is very uncomfortable. The modern fast monohull has a very deep keel with a bulb, a high tech light hull and wide beam. These modern monohulls are now similar in cost and lack of accommodation as the racing trimaran. These high tech monohulls have even got closer in speed to the racing multihull. However they still are not as fast. These high tech monohulls are even having the same structural problems as the early racing multihulls.

CENTERBOARDS

The centerboards are Gemini's secret weapon. Almost all other cruising catamarans have fixed, low aspect ratio keels. These keels are responsible for perhaps 65% of their resistance going to windward. They also do not go deep enough to act as a good leeboard. Fixed keels with a good shape do not seriously affect the boat's performance on a reach when there is no side slipping of the hulls. That is why wide fixed keel racing catamarans with lots of sail area produce high speeds in high winds. Unfortunately they are poor to windward and poor down wind in moderate winds

The centerboards are only needed when sailing into the wind with an apparent wind closer than 70 Deg. From experience, only the leeward board is necessary. The rational to this discovery is that the leeward hull is the hull doing all the work, whereas the windward hull is parasitic drag. Having the keel down on the windward hull will simply increase the parasitic drag of that hull. Unfortunately, having discovered this it was necessary to increase the size of the centerboards so that only one had sufficient area to prevent leeway.

The centerboards are also necessary for maneuvering under engine in a marina, particularly in cross winds. However, the ability to steer the engine makes Gemini one of the most maneuverable sailboats available, even without the centerboards. The centerboards rivet the boat to the water in strong cross winds, which is necessary for a lightweight boat.

One centerboard part way down is necessary in strong reaching conditions. The centerboard only one turn down gives a 7-ft long keel adding dramatically to the directional ability of the boat.

RUDDERS

The rudders should always be all the way down even in light airs. Part way up, the slot is opened and that will cause drag. The sheet stoppers that hold the rudders down only need the minimum of force just to hold them

down. Too much force will cause the rudders to stick and not kick up quick enough if the rudder touches bottom.

BUOYANCY TANKS

There are buoyancy tanks at each corner of the boat. These buoyancy tanks are not designed to float the whole boat but to stop the holed hull from going down too far and allowing water to flood across to the other hull and capsize the boat.

These buoyancy tanks are air filled tanks, but are not guaranteed as fully airtight. They should be inspected periodically. If someone wants to go off shore they can fill these tanks with styrofoam chips.

HEAVY WEATHER

The catamaran is the safest offshore boat. The trimaran is the worst followed by the monohull. To understand what happens in rough conditions and large waves it is necessary to understand the motion of water in a wave.

In the crest of a wave, water particles are moving in the direction of the wave with say a speed of 12 knots. In the trough, the water particles are moving backwards at 12 knots. The water particles move in a circular motion. Although these waves appear to be moving, in fact nothing moves, there is just this circular motion of water. Otherwise the whole of the Atlantic would end up in Europe in a Gale.

All boats will lay beam to the waves and wind with no sails up.

The wide trimaran with narrow bows and transoms will bury a bow or stern into the trough of a wave when the main hull is picked up by the crest of the wave and tips the boat to leeward. With the lee bow now buried several feet down in the trough of a wave moving to say the right, the main hull on the crest is moving to the left. This rotational movement will easily capsize the trimaran. This assumes there are no sails up while surviving a storm.

The monohull's keel is its enemy. In the trough of a wave when laying beam to, the deep keel is in static water, while the hull is on the surface where the water particles are moving towards the wave. This starts a pendulum motion with the boat rocking towards the wave. As the pulsation of the wave moves on the hull, it is then in a water particle moving with the wave. With the keel still in fixed water the boat will now rock the other way. This pendulum motion on the side of a huge wave can cause the boat to drop off the side of the wave and invert, rolling over 180 Deg .

The catamaran with high buoyancy hulls, will not dig a hull into the trough like a trimaran. The catamaran is also much narrower than the trimaran and does not have a hull in the middle, which can cause considerable heeling when punched by a wave. If a wave punches the windward hull of a catamaran upwards, because it is no where near the center of gravity, it can only have half the power, and because the boat is narrow, the wave quickly reaches the leeward hull and pushes that up.

The catamaran does not have the keel of a monohull and will not trip over it when falling sideways of a wave. The fixed keel catamaran is not as well off as the centerboard catamaran with the centerboard up. However, because the fixed, low aspect ratio keel does not work, this type of cat is still better than a monohull surviving a storm offshore.

