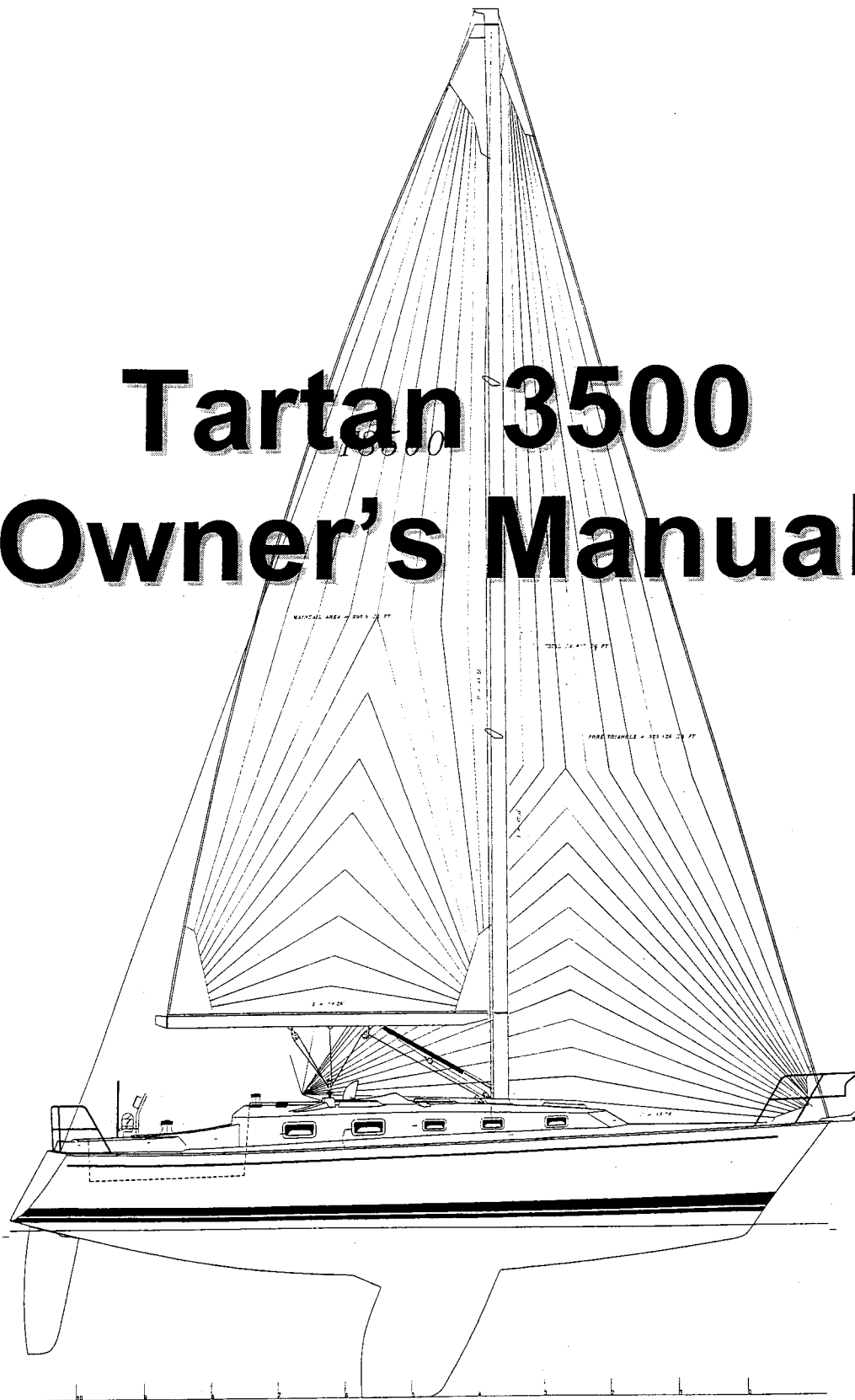


# Tartan 3500 Owner's Manual



TARTAN YACHTS  
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Again, this manual is intended to help you to know your new Tartan Yacht. It is most important to familiarize yourself thoroughly with all aspects of operating and maintaining your yacht in a safe and efficient manner. Read your manual carefully as well as the booklets supplied by the manufacturers of the components. If any questions arise for which you can not find an answer, your Tartan dealer will be pleased to help you.

It is Company policy that the Tartan line of yachts is continually upgraded and improved. Thus, you may find your yacht equipped with gear different from that shown in your manual. Any new piece of equipment will be in all cases equal to or better than, its predecessor.

On taking delivery of your yacht, be sure to read and understand the Tartan warranty. Complete the warranty card or the change of ownership card and return it to Tartan immediately.

If you are a seasoned sailor much of the manual may be old news but if this is your first boat, we hope this will prove useful. We know that you will have many satisfying and happy hours of sailing in your Tartan Yacht.

Should you need to contact Tartan Yachts please use the following addresses and numbers:

Tartan Yachts  
Customer Service  
1920 Fairport Nursery Road  
Fairport Harbor, OH 44077  
Phone: 440-354-3111  
Fax: 440-354-6162  
Websites: [www.tartanyachts.com](http://www.tartanyachts.com) and [www.tartanparts.com](http://www.tartanparts.com)

We would like to take this opportunity to thank you for choosing Tartan Yachts and we wish you good sailing.

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## 3.0 CONSTRUCTION

### 3.1 Hull

The hull of the Tartan 3500 is a single unit fiberglass molding which incorporates a specially developed NPG/ISO gelcoated hull. Alternating layers of strand mat and Unidirectional 'E' glass in Isotholic resin are locally reinforced and cored with Balsa in order to achieve an optimum balance of strength, stiffness and weight in the laminate composite.

The construction process ensures the complete weaning of the laminate complex with no voids or bubbles. Extra laminate is used in any area that would be subject to additional stresses. The exterior finish consists of gelcoat molded into the fiberglass backed up by a 4mm barrier coating of Vinylester anti-corrosive resin. The boot stripe is applied using *DuPont Centari Acrylic Enamel* while the cove stripe is a premium vinyl film. A Balsa Core is sandwiched between the laminate layers to add significant strength and stiffness properties to the hull, and yet ensuring that overall weight is kept to a minimum. The strength/weight characteristic of the sandwich composite as well as resistance to impact and abrasion is magnified by the use of Unidirectional 'E' glass in the laminate.

### 3.2 Deck

The deck and cockpit, like the hull, is a single unit fiberglass molding with a gelcoat surface. A Balsa core is incorporated into the structure between the laminate layers for additional stiffness. A non-skid finish is molded into the working areas of the deck.

### 3.3 Hull / Deck Joint

The top flange of the hull is capped with marine adhesive sealant. The deck is then fitted and fastened through the Teak or Aluminum toerail by means of stainless steel bolts. As the bolts are tightened, the sealant is forced into exposed crevices. If a leak should ever develop in the hull / deck joint, the through bolts may be tightened accordingly.

