# IV. OPERATING PROCEDURES

## A. Tips on Sailing the Out Island 41

A discussion of general boat handling and sailing techniques is beyond the scope of this manual. This section describes the sailing characteristics of the Out Island 41 and presents several tips on how to achieve maximum performance from your yacht.

All yachts are a compromise. As such, each design has its strengths and weaknesses; the Out Island 41 is no exception. She is very beamy to allow for more living space below and more room to enjoy the pleasures of being on deck. In addition, her draft was kept relatively shallow so as to allow her owners to enjoy many anchorages and gunk holes. These can be enjoyed only by dinghy when sailing deeper draft yachts. As a beamy, shallow draft yacht, she must be handled on some points of sail in a slightly different way than a deeper draft yacht with less beam. The most prominent distinction exists on the wind and close reaching. Sail trim on both these points of sail is critical for optimum performance.

First, do not sail the yacht with any greater than a 25° angle of heel. Since she is a shallow draft boat, it is important that the keel stay as deep in the water as possible so as to minimize leeway. Install an inclinometer so you won't have any doubts concerning your heel angle. As the winds pipe up, shorten sail; keep the keel under the boat instead of alongside it, and she will surprise you with her abilities to windward.

Second, don't overtrim the jib. In fact, don't overtrim any sail, but especially the jib. The roller furling 150% genoa reacher found on most Out Island 41's should not be trimmed any closer than a foot off the shrouds and usually not that close. Trimming the jib closer greatly reduces the speed of the boat. And, instead of making her point higher, this results in reducing considerably her distance made good to windward.

Third, the lead position is important on the jib and should be set such that the sail luffs in the top 1/3 of the luff just slightly before the other 2/3. To aid in determining the correct lead position, install three sets of yarns or tell-tales on the jib about one foot back from the luff and evenly spaced up the sail.

These will also help you to achieve proper trim on most all points of sail. With the aid of the tell-tales, you can easily find the proper lead. Trim the jib about 1-1/2 feet from the shrouds, and steer the boat up until all ribbons inside and outside are laying nicely back along the luff. Now ease her closer to the wind and see which windward (inside) tell-tales begin to flutter first. If those lower go first, move the lead back -- if those above are first, move it forward. Once the lead is set, mark the track so that if the snatch block gets moved, it is simple to put it back in the right place. As you come off the

A. Tips on Sailing the Out Island 41 (continued)

wind, toward beam reach, you will find that the upper tell-tales begin luffing even sooner. If you are fussy about trim, you could move the lead forward about six inches and call this a reaching lead. You could go to the forward lead when the apparent wind is further aft than 65°.

If your boat is equipped with Schaefer roller furling gear, you will note a significant sag in the luff of the sail when you sail to windward in 8 knots or better of true wind. This sag can only be minimized and can't be eliminated unless you go to a different furling system which uses the head stay. In adjusting the tension on the jib halyard for a Schaefer system, don't tighten it until the tension is taken off the headstay. However, you can tighten it almost to that point. The sag does reduce the boat's ability to point, however, not by as much as many believe. The sail is cut to accommodate the sag and hence to minimize the negative effect.

The alternative grooved headstay systems which can be installed instead of the Schaefer have the advantage that the headstay reduces the luff sag and improves windward performance of the yacht. However, it has one drawback. In order to change sails, the jib must be unfurled and lowered out of its groove to the deck. This process is quite difficult unless two people are available to handle the sail. One person must be at the mast lowering the halyard and helping bring in the sail; another must be at the headstay to pull the sail out of its groove. If the wind has freshened, and you are attempting to shorten sail, you will find that the stronger breeze also tries to blow the sail overboard since it isn't attached to the headstay after it is lowered. The Schaefer system allows for shortening sail simply by furling the jib, lowering the furled sail on deck, and hoisting the other jib. It is also possible to hoist another jib with the furled sail still in position simply by pulling the sheets forward and down as they won't interfere with the new sail. Note again the trade-off between the different systems.