NEW BOAT

When sailing, particularly a new boat, in rough weather, never just sit in the cockpit. Force yourself to walk around outside and in to look for trouble. Stare at the rigging looking for lost cotterpins or shackles coming loose or rivets in the mast coming out. Inside, look under the floorboards for leaks. If a small puddle of water is discovered, it is possible to find the source by tracing back the flow of water. If this leak is left until the whole area below the floorboards is full, it is impossible to find the source, particularly in a pitching seaway.

LEAKS

If a leak is detected, first taste the water to see if it is salty. If it is fresh, the leak is either water from the tanks or a topside leak from rain. If it is salty then it is a hull leak, The only way to find the leak is to completely dry the bilge and look for telltale trickles of water. It may be necessary to dry the bilge repeatedly because the first telltale trickle could be from water trapped behind a bulkhead. The leaks are almost certainly from a through-hull fitting: the speed, depth, toilet through hulls or centerboard pivot. A boat in rough seas could have a leak from up high such, as the gunwale joint, sail locker, anchor locker, or deck fittings.

SEA ANCHORS

A lot of articles are written about sea anchors. A lot of people swear by them. A sea anchor is without doubt a good addition to a cruising boat's inventory. When conditions have got bad enough that you just want to stop, then a sea anchor will keep the boat where it is. For survival there are certain types of boats that must have them but others that are marginal. The boats that race around the world do not use them. Sailing through a storm is still the best defense. There are enormous forces in the anchor line if a sea anchor is deployed in a storm.

Racing trimarans will use a sea anchor to keep the bow of the windward hull down. The cruising trimaran will use the sea anchor off the bow or stern like a monohull.

The monohull will use the sea anchor to turn the boat so that the keel faces the on-coming waves, so that the boat will not trip over the keel.

The problem with sea anchors is the rudders. The enormous force of a breaking wave over the bow will force the boat down onto the rudder. If the rudder turns sideways it will get ripped off. Anchoring by the stern will protect the rudder. Unfortunately the stern is not designed to take breaking waves. The hatches are now exposed.

The sea anchor is normally set so that the anchor is one wavelength away so that the anchor and boat are in the same water particle movements.

Gemini, in survival condition, is probably best just left. Pull the sails down, pull the centerboards up, turn the wheel so that the boat is trying to turn into the wave. Go below and cook dinner. A sea anchor is ok if you just want to stop and do not want to be blown to leeward.

LIGHTNING

There is very little known about lightning. If a boat is going to be grounded, everything on the deck must be connected together and connected to a 12" square steel plate, with 3/4" bolts. All the equipment used must be capable of handling 100 million volts, 100,000 amps of current, and 10,000 Deg. centigrade. Lightning does not travel in straight lines. If it strikes the boat at the shroud, it will jump to the next metal object before it will follow the shortest path through wires to the ground plate. If there is no grounding on the next metal part, the

lightning will go through the hull to the water. Grounded boats are struck more often than ungrounded boats. The main purpose for grounding is to protect people. The height of the mast gives a cone of protection with the base the same diameter as the height of the mast.

Four Geminis have been hit by lightning. People inside one boat reported a loud bang, all fuses being blown, everything magnetic demagnetized, some electronics lost, and for the next year reported strange problems – however there was no evidence of the lightning strike. Another showed obvious signs of a strike coming down the backstay and jumping to the rudders. Another had electronic problems and magnetic problems. None showed severe signs of a lightning strike. In an ungrounded boat, if a Gemini is in the vicinity of a lightning strike, there will still be a magnetic pulse induced in metal conductors that will destroy electronics and demagnetize magnets.

Lightning is normally cloud to cloud but occasionally there is a discharge to the ground. When lightning starts from a cloud, instantaneously there are feeders sent up from all high points on the ground. The lightning will connect with one of the feeders and that will be where the lightning strikes. These feeders need to be a better conductor of electricity than air. A lightning rod is normally metal, well grounded to earth with metal strap.

The worst thing to do is to have a badly grounded boat that will start the feeder lines, but will not be capable of handling the huge return current. Hanging starter cables off the backstay into the water, is one example of bad grounding.