### 3.4 Rudder & Steering

The rudder is constructed of two molded composite shells, which are bonded together and injected with two-part foam for added strength. The rudderpost is all stainless steel with a flat stainless steel plate reinforcing weldment positioned within the rudder.

Wheel steering is standard. The pedestal system is a silky-smooth Compact Rack & Pinion Whitlock steering system.. The pedestal manufacturer (Whitlock) has provided maintenance instructions concerning the steering system.

### 3.5 Ballast

The keel of your Tartan Yacht is of lead alloyed with antimony for added strength and cast to exacting tolerances. In addition to providing the yacht's stability, the foil shape of the keel produces hydrodynamic lift while sailing to weather, enhancing upwind performance.

The keel is fastened to the hull by means of stainless steel bolts, which are cast into the lead. These bolts project through the bottom of the boat and are bedded with a flexible *Thiokol* compound which allows for the divergent expansion and contraction rates of lead and fiberglass to prevent water leaks. The bolts are secured by stainless steel nuts and washers, which are visible in the bilge.

## 4.0 RIGGING

### 4.1 General Description

In order to tune your mast effectively, it is important that you are familiar with the basic associated principles. Some definitions and explanations follow.

The term 'standing rigging' refers to fixed pieces of stainless steel rod or wire supporting the mast. Those which offer fore and aft support are called 'stays' (backstay, forestay, etc.). Those which provide transverse support are called 'shrouds'.

The shroud running from the masthead to a chainplate on the deck near the rail is called the main or upper shroud. If it were to travel this route directly, the angle of support would be so fine as to induce extremely large tensile forces in the shroud and equally large compressive forces in the mast. To increase this angle of support, a spreader is positioned according to load requirements. This spreader should be angled upwards to bisect the angle formed by the shroud as it bends over the spreader tip. A horizontal spreader, or worse still a spreader angled downwards, is dangerous. The spreader may be forced to slip further down the shroud resulting in the loss of the spreader and possible collapse of the mast.

The spreader becomes a compressive member, and when properly loaded tends to push the middle of the mast to leeward. To eliminate such a leeward bow, a lower shroud is installed running from the mast at the base of the spreader down to the deck near the upper shroud chainplate. The primary purpose of the lower shroud is to provide athwartship support. The addition of the spreader and the lower shroud means that the mast is supported at more places transversely than fore and aft. Therefore, the mast itself need not be as strong transversely as fore and aft. The mast then may have a lesser (more aerodynamically advantageous) transverse dimension than fore and aft dimension.

## 4.2 Spars

Based upon the relationships described above, the more spreaders and shrouds used transversely, and the more intermediate forestays and running backstays used longitudinally, the smaller the allowable mast section may be. This can be advantageous as weight aloft and windage may be reduced in addition to minimizing the undesirable aerodynamic effect of the mast on the mainsail. The smaller the mast section, the less disturbed is the air flow across the main. However, a practical and functional balance of rig complexity and aerodynamic efficiency has governed the design of the rig of the Tartan 3500. Running backstays are not fitted on this model. The spar section is sufficiently large with appropriate wall thickness to be supported by a double spreader system; drag and its detrimental effect on the main is reduced by virtue of the sophisticated, aerodynamically shaped cross section to the mast.

Tuning involves adjusting the tension in these shrouds and stays so that the mast will remain straight in most sailing conditions with an appropriate amount of rake for comfortable helm balance. Tuning is carried out in two phases - tuning at the dock and tuning while under sail.

## 4.3 Tuning at the Dock

All turnbuckles are equipped with toggles at their base, which eliminates bending load on the swage and turnbuckle threads. Toggles are fitted to both ends of the forestay. As the boat tacks and the headsail loading varies from side to side, the forestay terminals are subject to extreme fatigue loading.

Start tuning the spar by ensuring that the mast is in the center of the boat, perpendicular to the designed transverse water line. Your boat may not sit level at the dock due to distribution of gear, stores and tankage levels, so check the water line position both sides. Then slacken the lower shrouds completely by undoing their turnbuckles. Take the main halyard and lead the shackle end to a point on the rail or chainplate. Adjust the halyard so that the shackles just touch the reference point on the rail or chainplate with a given downward tension, and then cleat the halyard. Then take the halyard to the same reference point on the other side of the deck. With the same amount of downward tension, you will be able to just touch the shackle to the reference point if the mast is plumb transversely. If not, let off one upper shroud turnbuckle and take up on the other in order to bring the masthead closer to center line until the halyard shackle touches both reference points under the same downward tension.

The particular part of the rail or deck you choose as your reference point is not important as long as it is the same point on each side. Once the mast is centered transversely, tighten both upper shroud turnbuckles uniformly, one full

turn one side, then one full turn on the other. Repeat until the turnbuckles become difficult to turn. Pin the turnbuckles.

Tighten the lower shroud turnbuckles so that almost all of the slack is removed; the center point of each lower shroud should have about 1 inch of play in either direction. Sight up the aft side of the mast to make sure that it is straight. The lower shrouds may require adjustment to straighten the mast.

Now check the rake. Rake is the fore and aft angle of the spar. The Tartan 3500 spar is designed to carry up to (approx.) 9 inches of rake. Rake effects the position of the center of effort of your sail plan and, consequently, the balance of the helm. The effects are more pronounced in heavier winds. The extent of rake on our boat should be determined by your particular sailing characteristics, the typical local wind conditions and your sailmaker's suggestions.

Forward rake should be avoided. The main halyard may be used to measure rake. In calm wind and sea, with the boat floating level on her lines, hang a plumb weight or equivalent, such as a hammer or wrench, from the main halyard. Adjust the halyard so that the weight is suspended just above the gooseneck. The fore and aft distance between the mast and the halyard at the gooseneck level is the amount of rake. Ease off the forestay turnbuckles and tighten the backstay turnbuckle (or vice versa) until the desired rake is achieved. Pin both fore and backstay turnbuckles.

Unless the rake has to be re-adjusted in the future to correct helm balance, these turnbuckles will need no more adjusting. Additional tension may be applied by the backstay adjuster.

Check that the outboard ends of the spreaders are padded and taped to avoid chafing the genoa.

Ensure that all turnbuckles are pinned. The mast should be fixed at the step to prevent fore and aft movement and to hold the mast in the step.

You are now ready to complete the tuning procedure while sailing.

#### 4.4 Tuning While Sailing

Select a day with a steady 8 to 12 knot breeze and reasonably flat sea. Put the boat on starboard tack, close hauled. Sight up the luff groove of the mast. If the mast seems to fall off to leeward at the spreaders, luff up slightly and tighten the starboard lower shroud as necessary. Put the boat back on the wind and check the spar again, adjusting as necessary. When the mast appears straight, bring the boat about and do the same on the port side.