When on the wind, the mainsail should be let out until a slight luff appears about two feet in back of the mast. It won't hurt the yacht's performance if it is sailed that way. This will allow the mizzen to become an effective airfoil, because it won't be backwinded by the main.

Because the OI-41 is intended to be an easy to handle cruising yacht, the mainsail is sheeted at the after end of the boom. This is so no deck or cockpit space is lost to accommodate mid-boom sheeting or a traveler. As a result, when the yacht is on a reach, the main boom tends to rise and allows the leech of the sail to spill a good bit of wind. For those who are concerned by these small inefficiencies, a boom vang is the answer. Since the toe rail is holed throughout, it provides a random number of locations to tack the boom vang. When reaching, fasten the vang about two feet forward of the boom when the sail is in trim. Locate the claw or strap over the tack. Tension the vang

A. Tips on Sailing the Out Island 41 (continued)

until the main leech has only a slight camber. Now, let the sail out until a slight luff appears. This sail trim will produce optimum yacht performance.

When sailing off the wind, the ordinary principles of sail trim prevail; ease the sail out until you get a little luff and then firm it up. Remember, always trim sail from forward to aft. That is, trim the jib first, then the main, then finally the mizzen.

As on any sailing yacht, halyard tension should be regulated so as to correctly position the draft of maximum camber of a sail. Tighter halyard tension moves the maximum draft forward, while looser halyards produce draft further aft. Halyard tension on Schaefer roller furling gear does not appreciably affect the draft, only the tension on the luff. However, for grooved stays, tension should be adjusted so that the maximum draft appears between 1/3 and 1/2 the distance back on the sail. Maximum draft on mainsails and mizzens should be 50% of the way back or approximately in the middle of the sail.

Your OI-41 should tack through 90-95° on the compass in breezes above 10 knots and through 95-105° in lighter winds. It is important to "sail the boat" through the tack so as not to stall her momentum. That means turn the wheel with moderate speed and break the old sheet just after the bow of the boat passes through the eye of the wind. Releasing the sheet sooner increases the chance of ending up in irons, while holding it longer means the boat will tend to stop as the jib backwinds.

When tacking from a reach to a reach, trim the jib in to a close hauled position before flipping. This helps the boat maintain forward speed while she goes through the wider tacking angle. Coordination between the helmsman and the sail trimmer is important to begin so that the optimum tacking speed can be learned. If you find your boat unusually difficult to tack, be sure you are following the above suggestions.

For cruising yachts without spinnakers, sailing downwind calls for a whisker pole. When sailing with the apparent wind between 150-180° on either tack, it is best to sail wing and wing. Pole the jib out to windward and keep the main to leeward. The jib will fill well up to 150°, and the whisker pole should be trimmed perpendicular to the apparent wind. On a ketch you can alternate jib, main, and mizzen on opposite sides of the boat to reduce the problem of backwinding. Be sure to put a preventer on the main boom, so you won't lose anyone in case of an accidental jibe.

When executing a jibe, it is always best to bring the main boom near midships before the jibe, then let it out after the stern passes through the wind. This

A. Tips on Sailing the Out Island 41 (continued)

reduces the hazards of a jibe and prevents the boom from riding up and hitting the backstay resulting in a goose-wing jibe.

Remember, all yachts incorporate compromises. The OI-41 will not go to windward like a 12 meter. Neither would you have any desire to go cruising on a 12 meter. However, once you learn the few principles necessary to get optimum sailing performance from your yacht, you will have attained the best of both worlds.

Note: Winches should not be used for operating the roller furling line. This over-stresses the roller furling heardware and could result in rig failure and possible dismasting. For ease in furling the jib, head the boat up until the jib starts to luff, then furl.

# IV. OPERATING PROCEDURES

## B. Spars and Rigging

### 1. Stepping the Mast and Dockside Tuning

Assembling the rigging and stepping the mast are normally part of the commissioning procedures. The following steps should be followed:

a. Check all rigging diagrams in this manual for proper attachment of the rigging to the mast. Rigging changes are much easier to effect on the ground than on a bosun's chair at the masthead.

b. Record lengths of each piece of standing rigging in the appropriate section of the commissioning check list (in the preceding section). In the first column, record the length shown on the Morgan tag attached to the piece of rigging. This is the correct design length. In the second column, record the actual measured length. Both numbers should agree to within 1/2". If a greater discrepancy is found, notify the factory.