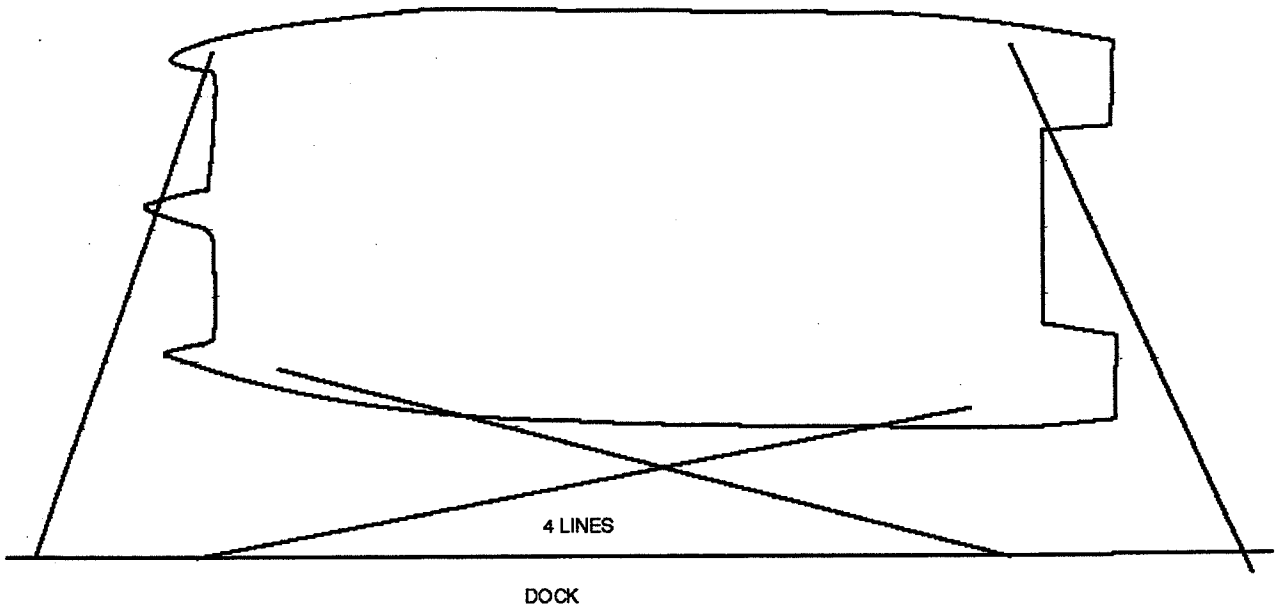
MOORING

To secure a boat to the dock, a line from the bow and stern will keep the boat in. A spring line from the bow running down the side of the boat to the dock, and another from the stern also running along the side of the boat going forward to the dock, will stop the boat moving backward or forwards. The lines to the bow and stern holding the boat in should go to the hull away from the dock so that these lines are long and can accommodate any rise or fall of the tide. The stanchion bases are through-bolted and can be used for additional mooring cleats.

When coming into the marina, have two lines secured to the bow and stern ready to either give to a bystander or to be ready to take ashore. When the boat is in position reverse the lines leaving the ends tied to the dock with the slack left on board. This stops people stealing the excess, tripping over them, or tying another boat with them. Always make sure that the lines are removable from one end even if the lines are under tension. Do not pass the loop of the lines through the cleat. If the boat is tied to the dock and the tide goes down, the mooring line needs to be able to be untied slowly lowering the boat down the wall. At night if the boat is moving, it is a good idea to be able to retie the boat while still on the boat, without having to go onto the dock, which could be dangerous in the dark.

Fenders secured to each stanchion base will be sufficient.

SUGGESTED MOORING TECHNIQUES: THIS TECHNIQUE WILL PREVENT THE BOAT FROM MOVING SIDE TO SIDE AND FRONT TO BACK, AND SEEMS TO BE THE SAFEST. REMEMBER TO TAKE UP THE EXTRA LINE ONTO THE BOAT AND NOT THE DOCK. ALSO TIE THE LINE AROUND THE CLEAT CORRECTLY. NOT WITH THE LOOP THROUGH THE HOLE AND OVER THE CLEAT



HEAVING LINES

A lot of novice people panic as the boat is coming into the dock, and try to throw a line that normally goes about 3 ft. There is a simple way to successfully throw a line. The first thing is not to panic. To throw a line, simply coil it up, split the coil and throw half of the split coil. Hold onto the end of the other half. The weight of the half being thrown uncoils the half still being held. The momentum of the half being thrown will then uncoil that half once the first half has been uncoiled

COAST GUARD KIT

Gemini is delivered with anchor, fenders, mooring lines and a compass. Because a lot of people have some boat gear we do not give a Coast Guard kit. The recommended items for minimal use are listed below.

Life jackets, for someone who wants to wear lifejackets all the time, including when wearing a safety harness, an automatic inflatable lifejacket with a combination safety harness is a good idea.
Fire extinguishers, a minimum of two mounted, one in each hull.
Fog horn or bell.
Throw cushion.
Flares, white and red.
Spare anchor, chain and line.
Flash lights.
Charts and Reeds Almanac.
Dividers.