Check the following carefully:

When the upper shrouds are at optimum tension and when at about 15 to 20 degrees of heel, the leeward rigging should look slack. This is quite appropriate and should never be tightened. When close hauled under genoa and main, the forestay may appear quite sagged. Tensioning the backstay will reduce the amount of sag, but the sag itself can never be eliminated. As a rule of thumb, the maximum static backstay pressure should never exceed one quarter of the backstay breaking strength.

If your boat is brand new, the rigging may seat and stretch to the extent that tuning from scratch again will become necessary in a matter of weeks. However, after this initial working-in period, you will find that the rig tends to hold its tune for considerably long periods of time. After becoming used to the feel of the boat, you may wish to either increase or decrease the amount of weather helm. Any sailboat, when sailing up wind, should have a slight tendency to "round up" or head into the wind if the helm is let go. If you find it typically difficult to hold the boat off the wind, the boat is carrying too much weather helm. This can be alleviated by reducing rake, which will move the center of effort of the sailplan further forward. Conversely, if you find the boat tends to fall off when sailing upwind and you must constantly push her to weather, then the boat carries lee helm and the rig will require more rake.

With constant tuning as the season progresses, your boats performance will improve. The boat will feel more comfortable to sail.

You will find that tuning is a bit of an art and you will begin to notice subtle changes in the behavior and response of your boat as you make subtle changes in tuning. The important thing to remember is to go about the process in a slow and orderly fashion. To record the details of the tuning and re-tuning procedures as well as the results achieved will provide you a better understanding of the rig and will serve as a useful reference for rigging the boat on subsequent occasions.

## 5.0 FUEL SYSTEM

### 5.1 Fuel Tank

The aluminum fuel tank has been pre-tested and is static grounded.

### 5.2 Fuelling

Before opening the fuel inlet deck cap, be sure all open flames aboard the yacht are extinguished, no person is smoking and that the electrical main switch as well as all electrical circuits are turned to "off". Once the tank has been filled, close the inlet cap tightly and wash down any spills with fresh water.

### 5.3 Fuel Grade

For specific fuel grades refer to the engine Owner's Manual.

## 6.0 POWER PLANT AND TRANSMISSION OF POWER

### 6.1 Engine

All necessary specifications and information concerning the engine installed aboard your yacht may be found in the engine Owner's Manual. Read this manual carefully so that it is thoroughly understood. The life and performance of the engine will depend upon the care it is given.

### 6.2 Transmission

The reduction gears and reverse gears are contained in the transmission casing attached to the after end of the engine. These gears normally require little maintenance, however, the oil should be checked from time to time (see the Engine Owners Manual).

To avoid damage to the gears and to increase clutch life, the engine should ALWAYS be at idle when shifting gears.

### 6.25 Saildrive (Optional)

All necessary specifications and information concerning the Saildrive installed aboard your yacht may be found in the engine Owner's Manual. Read this manual carefully so that it is thoroughly understood. The life and performance of the engine will depend upon the care it is given

### 6.3 Propeller Shaft (Standard)

The shaft is supported at the inboard end by the shaft coupling and at the outboard end by the strut which contains a water lubricated bearing. The shaft passes through the hull at the stuffing box.

### 6.4 Shaft Alignment

The propeller shaft and the engine are carefully aligned prior to delivery. However, each time the yacht is launched, the alignment should be checked, particularly if there is excess vibration when the engine is running or if loss of engine speed becomes evident.

Alignment is checked in the following manner:

1. Remove the flange bolts on the shaft coupling adjacent to the transmission box.
2. Support the weight of the shaft and coupling, then slide the coupling faces together by hand.
3. While holding the coupling faces together, insert a feeler gauge of 0.003 thickness at 4 points around the coupling. (3,6,9,& 12 o'clock)

If the feeler gauge does not pull out evenly around the entire coupling, misalignment is indicated. If the coupling faces are misaligned at the same point of coupling circumference, the engine mounts can be adjusted until the coupling faces match evenly. If the misalignment changes 180 degrees as the shaft is rotated 180 degrees, a bent shaft is probable, and the shaft must be removed and serviced as required.

Replace flange bolts after successfully completing the alignment check.

### 6.5 Stuffing Box

The stuffing box is located at the inboard end of the fiberglass tube, which passes through the hull. The fiberglass tube and the stuffing box are connected by means of a short length of flexible rubber tubing held in place by hose clamps. These clamps and the stuffing box should be inspected on a regular basis. If leaking is found, the hose clamps should be checked. If the leak is but a slight drip from the packing nut of the stuffing box, we recommend no further adjustment. If the leak is excessive, the stuffing box may be tightened by loosening the lock nut and tightening the gland nut slightly (perhaps one-quarter turn), then re-tightening the lock nut. Do not over tighten the stuffing box. This may cause excessive heating and possible seizure of the unit.

If the stuffing box continues leaking after tightening the gland nut and after the engine has been running for a number of hours, new stuffing box packing may be required. To replace the packing (available from your marine dealer), unscrew the gland nut and wind 3 or 4 turns of new packing around the shaft in the direction of nut installation. The gland nut is then moved towards the stuffing box against the packing, tightened just until the leak stops. The lock nut should then be tightened. If leaking still persists, have your Tartan Dealer investigate for a possible bent or scored shaft.

NOTE: The rubber tubing at the stuffing box must be inspected yearly. Replacement every two years is advised.

## 6.6 Propellers

The standard propeller supplied with the yacht is a fixed three-bladed bronze unit. (Folding standard on Saildrive)

When sailing, it is advised to lock the propeller shaft by putting the engine "in reverse" after it has been shut off. This will prevent the propeller from rotating or "free wheeling". In order to reduce drag, it is ideal to lock the propeller in the vertical position, aligned with the keel or strut rather than protruding horizontally into less disturbed water. This requires that the shaft be rotated to a predetermined position prior to locking. One must observe the propeller in its vertical position, then mark that position with a reference line on the shaft or coupling adjacent to the engine. Rotating the shaft into this referenced position before locking will ensure that drag from the propeller is minimized.

If a folding propeller is fitted, it should be locked in a position, which prevents either blade from falling open. In this case the reference point should be determined with the blades in the horizontal position. When the shaft is locked, neither blade can hang downward and both blades will be uniformly closed by pressure of the flow of water from both sides. (The folding propeller on the Saildrive will always self align)

A feathering propeller when installed will automatically feather with any forward motion. This eliminates the requirement of locking the shaft in a predetermined position.

## 6.7 Removal of Propeller

For both fixed and folding propellers, a propeller puller is usually required. This is available from a yard or major marine hardware dealer.

To remove a folding propeller, proceed as follows:

Remove all cotter pins from the pivot bar for blades and shaft. Salvage these cotter pins if possible.

Pull pivot bar from the blades. It will be noticed on some propellers that one end of the pivot bar is tapped for a bolt. Thread the bolt into this end of the pivot bar and pull the bar by means of the bolt, on other types, the pivot bar may be tapped out with a drift punch and hammer.