   Actual measurements should include the end fittings and the turnbuckle. The turnbuckles should be 2/3's extended during the measurement. (They are pinned in this position at the factory.) The measurement is taken from the centerlines of the pin holes (used to attach the piece of rigging to the mast) and the chainplates (extreme end pin holes).

c. Install spreaders, standing rigging, and halyards to the spar. Install any required electronics wiring in the PVC mast conduit provided. Check all attachments and test lights and electronics wiring for proper functioning. Check that the mast step(s) is ready to accept the mast(s). Slip mast boot(s) (if rubber boot supplied) on mast(s) before stepping, and temporarily secure.

d. Schedule the crane and suitable manpower to manually guide the mast(s) during stepping.

e. Remove cotterpins from turnbuckles and extend to their full open position. Raise the mast to the vertical position and lower slowly into the deck partner. Guide electrical mast wiring through the hole carefully to prevent damage. Place the neoprene mast partner around the spar and work into place inside the aluminum collar as the mast is lowered in place.

   Spray lubricant and a rubber mallet will help. Be sure wiring is held away from the step when lowering the mast onto the step.

# IV. OPERATING PROCEDURES

## B. Spars and Rigging

### 1. Stepping the Mast and Dockside Tuning (continued)

f. Attach the headstay first and then the backstay(s). Next connect the main shrouds and tighten turnbuckles by hand. Fully release crane support to the spar.

g. Tighten backstay(s) until about a 2" deflection is visible when side pressure is applied approximately four feet above deck. Tighten main shrouds so that they are equally engaged and tension will allow approximately one inch deflection with a side load applied about four feet above deck level.

h. Connect lower shrouds and tension equally for approximately two inch deflection. Sight up the mast to determine the straightness of the mast. If any bends are visible, adjust lower shrouds accordingly until mast is reasonably straight. Intermediate uppers should be tightened to 1-1/2 inch deflection. Tighten mizzen mast lowers to ± 1-1/2 inch maximum deflection. Final adjust under sail.

i. Install cotterpins, bend over, and tape with rigging tape. Be sure spreader angle bisects shroud angle, then seize the spreaders and install spreader boots or tape ends. Install mast boot. Install boom and connect topping lift. Bend on sails and furl.

### 2. Tuning Under Sail

With a 10 to 12 knot breeze, sail your yacht to weather. Sight the mainsail tracks for visual straightness. If the mast appears to take on an "S" curve laterally, luff up and adjust the weather shrouds accordingly. It will usually take only three or four turns on any single turnbuckle. Go back on the same tack and sight the track. If straight, change tacks and repeat the same procedure.

Adjust the fore and aft lowers to remove any bends in the longitudinal direction. The mast should be straight fore and aft, or have a very slight hook forward near the masthead. You may also notice the masthead falling off to leeward slightly, which is acceptable.

Check the final tuning by tacking several times until satisfied.

In moderate to heavy weather, a noticeably visible slack should appear in the leeward main shrouds. The lower shrouds to leeward should not be loose enough to flop around, but should have a feel of reduced applied load.

B. Spars and Rigging

2. Tuning Under Sail (continued)

You may find it necessary to re-tune during the first fifty hours of sail. During this period, the shrouds may stretch slightly and the chainplates will take their final position.

Your Out Island has a pre-determined headstay length which has been determined by experience to provide the correct balance. If you experience lee helm or excessive weather helm, this can usually be corrected by changing the rake of the mast. Before changing the rake, be sure the actual setting matches the rake shown on the sailplan. Rake is changed by moving the mast step fore and aft. For excessive weather helm, the mast step is moved aft to decrease the aft rake of the mast. To correct lee helm, the step is moved forward to increase the aft rake of the mast. It is necessary to re-tune the rigging after changing the mast rake.