OFFSHORE CRUISING

The sea can be a very rough environment. The closest thing to indescribable hell is punching to windward in 25-knot winds and 15-ft seas for hundreds of miles. When beating to windward, 2.5 knots is the best any boat can expect to make to windward. Even if the boat is sailing at 7 knots, 40 Deg off the wind. At 2.5 knots in 10 hours of daylight only 25 miles have been traveled. In these conditions, eating sleeping and cooking is difficult. A lot of people will suffer from seasickness. To add insult to injury, most boats after several hours of this type of grueling punishment will need attention. 25 knots of wind is not the worst but is deceptively rough and can go on for days. A gale is normally short lived even though the conditions can be bad. Pulling the sails down will make a gale easy to cope with. Unfortunately most people are trying to get somewhere and do not have time to pull the sails down in 25-knot winds that last for days. That is why 25-knot winds on the nose can be the worst condition.

Because of the horrendous conditions that can exist offshore and the fact that there is no one around to help, it is up to the skipper to make sure the boat is up to the condition that they intend to sail in. There is no boat built that is suitable to go straight from the factory into these rough conditions. All boats must be tested thoroughly in progressively worsening conditions. As problems occur during the testing, they should be rectified and made stronger. This is not the responsibility of the boat builder, unless the boat was sold specifically as suitable for offshore racing.

With today's high tech sailboat, incorrect sailing techniques will easily break the boat. Running backstays have to be correctly set up along with the rigging; otherwise the mast will easily fail. Today's mast is much thinner, which is why boats are faster. Severe pounding on today's flat bottom boat will break them up. Even 65 footers recommend slowing down when pounding to windward to prevent structural damage. Catamarans with a bridge deck can be damaged if the boat is recklessly overloaded and pounded to windward.

Gemini is a boat that is suitable for many uses. Gemini is built to a price so that the average buyer who is an early retiree who has dreamed of going cruising can follow his dreams in an affordable package. However, because of Gemini's design, Gemini is also capable of offshore racing. Gemini is not built specifically for offshore racing or around the world cruising. If an owner wants to do that then the recommendation is to take a standard Gemini and thoroughly test her. Reinforcing the parts that seemed inadequate during the testing. It must also be remembered that a boat cannot be suitable for all conditions. An around-the-world boat will be a disaster in the light airs of the Chesapeake Bay; she will have too short a mast and too heavy a sail. An around the world boat will have few hatches for safety. This boat will be unbearably hot in the windless conditions of the Chesapeake Bay.

For racing, Gemini is kept light and will perform well racing to Bermuda with three people and only the food and water necessary for the trip. No matter how rough the conditions, Gemini will not pound the bridge deck. However, if this same Gemini were to be loaded for a two year cruise of the Caribbean, then do not expect to sail to windward in rough seas and strong wind without experiencing bad bridgedeck pounding. Being overloaded does not make the boat unsafe, in fact, it is probably safer. The only problem with overloading is bridgedeck pounding. Gemini is no different to any other cruising catamaran. Catamarans are designed to go over the waves. If they are overloaded then they try to go through waves, and no matter how high the bridgedeck, they will pound.

There are three factors that should be considered for sailing across oceans, and the potential ocean sailor must have at least one of them. A large, specially built, ocean going boat, considerable experience, and/or strength and fitness. In other words, with the proper boat, an older, less experienced skipper might make it across the Atlantic. An experienced delivery skipper can probably nurse any boat across the Atlantic. Three young, very strong men, by virtue of their strength, can power their way through most problems, and cross the Atlantic.

Gemini is not a boat built to cross oceans, but with experience or strength she will easily make the trip. The boats built to cross oceans are over 40 ft and then not suitable for coastal sailing.