For both fixed and folding propellers:

Remove the shaft nut, which is counter sunk inside the propeller hub on folding props and exposed on fixed props. To remove the shaft nut, a ½" square drive handle with extension is required for folding props; a socket for fixed props.

To remove the propeller, leave the propeller retaining nut in place, but installed about one or two turns loose from the fully tight position (to protect the threads). The puller shaft should never bear directly on the end of the propeller shaft. As it bears on the propeller retaining nut, a spacer of brass, aluminum or copper should be used to protect the nut. The puller must be installed straight and centered carefully so that its maximum effectiveness can be realized. Place the claws of the prop puller behind the propeller hub and withdraw the propeller.

## 6.8 Installation of the Propeller

Ensure that the bore of the propeller is free from dirt and corrosion and that the end of the shaft is clean. The keyways of the propeller and shaft must be free from burrs. Place the propeller on the shaft with the keyways in the shaft and propeller in line. The key should fit snugly at the sides with a 0.0111 minimum clearance at the top. Do not force the key in as this may cause the propeller to be forced off center. The propeller, locking nut and the cotter pin are then assembled on the shaft. Check to ensure that the propeller is correctly aligned.

## 6.9 To Check Propeller Alignment

Clamp a piece of thin metal or wood on the propeller strut so that it just touches one blade of the propeller. Rotate the shaft and propeller by hand. Any variance in the track of the blades will be indicated by either a gap between the next blade or that blade striking the indicator. If the propeller is found to be out of line, it should be checked and balanced by a marine yard.

## 6.10 Exhaust System

The exhaust system utilizes a horizontal type muffler. In operation, the engine water pump draws water through the engine intake port, circulates it through the engine block then into the muffler. The water is mixed with the exhaust gases in

the muffler and discharged overboard through the exhaust port in the stern of the yacht.

In a yacht fitted with fresh water cooling, an auxiliary pump draws water through the intake port, circulates it through a heat exchanger then pumps it into the muffler and overboard through the exhaust port. Seawater in the heat exchanger lowers the temperature of the engine coolant circulated through the engine block by means of the normal engine water pump.

## 7.0 CONTROLS

### 7.1 General

Please refer to the engine Owner's Manual for starting procedure and engine panel functions.

### 7.2 Starting and Operating the Engine

1. Turn main battery switch to "on".
2. Check that engine water intake valve is open.
3. Check that the gear shift lever is in neutral.
4. Follow specific instructions as offered in engine Owner's Manual.

Note: When a folding propeller is fitted, excessive vibration may occur when the engine is placed in forward gear. This may be caused by one blade of the propeller not opening. Should this occur, slow the engine to idle, shift into reverse gear and accelerate the engine. This should open the blade. Idle the engine and shift to forward gear.

Note: When sailing, it is always advisable to start the engine before the sails are lowered. In this way, it is still possible to maneuver if the engine should not start.

### 7.3 Engine Shut Down

1. Close the throttle to slow idle. Place the gear shift in neutral. Stop the engine.
2. If the engine is not to be used again for a long period, the water intake valve may be closed.
3. Turn the main battery switch to "off", if no other electrical service is required.

## 8.0 ACCESSORIES

### 8.1 Installation of Thru Hull Fittings

Note: To ensure correct positioning of the thru hull fitting, consult with your local TARTAN Dealer.

Installations in Non-Cored Areas:

- A. Drill hole size to accommodate the thru hull fitting.
- B. A small backup plate is required for strength purposes. Marine plywood is suitable. A hole the same size as that in the hull should be drilled in the wood. The holes may then be aligned, and the wooden backup plate may be bedded with marine sealer and allowed to dry.
- C. Install the thru hull fitting, and securely tighten the nut.

Installations in Cored Areas

- A. Drill hole size to accommodate the thru hull fitting.
- B. Using a knife, remove the Balsa core from the area surrounding the hole at least two inches beyond the edge of the hole.
- C. Fill this area with resin saturated fiberglass mat and let cure. The hole may have to be trimmed or reshaped to accommodate the thru hull.
- D. Mount the thru hull fitting with marine sealer on the flange portion of the fitting. A layer of marine sealer should also be applied between the interior portion of the fitting and the hull. Allow to dry.

Note: After applying the marine sealer between the exterior of the fitting and the hull, tighten the nut. The thru hull fitting should not be allowed to turn as this may break the seal. A wrench to tighten the nut and a wrench to hold the thru hull will be required.

## 9.0 ELECTRICAL

### 9.1 General

The electrical system in your Tartan Yacht has been designed to ensure as much trouble free operation as possible. Wiring and connections are kept as high in the interior of the yacht as practicable, reducing the possibility of exposure to water. The main switch panels are located to protect them as much as possible from the elements.

## 9.2 Batteries

Tartan Yachts are factory supplied with batteries. The battery box is located under the aft berth. The circular, explosion proof main battery switch has four positions: "OFF", "ONE", "BOTH" and "TWO".

Note: Do NOT turn the main battery switch to "OFF" while the engine is running as serious damage to the charging system will result.

Note: The engine manufacturer recommends that you do not change batteries with this switch while the engine is running.

Recommend batteries are the series G27 deep cycle which is a higher quality battery (or equivalent).

## 9.3 Alternator

All engines are equipped with the standard alternator as supplied by the engine manufacturer. However, you may have an optional HIGH OUTPUT alternator installed. Please consult the product manufacturers manual for details on operation and care.

## 9.4 Charging System

### ENGINE BATTERY (1)

1. The engine battery (1) will only take a charge from the Yanmar alternator if the battery switch is on (1) or (BOTH) while the engine is running.
2. At the dock the engine battery will take a charge from the inverter/charger only if the battery switch is set to (BOTH). There is no other alternative to charging the engine battery (1).
3. Setting the battery switch to (BOTH) is not recommended especially if the house batteries are drained because the inverter/charger will send the most charge it can towards the low batteries (house) which will be too much charge for the engine battery assuming it is fully charged. This will rapidly destroy the engine battery.
4. The engine battery (1) will not charge at dockside with the battery selector switch on (1).

### HOUSE BATTERIES (2)

1. Underway the house batteries (2) will charge from the Yanmar alternator if the battery switch is set to either (2) or (BOTH). Again, setting them to (BOTH) is not recommended.
2. At the dock, the house batteries (2) will charge from the inverter/charger regardless of where the switch is. Once again, we don't recommend setting the switch to (BOTH).

## 10.00 ELECTRONICS

### 10.1 General

Many owners add electronic equipment such as knotmeters, distance logs, depth sounders, (all of which usually require thru hull fittings) and relative wind indicators, wind speed indicators, radio direction finders, VHF, SSB radios as well as various types of electronic navigation aids such GPS and Loran. Many of these items may be installed while the yacht is being built or later by the Tartan Dealer.