3. Halyards and Outhauls

The halyards are located on the mast and are used to raise and tension the sail in the vertical direction. When the sail is fully up, there should be three to five wraps around the halyard winch, and the rope tail should be used on the cleat. A wire rope halyard is provided for the Schaefer roller furling halyard only.

The outhaul is located on the boom and is used for sail foot tensioning. It can be thought of as the horizontal halyard of the sail.

The clew of the mainsail is attached to the outhaul car which travels on a track. The car is controlled via a multi-purchase rope assembly (internal) that leads out to a cam cleat on the port side of the boom. The clew of the mizzen sail is an external, manually controlled rope assembly leading to the cleat on the port side of the boom.

If a greater air pocket is desired for prevailing air conditions, the tension on the clew of the sail can be reduced by releasing the outhaul rope. This will allow the sail and outhaul car to travel forward on the track.

If prevailing air conditions require a flatter sail, tension is added to the clew outhaul rope, pulling car and sail toward the aft end of the boom.

Amount of adjustment required for each condition of sail is at the skipper's discretion.

It is recommended that when the yacht is at anchor, the clew outhaul tension be released to avoid stretching the sail.

B. Spars and Rigging (continued)

4. Quick Reefing

The following operating procedure is simply a suggested method of quick reefing with actual practice left to each individual skipper's discretion.

Reefing points are provided on the mainsail with reefing lines, blocks, etc. If your mainsail does not have lace lines, they should be added.

It is suggested that the aft end of boom (sail clew) be reefed first, then the tack. The reef line on the boom should be uncleated and tension added to line via the winch to raise boom to reef point. The reefing line should then be re-cleated.

The halyard should now be eased, and the sail pulled down, bringing the sail down to the boom gooseneck reefing hook, leveling the boom. The halyard should be re-secured. The sail should now be laid on the boom, and the lace lines tied around the boom. The sail should now be neatly reefed to the boom.

If your sail has double reefing, the procedure should be the same as that above.

# IV. OPERATING PROCEDURES

## C. Engine

### 1. Pre-Starting Check Off

It is advisable to use a pre-start check list, as even the most experienced skipper can overlook an important detail that may evolve into an unpleasant or costly mishap. The check list will vary, as each owner may have optional equipment that will require attention at this time.

The following procedures are offered to help you develop your check list:

a. Check fuel level.
b. Open fuel shut-off valve.
c. Check engine oil and transmission.
d. Check for signs of fuel or oil leakage.
e. Check engine coolant level.
f. Open sea water intake to engine (gate valve).
g. Check bilge, shaft log area.
h. Check battery switch "on".
i. Turn on "blower".

### 2. Starting Procedures

a. Release shaft lock, if so equipped.
b. Set controls in neutral. Pull throttle control knob "out", if so equipped.
c. Check operation of "stop" control.
d. Advance throttle slightly - approx. 1/4.
e. Turn ignition switch to "on" and operate "starter".
Note: Some engines equipped with "pre-heat". Check engine manual for instructions.
f. Operate engine about 1000 rpm. Check immediately for oil pressure reading.
g. Check for water discharge from exhaust port.
h. Check voltmeter for "charge" indication.
i. Allow engine to reach normal operating temperature and observe any tendency to continue to rise.
j. A final visual check of the engine room is recommended as the engine is warming up.
k. Check forward and reverse operation at idle speed before "casting off" lines.

## IV. OPERATING PROCEDURES

### C. Engine (continued)

#### 3. Engine Operation

a. Run engine at speeds as recommended in engine manual. Always reduce engine rpm to "idle" before shifting, and make throttle adjustments gradually.
b. Observe engine instruments periodically.
c. Avoid long periods of maximum rpm, as well as extended "idle" periods. Always run engine long enough to reach normal operating temperature, as short runs cause excess engine deposits and sludge formation of oil.
d. Become familiar with the sound of your engine at its cruising speeds, and note any vibration characteristics. When an abnormal sound or vibration occurs, reduce rpm and make a quick check of instruments and conditions. Have problem checked as soon as possible.
e. Observe voltmeter readings periodically; and as battery becomes charged, you may switch over to the #2 battery. Caution: Do not turn battery switch to "off" position while engine is running. To do so will damage voltage regulators and possibly destroy diode rectifier in the alternator. It is advisable to reduce rpm to idle if possible, while switching batteries to prevent unnecessary surge on the system.