A LIST OF EXTRA EQUIPMENT FOR OFFSHORE:

radar reflector
solas flares; red, white and orange
safety harness
bilge pumps
GPS
Single Sideband
liferaft
emergency water and food in containers
water maker
solar power
storm sails
charts and Reeds Almanac and other local pilots
navigation equipment such as dividers
ships log
hand bearing compass
first aid gear
EPIRB
life sling to recover a man overboard, complete with pulley block system to raise man overboard.
man overboard equipment such as a MOM8, plus life ring for less serious man overboard situations
Captains chair secured to the floor
foul weather gear
tools
spare parts including sealants and fiberglass paste
sail repair equipment
emergency steering
binoculars
flash lights and high beam spot lights
Bosun's chair
set flags
bucket

MAINTENANCE

BOTTOM PAINT

Gemini is delivered with bottom paint. The problem with new boats is that the fiberglass is new and still releasing Styrene. It is difficult to get bottom paint to stick, even with coarse sanding. The procedure we follow is recommended by Interlux. We use Solvent wash 202 to remove traces of the mold wax. This is done using many rags and taking care not to simply dilute the wax and smear it over the bottom. No-sand primer is then painted on the bottom. As soon as the no-sand primer is dry we paint on Fiberglass bottom coat. The bottom is not sanded because that will damage the gelcoat.

There are two types of bottom paint. A paint with copper in it at various percentages and a paint that slowly washes off called an ablative paint. With the first paint it works well for the first 6 weeks because the copper is at the surface. As the surface copper dissolves the bottom paint starts to loose its efficiency. Applying numerous coats is a waste of time. This loss of efficiency is true of all bottom paints no matter how much copper they have. Some people like paints like Trinidad, which has a high concentration of copper, perhaps 70 %. However, the real reason people like this paint is because it is a soft paint that is easy to remove when repainting.

The ablative bottom paints like Interlux CSC work well because as the paint is worn off new copper is exposed. The more coats that are applied the longer the paint will last. These types of paint will last many years.

Because Trinidad and Interlux CSC are soft paints they will fall off easily if the hull is new and still releasing styrene.

The system applied to Gemini from new will start to loose its efficiency in the first few months and will need repainting in 9 months. When the need to repaint comes due there is no need to remove the original paint, simply remove the barnacles and weed, power wash, and over coat with several coats of, say, an ablative paint.

Do not leave the boat with the original bottom paint for years, even if to begin with, barnacles are scraped off, then allowing barnacles to grow directly on the hull. From experience, barnacles that are allowed to grow directly on the hull seem to damage the gelcoat.

BLISTERS

Many years ago blisters were probably caused by inferior, perhaps filled resins. A few years ago a new problem started. With the explosion of the small powerboat market, resin and gelcoat manufacturers started to reformulate their resin for rapid cure. With these resins a small hull could be gelcoated in the morning and be ready for release in the evening. Unfortunately, a larger, more complex hull could take several hours to just gelcoat. The skincoat could also take several hours and of course the skincoat could not be applied until all the gelcoat was cured. The main lay-up would comprise several layers. Normally all these layers are applied at once. With these newly formulated rapid cure resins, the molecular interlaminate bond between the gelcoat and the skincoat and then the main lay-up was not as good as it could be. However, because the main lay-up was all applied at once, there would be no suspect interlaminate bond in the main lay-up. If there were any problems with these boats the problem would be obvious within two years. Coating with epoxy was a good cure. It was not advisable to use sand blasting. Simply removing any loose surface was suitable.

Three or four years ago, coincidental with the decline of the power boat business, the resin manufacturers came out with premium gelcoats, vinylester resins and fine fiberglass veils. Gemini is built with these materials and

no problems have been experienced. Vinylester resins are the most waterproof. Gemini has a 20-mm veil with vinylester resin applied just behind the gel coat.

The one thing that must be understood is that there is no such thing as a totally waterproof resin. Eventually water will penetrate all fiberglass hulls. It is possible that as the water penetrates the hull, any impurities can be dissolved, forming a thick liquid that will expand to form a blister. If this should happen it will be isolated and should simply be ground out and the void filled with a low shrink waterproof putty. This is like cavities in teeth. There is no need for drastic action when cavities are found in teeth. They are simply ground out and filled.

As described in the Construction chapter, Gemini is a difficult boat to build. Only the best materials are used. Applying the fiberglass to vertical surfaces from several feet away using a 6' pole on a roller, can produce a situation where there are air voids between the main lay-up and the skin or gelcoat. When the boat comes out of the water for storage or repainting, if there are any air voids under the gelcoat they will be noticeable as a blister. These blisters should simply be ground out and the void filled with a low shrink putty. The boat can then be bottom painted. These blisters are almost certainly not structural and can be easily fixed.

BLISTERS ON THE DECK AND INTERIOR

It is possible that with use, small parts of the gelcoat on the deck or interior may chip away like an eggshell, exposing a dark void below the skin. These are not structural and go with the territory of a hand made fiberglass product. The surface area of Gemini is 600 sq. ft, and every inch is hand rolled. When the polyester resin is applied over the fiberglass mat, because of the initial stiffness of fiberglass mat, air is trapped below the mat. The mat is saturated with polyester resin and rolled with a small metal roller into all the corners. The air is rolled out from under the mat. In places the air is not seen it is left under the mat, this trapped air is a void that will expand or break out at some time in the future. There is no way these voids can be produced with time. All the voids are there to begin with.