Many problems develop in electronic instrumentation due to faulty installation. This should be done in the first instance by a qualified specialist.

### 10.2 Thru Hull Fittings

If other than standard thru hull fittings are required and are to be added after the yacht is built, consult the Tartan Dealer to determine the correct positioning of the thru hull fitting. Directions concerning the components and installation of the thru hull fittings should be supplied with the unit. See section 8.1, "Installation of Thru Hull Fittings".

### 10.3 Masthead Fittings

Masthead fittings should be installed carefully, following manufacturer's recommendations. Cables leading from the masthead fitting should come out at the foot of the mast, and a connector installed at this point which facilitates easy disconnecting when the mast is un-stepped. Keep all connectors, junctions and wiring as high in the yacht as possible to prevent them from coming in contact with water.

### 10.4 Electronic Equipment

All electronic equipment serviced by the yacht's 12 volt electric circuit should be separately protected by a circuit breaker or fuse. Radios and other DC accessories can be wired directly to the yacht's circuit panel. Make sure that the polarity for electronic accessories is correct, and that they are installed according to the manufacturer's recommendation.

## 11.0 SAFETY EQUIPMENT

SAFETY SHOULD BE THE FIRST CONCERN OF EVERY SAILOR, AND CERTAIN ITEMS SHOULD ALWAYS BE CARRIED ON THE YACHT.

### 11.1 Fire Extinguishers

Fire extinguishers should be carried on each yacht. Depending upon the size of the yacht, owners may carry several extinguishers mounted in the yacht so they would be readily accessible. These extinguishers should be certified with regular inspection and testing dates shown on each unit. Please consult governing regulations as they apply to your yacht and area sailed.

### 11.2 Life Jackets

One life jacket for each member of the crew must be carried. They should be of a type approved by your respective governing agency.

### 11.3 Life Buoys

Many yachts carry life buoys, which can be easily stowed in a bracket on the stern or adjacent to the helmsman. These life buoys should have a gravity-activated strobe or other bright light attached, along with a long line, which connects to a -man-overboard pole. The assembly facilitates spotting the person to whom the buoy has been launched in any type of sea or visibility conditions.

### 11.4 Life Lines

The lifelines aboard your yacht should be checked regularly to ensure their integrity. Always be sure that access gates (if fitted) are closed before leaving the dock. Check carefully that the swage end fittings are not pulling out and that the lock rings are on the turnbuckle ends and the turnbuckles are tight.

### 11.5 Safety Harnesses

Just as with life jackets, a safety harness should always be worn by anyone on deck. These harnesses allow the wearer to be attached to some permanent fixture on or above the deck. They should be of good quality and capable of carrying the full weight of the wearer falling several feet.

### 11.6 Flashlights

The yacht should be equipped with several water-proof flashlights, routinely checked to be in good condition with well charged batteries. Flashlights serve as a convenience at night while moving about the yacht and in trimming sails as well as a safety precaution locating a person overboard. At least two of the lantern type should be available on the yacht.

### 11.7 Dinghy or Life Raft

An inflatable dinghy or life raft may be carried. It should have the capacity to carry your full crew in an emergency.

The dinghy may also serve as a convenience in moving from yacht to yacht or from yacht to shore. Inflatable craft should be thoroughly checked every year to ensure safe and proper operation. Your Tartan Dealer can advise you where such inspections are offered.

### 11.8 Safety Flares

Please consult Government regulations as they apply to your yacht and your area.

### 11.9 Fog Signals and Radar Reflectors

Both of these items are extremely important if sailing conditions deteriorate and visibility is restricted. Foghorns of the canister pressure type are good. Spare canisters should be carried aboard, and the "lung power" type makes a reliable back up.

Sailboats may not be identified well on radar, therefore a radar reflector is a must. These can be purchased commercially. The radar reflector should be stored carefully to prevent damage because the performance of the unit is directly related to the accuracy of the intersect angles of the component planes.

### 11.10 Anchor

The type and quantity of anchors carried will vary from region to region according to the sea bottom conditions. Each anchor should include an adequate size and length of line along with chain to ensure that the anchor lies properly and penetrates the bottom. Chain, also, is immune to chafe from bottom structure such as coral.

## 12.0 MAINTENANCE

Yachts kept shipshape and in good order require maintenance on a regular and frequent basis. The frequency will depend upon the conditions under which the yacht is being used. You must continually check the running and standing rigging, winches, engine, bilge and head as well as surface finishes for signs of needed maintenance. All deck hardware should be washed down with fresh water after sailing in salt water.

## 12.1 Gelcoat Surfaces

Wash down the gelcoat surface of the hull and the deck regularly with fresh water and a good detergent. A sponge or soft brush should be used on smooth surfaces, and a stiffer brush may be used on the non-skid areas of the deck. Follow by rinsing with fresh water.

At least once a year the topsides of the hull should be waxed with a good automotive or boat wax, then polished. This will help the gelcoat retain its color and appearance. Do not wax the non-skid surfaces of the deck. Dark color hulls may require waxing at more frequent intervals in order to prevent oxidation. Minor scratches in the gelcoat surfaces can be repaired by buffing with a light abrasive buffing compound followed by waxing and polishing. Scrapes or damages that have broken through the gelcoat surface can be repaired with the gelcoat repair kit which is provided with your yacht. Directions for these repairs are included with the gelcoat repair kit. For major damage, where a large area of the gelcoat has been removed, or where the damage extends into the glass lamination below the gelcoat, consult your Tartan Dealer or a qualified marine yard.

Gelcoat surfaces below deck are cleaned with a good detergent and water, then rinsed with fresh water. These surfaces may also be waxed to maintain the appearance.

The galley and head sinks are fiberglass and can be maintained with the same care as other gelcoat surfaces.

Gelcoat surfaces will stain if the yacht is moored where leaves fall on deck or birds roost. Under these conditions, surfaces should be scrubbed down very frequently. A protective cover may offer protection and reduce maintenance.

### AWLGRIP Surfaces:

Contact the U.S. Paint Corporation for care and maintenance guidelines on your Awgriped hull. Touch up kits are available through an authorized U.S. Paint Dealer.

U.S. Paint Corporation  
831 S. 21<sup>st</sup> Street  
St. Louis, Missouri 63103  
Phone: 314-621-0525  
Fax: 314-621-0722  
Website: [www.uspaint.com](http://www.uspaint.com)

## 12.2 Portlights and Hatches

The portlights and hatches of your yacht are manufactured by various companies. The portlights are stainless trimmed with safety glass. Screen inserts are included. Lexan, which is impact-resistant and very durable is used in the hatches as well as the companionway sliding hatch. However, the surface of the Lexan is not abrasion resistant, and therefore, gritty cleaning agents should never be used on them. Clean Lexan with mild soap and water. If Lexan requires polishing, Lexan polish is available from most major hardware dealers. Toothpaste may be used as a substitute for Lexan polish. Rinse afterward with mild soap and water. Please consult the hatch and portlight manufacturers for care and maintenance guidelines.