The alternator should not be charging at maximum for long periods of time, any more than an engine should. If this occurs, it is advisable to allow a cooling off period at 10 minute intervals, switching to the "charged" battery or operating at lower rpm's.

#### 4. Engine Shutdown

a. Allow the engine to idle for a few minutes before stopping and check instruments for proper readings.
b. Pull "stop" control and hold til engine stops. Return to "run" position.
c. Turn "off" ignition switch and blower.
d. Close fuel valve and seacock if boat is to be left unattended.
e. Visually check engine room and bilges for leakage.

NOTE: Check engine hours for maintenance scheduling (see engine manual).

READ AND USE YOUR ENGINE MANUAL

# IV. OPERATING PROCEDURES

## D. Fuel System

The standard fuel tanks on your Out Island 41 are of fiberglass construction, mounted in the engine room. The auxiliary fuel tank shutoff valve is operated by remote push-pull cables. The knob is located in the starboard locker in the cockpit. The knob is labeled "Fuel shut-off". Pull for off. The main tank (below engine) has access to the fuel valve via a drop-in under the galley sink.

Note: A fuel tank selector valve is located in the engine room on the forward bulkhead. When selecting the fuel tank to be used, it is also necessary to position the "return" valve (adjacent to the "feed" valve) to the same chosen tank.

A bulkhead mounted fuel filter-water separator is provided in line between the engine and tank selector valve board. Check periodically for water accumulation at this point by removing bottom plug and draining into a container. Replace the element at least once each season or as required by manufacturer's recommendations. There is also a final fuel filter on the engine itself which should be changed at intervals specified in your engine manual. The quantity of fuel in the tanks can be gaged by the use of a dip stick through the deckfill plate. Due to the contoured shape of the fuel tank, it is difficult to acquire a reliable electric gage. The dip stick, though slightly inconvenient, is still the most accurate and reliable method to use.

The fuel tank and fill-deck plate are electrically bonded to the main ground at the engine. Although diesel fuel is considered relatively safe, safe fueling practices are always recommended:

1. Turn off heaters and galley equipment.
2. Extinguish all cigarettes, pipes, etc.
3. Stop engine and turn battery switch to "off".
4. Close all hatches and ports to prevent entry of fumes.
5. Do not attempt to take on fuel in rough water or inclement weather, as water might enter through the deck plate.
6. Avoid fueling after dark or in poorly lighted areas.
7. Maintain continuous contact between the nozzle and the deck plate fitting to eliminate the possibility of static electric discharge while filling.
8. Take on only gallonage anticipated by dip stick reading. Do not overfill to point where fuel remains in fill hose.
9. Wipe up or wash down spills after replacing and tightening deck plate cap.
10. Open all hatches, air bilges, and operate blower before starting engine or re-lighting galley stove. Turn batteries "on".
11. See engine manual for "bleeding" procedures.

# IV. OPERATING PROCEDURES

## D. Fuel System (continued)

Another note worth mentioning is to acquire your fuel from a reliable source. A diesel engine requires clean fuel; water and dirt being its worst enemy. Keep a clean and tight fuel system, and you will have a most reliable engine.

# IV. OPERATING PROCEDURES

## E. Electrical System

It is important to remember that the D.C. electrical system in a boat is not the unlimited source of power that one is accustomed to in the home. The battery is a rechargeable storage cell. You can only take out of it what you have put into it, for a limited period of time. There is generally an over-abundance of electrical equipment drawing from the battery, and it is not intended to supply all these fixtures at one time.

### 1. Batteries

The battery requires periodic attention to terminal connections, electrolyte level, and secure fastening. The use of a hydrometer is an inexpensive and accurate measure of the battery's condition. Specific gravity measurements of the electrolyte should read between 1.275 and 1.280 on a normally "charged" battery. All cells should read relatively equal; any one cell that has a noticeably low reading is an indication of a bad cell, and the battery should be replaced. The electrolyte (acid) level should be maintained to cover the plates in the battery. Add distilled water as necessary to maintain that level. Excessive need of water is an indication that the charging rate is too high. A check of the charging voltage should not read over 15.5 volts.