These voids should be opened out completely and ground. The surrounding gelcoat should be sanded with 120-grit paper in a ring 3/4" around the void. Gelcoat thickened with Cabosil, (a very fine powder of fumed silica, that magnetically holds together when mixed into gelcoat, forming a non-drip paste that, because of its microscopic size does not show on the surface so that the cured paste can be polished, just like the original gelcoat) is catalyzed with 2 to 5 % of MEKP liquid catalyst. This catalyzed paste is trowled into the void. Unfortunately, as the paste cures it shrinks, so either excess paste is applied or the void is filled level three times after hardening. This paste, because it shrinks when curing, is not advisable below the water. The water can enter through the void left between the shrinking paste as it cures, and the side of the void. The cured paste is sanded almost level using 120 grit paper (80 grit is ok providing this paper is only used to remove excess and then 120 paper is used to bring down close to level. 180 then 360 paper is used to level and finely sand the repair. The repair is then compounded to gloss the repair like the surrounding gelcoat. The reason for sanding 3/4" around the void before applying the paste is to blend the repair into the surrounding gelcoat.

CLEANING AND CARE OF FIBERGLASS

We have found that Tide is a very effective cleaner. It is best if the water is hot. It takes two buckets of hot water to clean the boat, each with a cup of Tide. Spray Clorox is also a good cleaner. Acetone may be necessary to remove resins, glue or sealers used to manufacture the boat. Keep acetone away from vinyl, paint and the windows. After a while the surface will turn chalky. Waxes may reduce this but it is only cosmetic. The Gelcoats used are called Buff Back, and can be compounded to bring the color back. The hulls will become stained with oil or metal. Both these stains can be removed with a special chemical soaked into a sponge and then wiped onto the stained hull. Once the stain is removed, the chemical can be washed off.

TEAK

With this new boat a great deal of trouble has been taken to remove any teak outside. Even the handrails are stainless. Inside, the teak is coated with several coats of Tip Top teak oil. The teak oil is applied with a rag and simply wiped over the teak. The surrounding surfaces are wiped with a clean rag to remove the excess teak oil.

Varnishing with a mat varnish is another treatment for the teak. This is a time consuming process because all the teak has to be masked and the surface must be sanded between coats. At least 3 coats must be applied. Prevarnishing is not satisfactory because as the wood is counter sunk to secure it in place the teak plug now has to be varnished, which would stand out as the varnish goes over the surrounding surfaces that already have 3 coats of varnish.

WINDOWS

The windows around the cabin are made of polycarbonate with a chemical and scratch resistant surface. These windows should be washed with only warm soapy water. If the film on the polycarbonate is broken, chemicals will seriously attack the polycarbonate. Polycarbonate will expand 1/16" per foot. Therefore an 8' window will expand 1/2". Fortunately, the surrounding surface will also expand a little. The problem with sealing the window is having a seal that will accept this movement. In the past, butyl rubber was used in a preformed 1" by 1/8" strip. Unfortunately this material, although remaining flexible, had problems in the summer. With extreme summer heat the butyl rubber eventually dripped out from under the window.

Today the windows are sealed with a GE silicone. The secret to the success of this material is to get the silicone at least 1/8" thick between the window and the cabin sides. This is achieved by creating a silicone dam on the insides of the screws. Liberal amounts of silicone are applied between the dam and the edge of the window under the window. The excess silicone is wiped off, and previously applied masking tape is removed leaving an attractive straight line with the silicone tapering out from the window.

No maintenance is required for this window sealing.

WATER

The water tanks are ABS plastic, and the hoses are designed as taste free. Theoretically these materials do not taste. Unfortunately material stored in plastic will taste. It is possible that people can get used to the taste if the water is used frequently. There are chemicals that will help reduce the taste of plastic. After water is stored for long periods, chlorine may be necessary to make the water useable. For occasional use, bottled water is good for drinking and the tank water will do for washing.