## 12.3 Wood

Interior teak surfaces are maintained in the following manner: Remove dirt or cooking grease from teak surfaces before refinishing. This can be done by washing down the surface with mild soap and water. Interior surfaces should be cleaned and treated once or twice a year with an interior teak oil.

Interior cherry surfaces have a varnish finish. This should be regularly washed off with fresh water and a little liquid detergent, then polished with a chamois leather.

## 12.4 Bottom of the Yacht

**DO NOT SAND THE GELCOAT FINISH ON THE BOTTOM OF THE YACHT. THIS WILL VOID THE WARRANTY. PLEASE USE A SANDLESS PRIMER BEFORE PAINTING THE BOTTOM. PLEASE CONSULT YOUR TARTAN DEALER FOR BOTTOM PAINTING INSTRUCTIONS.**

When applying seasonal applications of bottom paint, it is extremely important that the coatings be the best quality and that they be applied carefully and strictly according to manufacturer's instructions.

Thereafter, the routine maintenance of the bottom will be much easier with the best possible results.

The frequency and amount of maintenance required on the bottom is governed by the nature of the water in which the yacht is kept, and to some extent, by the use it gets. If the waters are polluted or are conducive to marine growth, the yacht may have to be hauled frequently and the bottom scrubbed down with brushes, detergent and fresh water immediately upon hauling. If for any other reason the yacht is hauled and it is planned to keep it out of the water for any length of time, the bottom should be scrubbed down immediately before any marine growth dries and hardens upon the bottom.

## 12.5 Cove Stripe

The cove (just below the deck line) is colored vinyl tape. The cove stripe may be cleaned by using a mild detergent solution. The vinyl tape, if needing replacement, can be purchased through your Tartan Dealer.

## 12.6 Standing Rigging

Standing rigging is defined as those fixed parts of the rigging which support the mast. The standing rigging and all the components listed under "Stainless Steel" should be checked each time before going sailing and given a detailed monthly examination. Turnbuckles should be inspected to make sure that cotter pins are in place at top and bottom, that cotter pin ends are turned back carefully and that they are covered with plastic tape. Each spreader should be checked that the pins are properly in place and that the spreader is not out of alignment. The end of the spreader where the shroud passes through should be padded with a piece of foam and taped over to prevent chafing sails. Any stranded wire rigging should be checked for broken, protruding strands. Check also for any signs of rust in wire rigging. A good practice is to paint a small white ring around the wire where it enters the terminal. The paint will show if any slippage occurs and will prevent salt from collecting in the minute spaces between the strands, which will induce corrosion. Examine carefully where the wire enters the terminal end fitting for signs of rust or wear since this is a particularly vulnerable point when the yacht is sailed in salt water. If signs of rust or wear are found, the rigging should be replaced. Rod rigging should be examined for nicks or kinks and any signs of fatigue where the rod enters the terminal end fitting. If any potential problem is found, consult your Tartan Dealer.

## 12.7 Running Rigging

Running rigging comprises the gear that is normally used in handling and trimming sails such as sheets, guys, halyards and vang. Main and genoa halyards are subject to heavy loading and constant flexing as they pass over the sheave at the head of the mast and turning blocks at the foot of the mast. Over a period of time, the constant flexing tends to fatigue the metal. Consequently, halyards should be examined regularly for signs of stress or broken strands. When signs of wear appear, the halyard should be replaced. Again, the end fitting on each halyard should be examined carefully. On wire halyards with rope tails, the splice, which joins the wire and rope sections, tends to be a point of wear and possible weakness. This splice should be checked regularly.

Rope halyards are typically not subject to wear as severe as wire halyards, but should be examined several times each season. The end fitting should be checked each time the yacht is sailed to ensure it closes and locks smoothly and securely. The splice at the end fitting should also be checked with each sail.

Rope sheets tend to fray over a period of time and should be replaced when any strand of the outer layer of braid begins to fray.

## 12.8 Lifelines, Pulpits and Stanchions

Lifelines, like standing rigging, should receive regular, periodic inspections. The terminal ends at the connector must be well screwed into the barrel in order that all the threads of the barrel are fully engaged. The lock rings must be installed. Check the swaged ends for signs of rust. Check pulpits and stanchions for dents or cracks. Ensure that they are properly secured into their bases.

## 12.9 Winches and Blocks

Most problems which develop in winches are due to insufficient or improper maintenance. When sailing in salt water, winches should be stripped down, cleaned and lubricated no less than once a month. In fresh water areas this maintenance procedure should be performed at least twice each season. The bolts securing the winches should be checked at least once each season. Access to the bolts which secure the cockpit winches may be gained by removing the winch drums. Bolts securing the winches on the coachroof may be checked by removing the winch drums as well. If it is necessary to remove a winch base and remove the bolts, the bolts should be resealed with marine sealant.

Blocks normally require little maintenance, but they should be examined regularly for damage, particularly at the shackle connection. Never leave a snatch block open, and be sure the snatch is properly closed before applying load so that the cheek of the block will not be bent. Sheaves and blocks can be sprayed with a silicone lubricant to keep them running freely. The sheaves at the head of the mast should be checked before the spar goes into the yacht at commissioning. These sheaves should also be checked periodically during the season (this necessitates going up the mast in a bosun's chair) to ensure that they are running freely and that the wire halyard is not cutting a groove in the sheave. The sheaves for the main and genoa halyards have oil-lite bronze bushings and normally do not require lubrication, but once each season, a few drops of light machine oil will be adequate. All running rigging should be washed down with fresh water after sailing in salt water.

## 12.10 Engine

The maintenance of your engine is covered in the engine Owner's Manual, which should be read carefully.

Note: Once the engine is started, it should be operated until it reaches full operating temperature to prevent corrosion. This may take several minutes in cold water.

Before changing the oil, consult the engine Owner's Manual for complete instructions.

Routinely check fuel lines for tightness and integrity. Probably your nose is your best guide here. If you smell fuel, there may be a leak somewhere in the system. A gentle tightening of each connection in the fuel line will often solve the problem. If you smell fumes aboard, extreme caution must be taken to prevent an explosion. Consult a qualified service mechanic immediately.

## 12.12 Power Train

Details of shaft alignment, removal of the propeller and maintenance of the stuffing box are given under Section 6.

## 12.13 Electrical

The electrical wiring should require little or no maintenance. Exposed terminals and connections should be checked several times each season and more frequently in saltwater environment. Check for tightness of the connections and the presence of any corrosion. Connections may be protected with a light application of spray coating obtainable from an electronics parts supplier.