Exercise care in using a hydrometer, as well as all operations around the battery, due to the corrosive nature of sulfuric acid. It is a good practice to have a solution of baking soda around to clean up spills or drippings before they can do damage. Flush with fresh water. Baking soda is excellent for cleaning around batteries, provided the solution is not allowed to get into the cells. After cleaning the battery post and cable connections, a light coat of grease, Permatex, or special spray paint is an effective means of controlling further corrosion.

### 2. Alternator

The next most critical point in the electrical system is the alternator. Its job is to maintain the battery's charge and cover the demands on the electrical system while the engine is running. The alternator converts mechanical energy into electrical energy, and the drive belt is its only link. This is normally the only periodic attention the alternator will need, maintenance-wise. With the engine stopped, the drive pulley on the alternator should not be able to be turned by hand. Belt tension may seem tight enough, but the pulley may still slip if the belt is glazed or oily. When checking or tightening the alternator and its connections, it is advisable to turn off the battery switch. This prevents accidental "shorting" of the output terminal which is "live" even when the engine is at rest.

# IV. OPERATING PROCEDURES

## E. Electrical System (continued)

### 3. Starter

The engine starter motor is the most demanding load that will be placed on the electrical system and is not fused or protected by an overload device. Therefore, it is wise to make periodic checks on the connections at the starter and solenoid switch for tightness and cleanliness. Do not allow tools or other metal objects to come into contact with these connections while the battery is "on".

### 4. Battery Switch

The main battery switch connects either or both batteries to the engine circuit and the D. C. switch panel, which serves the boat's interior circuits. Do not switch to off position with engine running. "Both" position is intended for emergency or extended engine cranking ability. Continuous running in the "both" position when the batteries are in a low state of charge, can cause overload and possible damage to the engine alternator.

### 5. Electrical Panel

The AC-DC breaker panel is located in the walk-thru area just aft of the forward companionway. This panel is equipped with high quality hydraulic-magnetic circuit breakers.

Each circuit breaker is wired to an indicator light to show at a glance if the circuit is on. The D. C. indicator lights are solid state light-emitting diodes which require very little current draw. The A.C. indicator lights are neon, and each of the A. C. breakers are of the single pole type which breaks the hot side of the circuit when tripped.

The D. C. ammeter monitors the amount of current drawn from the battery, and the voltmeter gives an indication of the battery's condition.

The voltage reading may be interpreted as follows:

| | | Battery Condition |
|---|---|---|
| Engine off and electrical system under minimal or no load | Below 11 volt | Very low |
| | 11-12 volts | Low |
| | 12-13 volts | Well charged |
| Engine running fast idle or above | 12-13.5 volts | Low charge rate |
| | 13.5-15.5 volts | Normal charge |
| | 15.5 or higher | Excessive voltage (Voltage regulator defective. Replace or adjust.) |

# IV. OPERATING PROCEDURES

## E. Electrical System

### 5. Electrical Panel (continued)

The voltage readings should be taken in either battery position, not in "both". Start your engine on the highest charge battery and allow time for the battery to return to its full charge state before putting it on reserve. When switching over to the other battery, be sure not to switch through the "off" position. This would damage the regulator and possibly the alternator diodes. The "both" position is for emergency or extended cranking periods and should not be used to charge two batteries at the same time. This could overload the charging circuit if the batteries are low.

### 6. Pedestal Switches

The navigation lights, foredeck light, and bilge pumps are controlled by switches on the pedestal.

The automatic bilge pump switch may be left in the "auto" position, and the pump will come on whenever there is sufficient water in the bilge to activate the float switch. At this time, an indicator light on the pedestal will show that the pump is "on". The "manual" position allows the pump to run continually, overriding the float switch, until the switch is returned to the center "off" position.