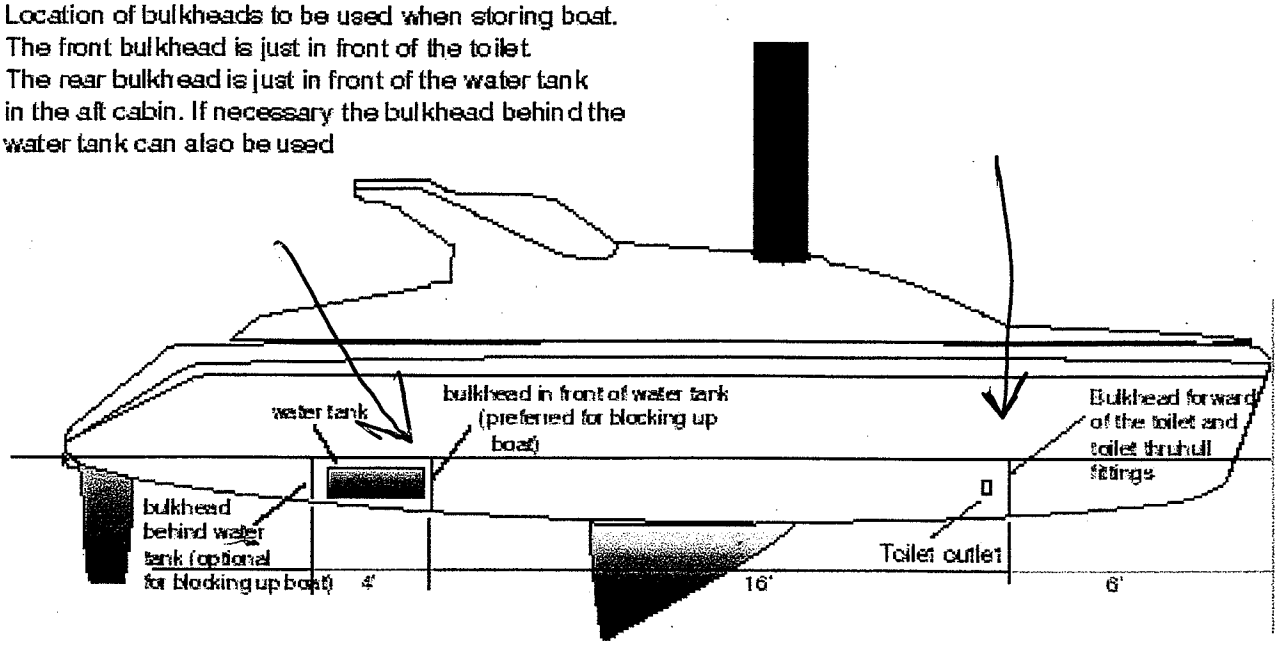
FUEL

DIESEL in tanks will grow a fungus, which is like a black sooty deposit. This deposit will block the hoses, filters, pumps and injectors. Even a filter will not help because the hoses leading to the filter will get blocked. A diesel additive is important to stop this problem. Diesel will also be subject to water condensation. It is advisable to leave the tanks full.

HAULING

Hauling a Gemini is a relatively easy procedure because of the straight keels. The straps of the lift will go right under both hulls and since the straps do not stretch there is no tendency for them to crush the hulls.

Once the boat is out of the water if it is being stored for the winter, it can simply be placed on top of four piles of cinderblocks with four blocks in each pile, (making a square pile). Place the front two piles of bricks under the bulkhead at the back of the buoyancy tanks in the bow. (just ahead of the toilet) Place the rear two piles under the front edge of the aft bed. Place a piece of 1" plywood about 18" square, between the blocks and the hull. Wedge under the wood so that the plywood follows the angle of the bottom of the hull.

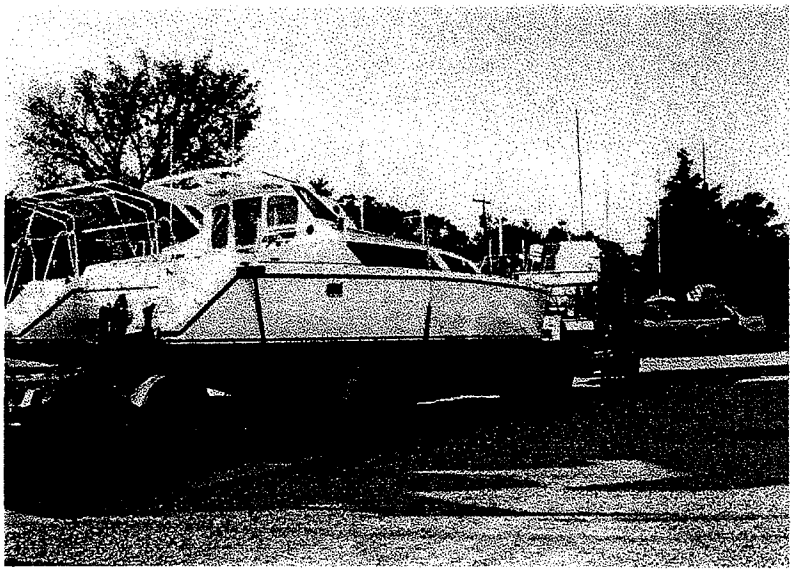


THESE BULKHEADS SHOULD BE USED FOR STORING THE BOAT ON LAND, IN A BOAT LIFT, ON A TRUCK OR WHEN HAULING THE BOAT.