**"Clean, Dry, Tight" are the three most important factors in battery and electrical maintenance.**

## 12.14 Upholstery

### CLOTH

The cushions and seat backs on your Tartan Yacht are covered with relatively stain-resistant fabric, which should only be dry cleaned. However, consult your local dry cleaner before attempting this process. It is important that the upholstery be kept aired and that it be dried after use to prevent mold development. If the yacht is to be left unused for prolonged periods, it is advisable to stand the cushions on end so that air can circulate around them. It is also advisable at such times to clean out all lockers, removing all dampness and leaving locker doors open.

### ULTRASUEDE and ULTRALEATHER

Machine wash on the delicate cycle. Use warm water and a mild detergent (Ivory Snow, Woolite, etc.) that's free of bluing agents and no bleach, please. Line or tumble dry on a low temperature setting.

## 12.15 Steering

The manufacturer's instructions for maintaining your pedestal steering system should be followed closely.

The complete system, including bolts should be inspected thoroughly each season.

In addition to the above, an inspection should be carried out every other year with the system under heavy load. While under load, look for parts bending, distorting or creaking. Watch for any indication of failing in the system when under full load for a period of time, and report any abnormalities to your Tartan dealer.

## 12.16 Deck Fittings

Any deck fitting which is under load (chain plates, genoa tracks, line stoppers, etc.) should be checked on a regular basis and re-bedded with marine sealant if found to be leaking.

## 12.17 Miscellaneous

Good maintenance is most important aboard your yacht. If you take care of the yacht's system, it will take care of you.

## 13.0 FITTING OUT

Note: Tartan Yachts must not be lifted in their shipping cradles by fork lifts without additional strengthening of the cradle. Most fork lifts tend to concentrate the maximum weight in a small area, therefore damage may occur. Recommended procedure requires that boats being lifted in shipping cradles have straps placed under fore and aft upright supports and be lifted by a crane.

### 13.1 Prior To Launching

The exterior of the yacht should be sponged down with soapy water to reveal any scratches or damage. Repair damaged areas.

Wax the hull exterior. Color pigment may be mixed into the wax before application. This tends to make small scratches disappear when the hull is polished.

Check and clean the propeller and shaft. Check for any excessive play in the strut bearing. If a folding propeller is fitted, check that the blades open and close readily, and that the cotter pins are in place and secure.

Examine all deck fittings for security and service all winches.

Check that batteries are fully charged, that battery terminals are clean and that all electrical connections are clean and secure.

Prior to launch, all thru hull valves should be closed to prevent any leakage. Check that all thru hull fittings are secure and that valves open and close easily.

Replace engine block and water pump drain plugs. Remove any winter cover protecting the engine air intake and plug or cover at the stern exhaust port.

### 13.2 After Launching

Check all thru hull fittings, sea cocks and the bilge to ensure that no leakage exists.

Open the intake seacock for the engine cooling water.

Turn on the main power switch.

Start engine. After the engine has reached operating temperature, shut down and change oil.

Check propeller shaft alignment as indicated in Sec. 6.4.

### 13.3 Stepping the Spar

**CAUTION: ENSURE THAT THERE IS NO POSSIBILITY OF CONTACT WITH OVERHEAD ELECTRIC OR OTHER WIRES WHEN LIFTING AND STEPPING THE SPAR AS DAMAGE, INJURY OR FATALITY COULD RESULT.**

The spar is stepped through the deck at the mast collar and is seated on the mast step in the bilge.

a) Good preparation and maintenance of the spar and rigging is essential prior to stepping. The spar should first be laid carefully on two or more supports, washed and inspected from top to bottom. Check the masthead and sheaves for excessive wear or abrasion. Lubricate all moving parts so that the halyards will run freely. Inspect all halyards from end to end for signs of wear, abrasions or broken strands, and replace as necessary. A heavy leather glove should be worn while inspecting wire halyards to prevent injury to your hands from broken strands. Inspect the standing rigging carefully, looking for broken wire strands, cracked swage terminals or nicks, scratches and dents in rod rigging. Inspect all clevis pins for wear, and to be certain that they are properly pinned and taped so

that they do not damage sails or halyards. Consult your Tartan Dealer if you detect any potential problem.

b) Install the spreaders and secure the rigging to the spreader ends. Be sure the halyards are not entangled with the spreaders. Pad the spreader ends with foam and tape over thoroughly to prevent chafe to the sails. Test all mast lights with a portable 12 Volt battery and label all wires at the mast base accordingly. Tie all running rigging together and secure the bundle to the spar at the lower black band. Tie all standing rigging together and secure the bundle to the spar at the lower black band. Remove cotter and clevis pins from all turnbuckles and place them in a container for future use. Back off all turnbuckles and lightly grease the threads of the turnbuckle screws. If the turnbuckle threads have tape adjustment marks, do not remove the tape or alter the positioning by adjusting the turnbuckle unevenly.

**DOUBLE CHECK EACH OF THE ABOVE STEPS BEFORE PROCEEDING.**

c) Prepare a rope sling, of adequate capacity, which will take the weight of the spar. Place the sling **INSIDE** the standing and running rigging so that it will not crush the rigging against the spar. Next, make fast a ½" diameter tie-down line to the sling, securing the line at the lower end of the spar. Ensure that the tie-down will not interfere with the removal of the bundle of standing rigging which will be undone before the sling is removed. To prevent the weight of the spar being carried by the spreaders or mast hardware when the spar is raised to a vertical position, adjust the tie-down so that the weight of the spar is carried by the sling and tie-down only.

d) Attach the crane lifting hook to the sling. It is recommended that a piece of carpet be wrapped and taped around the lifting hook to prevent it from marking the mast during stepping.

**DO NOT STAND OR POSITION ANYONE DIRECTLY BELOW A SUSPENDED MAST.**

At least three persons in addition to the crane operator should be present when stepping the spar. Position one person at the foot of the mast to guide the foot as the mast is being lifted, slowly swing the crane toward the yacht while keeping the foot pointed toward the base of the crane. This will keep the spar from swinging into the crane.

**DO NOT PLACE HANDS, ARMS OR FEET DIRECTLY BELOW THE SPAR AS IT IS LOWERED INTO THE YACHT.**

When the crane is in position, move the foot of the spar over to the second person who should now be aboard the yacht. Carefully pass the spar to the person aboard. Slowly raise the spar to an almost vertical position and guide the

foot through the mast collar. Be careful not to let the masthead swing and hit the crane arm. When lowering the mast through the collar, all mast electrical wiring should precede the entry of the mast. Check aloft that the mast and crane are not fouling. With the foot of the mast through the collar, untie the bundle of standing rigging and clear each piece away from the crane lifting cable.

e) Lower the mast through the collar, being careful not to scratch the mast as it passes through the collar opening. A piece of carpet placed between the sides of the mast and the collar will reduce the likelihood of scratching as the mast is lowered to the step. With the weight of the spar on the step, attach the forestay, backstay and both port and starboard upper shrouds. Position the wedges around the mast at the collar to support it at this point. Lower the crane cable sufficiently to allow the sling to be lowered and released, taking care that the sling and hook does not damage the steaming light on the forward side of the mast. It may be necessary to retrieve the sling by sending a person aloft in a bosun's chair. Attach the deck collar tie-down straps to the mast below deck. Connect the lower shrouds and snug up all turnbuckles by hand. Replace all cotter pins into the clevis pins. To prevent damage to sails, insert all clevis pins with the heads forward or outboard, and tape over the bent cotter pins. Release the bundle of running rigging and lead each line fairly to the appropriate blocks, stoppers and winches. Connect the mast electrical wires and test each circuit.

f) To un-step the spar, reverse the above procedure. Before removing the spar for winter storage, make a diagram of the location of the running rigging and the connections of the electrical wiring to serve as a guide when re-stepping the mast. Mark the turnbuckle screws with black electrical tape to facilitate returning to the same position on re-stepping. Do not use masking or filament tape on the spar as it may harm the surface finish. Do not expose a spar wrapped in plastic to direct sunlight.

## 14.0 LAYING UP FOR WINTER

### 14.1 Hauling

The proper placement of slings and supports is most important when hauling out. Improper placement stresses the hull and may result in gelcoat fractures or other damage. Slings should never be placed on the propeller shaft or strut. The forward sling is to be placed in the area of the forward main bulkhead. To prevent the slings coming into contact with the vinyl rub rail, the hull may be padded with carpet, placed flat against the hull just below the cove line. Tie a line between the slings fore and aft to prevent them from slipping.

### 14.2 Cradle Support

When hauling on a marine railway or placing the yacht in its storage cradle at least 60% of the weight of the yacht should be on the keel. The hull supports

should not bear more than 30% to 36% of the weight of the yacht, otherwise structural damage may result if these weight percentages are not followed. Do not put weight on the keel further aft than the last keel bolt. The extreme aft tip of the keel is tapered to a thin section and will accept little weight without the possibility of bending (see 3.5). It may be necessary to go through the loading process two or three times, checking the keel position relative to the center line of the cradle, before it is finally positioned,

#### 14.3 When the Yacht Is Hauled

Scrub down the bottom to remove any marine growth and grease. Wash down the topsides and deck.

All gear that may be damaged by cold or damp, such as clothing, life jackets, books, batteries etc., should be removed from the yacht and placed in a warm, dry storage area.

All cushions should be stored on edge allowing air to circulate freely to reduce the chance of mold.

Lubricate and cover all exposed mechanical fittings to guard against ice or snow.

Check all electrical and mechanical components on the yacht and remove those needing service or replacement during the winter. Cover any exposed holes.

It will only be necessary to winterize the raw water side of the engine's cooling system. The freshwater side should always contain antifreeze of a type appropriate for your particular climate.

Refer to the engine Owner's Manual. Remove the engine drain plugs. The engine Owner's Manual or your Tartan Dealer may be consulted for the location and quantity of these plugs. After allowing drainage for five to ten minutes, replace the plugs and secure. Remove the engine water inlet hose from the seacock and place this hose end in a gallon container of automotive antifreeze. Start the engine and run until the antifreeze comes out of the exhaust outlet. Stop the engine. Replace the inlet hose on the seacock and tighten the hose clamps. Antifreeze will now be distributed throughout the cooling system as well as in the muffler. It is recommended that the drain plugs be again removed and the engine drained for total protection. Place a wooden plug in the exhaust outlet in the stern and shut off the fuel tank valve.

#### 14.4 Fresh Water System

Pump the system dry.

Pour a minimum of 2 gallons of recreational vehicle antifreeze (this is a non-toxic formula appropriate for potable water tanks) into the water tanks.

Pump the antifreeze throughout the fresh water system by operating each fixture, ie. faucets, shower, etc.

Remove the inspection port on the top of the water tank and dry the interior of the tank with a cloth.

Place some baking soda in an open glass container and position this in the tank. Lay the inspection port back in place.

Note: Although the water system is being stored essentially "dry", do not forget to flush the system thoroughly at re-commissioning. Read through the above schedule to ensure that the tank is ready to be re-filled and is watertight.

#### 14.5 Head and Holding Tank

Clean the bowl of the head and pump water through. Pump out the holding tank, and flush thoroughly. Add some holding tank disinfectant through the deck "waste" fitting. Add some antifreeze to the bowl of the head and pump it through the system. For best protection and trouble-free operation next season, follow the manufacturer's instructions and clean all valves in the head.

#### 14.6 Batteries

Remove the batteries from the yacht. Clean the terminals and fully charge the batteries, then store them in a protected area with a moderate temperature. If the batteries are to remain on the yacht, make absolutely sure they are completely charged to help reduce the possibility of frost damage.

#### 14.7 Diesel Engines

About a weekend or two prior to the end of the season, change the engine oil and filter. Re-useable oil filters should be cleaned in clean Varsol, gasoline or a similar agent, provided the element is in good condition. Prior to re-installation of a cleaned filter, however, make certain the filter is entirely dry; gasoline fumes are not conducive to proper diesel engine performance! The engine should be run for a sufficient time, prior to the end of the season, to ensure that the clean oil circulates throughout the entire system. At the same time, all fuel filters and filter elements should be drained, cleaned and replaced where necessary. The same attention should be given to the water separator. The fuel system should then be bled and the engine re-started.

During the final hours of preparation for lay-up, it is suggested that the fuel tank be topped up and a recommended quantity of diesel fuel stabilizer (only) added to the fuel for winter storage. Do not add methyl hydrate to diesel fuel, for it will damage the engine.

When the time comes for actual lay-up of the yacht and after the yacht is hauled out, drain the seawater side of the cooling system and the exhaust system completely. Then close the engine water intake valve. Disconnect the intake hose and place the end of the hose in a container of pure ethylene glycol or "permanent" antifreeze. Run the engine until the antifreeze mixture comes out of the exhaust port. Stop the engine and open all engine drain plugs as an added safety measure. The coolant in the closed system should be checked to determine if the solution is of sufficient strength for the winter.

After the antifreezing process, the intake hose should be replaced and made fast to the intake seacock. Once again, this is the best time to re-open the water intake valve and to prepare a note to check the valve in the spring prior to starting the engine.

It is recommended that the water pump be removed and kept at home during the winter or that the impeller be removed and stored in a warm place. Both options are to prevent permanent "set" in the blades of the impeller which may result from exceptionally cold weather. Additionally, it is best not to leave neoprene in permanent motionless contact with ethylene glycol for long periods of time. An impeller is best stored in a plastic bag with talcum powder. The talc not only serves as a good preservative, but acts as a lubricant as well.

Finally, insert a wooden plug or oily cloth into the exhaust port at the transom and loosen the alternator belt. The engine will now be prepared for the winter storage period. If there are any doubts about proper procedures, you should contact your Dealer, the engine manufacturer or a qualified mechanic.