TRUCKING

Being only 14' wide, Gemini can be trucked anywhere far easier and cheaper than any other catamaran. However, the transom and rudders must be lifted above the rear wheels of the truck. The flat bed of the truck is normally 8' wide but the keels of each hull are 10' apart. This requires that two large timbers be placed on the flat bed for the boat to sit on. These timbers are10" x 12" x 14' long. They are placed 16' apart on the flat bed. The front timber will be directly under the bulkhead at the back of the forward buoyancy tanks. (Roughly 6' back from the bow) The rear timber will be under the bulkhead in front of the aft bunks. (Basically the same places as the cinderblocks when storing the boat) Then a series of wedges about 4" high must be nailed to the timbers at the sides of the hull, to give additional side support and stop the boat from moving. Obviously put carpet between the hulls and these timbers and wedges to prevent any scratching of the gelcoat.

Once the boat is in place, use a chainsaw to remove as much excess wood from the side of the timbers. Tie the boat down with lines going from the four corner cleats, diagonally down and back to the flat bed. This will prevent movement up and down as well as back to front. The timbers must also be chained to the truck. Also, to stop the centerboards from hitting the road should they fall down, take a line from the stanchion above the centerboards, down under the hulls to the truck.



WINTERIZING: Freezing is the biggest problem in the winter.

WATER
The water in both tanks should be pumped out, leaving only a few gallons. Non-toxic antifreeze, perhaps a gallon for each tank, should be poured into each tank, and then the tanks should be pumped dry. At the minimum the water should be drained from the water heater. For added protection, water could be drained from the electric pressure pump and the foot pump.

DIESEL ENGINE
Most people will get the marina to winterize the engine. Read the Engine book for winterizing details. Basically, the engine is run with the water intake in a bucket of antifreeze until the antifreeze is all gone. In this way the heat exchanger and water lock is protected. With the engine warm the engine oil is changed. Just before the engine is switched off, oil is sprayed into the intake to prevent rust in the cylinders. The zinc is checked in the heat exchanger.

SAILS
The sails should be removed to prevent ice damage. There is also the chance that the severe gales that go with winter could damage the sails or even the boat if the sails got loose.

BATTERIES
If the batteries are fully charged they will be full of sulfuric acid that will not freeze. The most important thing to do for the batteries is to keep them fully charged. If left, the batteries will discharge over the period of 2 or 3 months and will then never fully recover. A lot of people take the batteries home and leave them on trickle charge in their garage.

SNOW
The dirt in snow will leave stains in a series of ridges where the snow line was. This is difficult to remove. Tide is a possible detergent that will remove this stain.

DRY STORAGE
Once a year the boat needs to be bottom painted. All fiberglasses will absorb water as much as 10 % of the hull weight. Ice and gales can damage boats during the winter. It is advisable, for all of the above reasons, to have the boat hauled during the winter. However, lots of boats are left in the water during the winter with ice eaters to prevent ice damage. There does not appear to be any more possibility of damage for a multihull than a monohull.

THIS SPARE PARTS KIT IS AVAILABLE FOR ORDER FROM PERFORMANCE CRUISING:

MK II CAT SPARE KIT
PERFORMANCE CRUISING SPEC.

1 CVJ gaiter
1 pair prop seals
1 transom oil seal
1 17-spline tab washer
1 ¾ x ¾ DU bush
2 ¾ x ½ DU bush
1 grease nipple
1 latch spring
2 7/16 A2 washers
1 drain plug
1 transom anode
1 prop shaft anode
2 x 1/8 split pin
2 x 3/32 split pin
2 x ¼ UNC x ½ SKT cap
2 x ¼ UNC x ¾ SKT cap
4 x ¼ UNC x 1" SKT cap
2 x 5/16 UNC x ¾" SKT set
1 loctite and instant gasket
1 keenol grease
1 spare parts price list
1 sheet of reminders for Gemini Owners