The switches on the fuse panel are connected to an enclosed fuse panel inside the pedestal. A chart inside the panel cover identifies the fuse, location, and size required.

Spare fuses should be kept on board for these circuits as listed below:

| | | | |
|---|---|---|---|
| Running Lights | 10 amp | Bilge Pump | 7.5 amp |
| Bow Light | 2 amp | Blower | 10 amp |
| Foredeck Light | 7.5 amp | Inst. Light | 7.5 amp |
| Masthead Light | 2 amp | Compass | 2 amp |
| Main Engine Feed | 60 amp | | |

### 7. A.C. 110 Volt Shore Power System

The A. C. system is a three-wire shore-grounded circuit. The shore power inlet is rated at 30 amps and is mounted on the starboard side of the cockpit coaming.

The main circuit breaker is located in the engine room on the forward bulkhead adjacent to the engine room door. This, in turn, feeds the A.C.breaker panel. Each circuit (A.C.) is protected by a double pole breaker. There are two breakers provided for the separate receptacle

E. Electrical System

7. A.C. 110 Volt Shore Power System (continued)

circuits. For reasons of safety, it is recommended that all appliances used aboard be equipped with a three-wire grounded cord.

The hot water heater is connected to a breaker on this panel, but also has a high temperature re-set button built into the heater. Before applying power to the water heater, always be sure the heater has been filled by turning on one of the hot water faucets long enough to get a steady flow. An empty hot water heater will burn out the heating element before the temperature re-set button can break the circuit.

The proper procedure for connecting shore power to the boat safely is as follows:

a. Turn ship's main breaker to "off".
b. Turn receptacle on dock to "off", if possible.
c. Connect cable to power inlet on boat first (to prevent handling a "live" power line and possibly coming in contact with water).
d. Route the cable in such a way as to prevent strain on either connector, allowing for the rise and fall of the tide, and to prevent chafing.
e. Connect to dockside receptacle and turn shore switch on.
f. Turn on ship's main breaker.

Disconnect procedure:

a. Turn off ship's main breaker.
b. Turn off dockside power and disconnect cord.
c. Replace all weather-tight caps on receptacles.

The owner must be aware of the hazards of using high voltage A.C. aboard ship and should maintain this system in safe condition.

Don't take chances handling A. C. equipment in wet weather or while washing down topsides. Caution guests and children about hazards, and do not use any equipment that does not function properly or is suspected of being defective.

8. Battery Charger Option

The battery charger, or converter, as it is also referred to, is connected to the feed or "output" side of the main battery switch. This allows you to select either or both batteries to be put "on the line" for charging when

E. Electrical System

8. Battery Charger Option (continued)

the engine is at rest. It also insures that, when the battery switch is "off", all circuits are positively disconnected from the batteries during an emergency shutdown.

Do not turn the battery charger on when the battery switch is in the "off" position. This could possibly feed the ship's circuits without the back-up support of the batteries. It could also cause premature failure of electrical equipment in the boat, if the regulator section of the charger should fail, allowing high voltage into the system.

The charger is protected by internally-mounted fuses on the A.C. and D.C. circuits, as well as the main circuit breaker on the A. C. panel. Be sure all the related circuits are "off" when opening the charger cabinet for service. The charger is an air-cooled unit with louvers on top and bottom. Care must be taken not to restrict the ventilation provided, nor allow small tools or hardware to fall into the charger while performing maintenance work in the engine room.

9. A.C. Generator Option

The A. C. generator option presently being installed is an Onan 7.5 kw diesel powered unit. It is advisable to read owner's manual provided with the unit and become familiar with the check points and operation before starting this unit for the first time.

Normal start up checks should include the following steps:

a. Check oil and water.
b. Open sea water cooling gate valve.
c. Open exhaust thru hull gate valve.
d. Check main generator circuit breaker(s) "on".
e. Check fuel shut off valve at tank for "on".

Generator starting:

a. Hold pre-heat switch on for 15 seconds.
b. Hold start switch on until unit begins to run. Starter will automatically disengage when engine reaches running speeds.
c. Release both switches.
d. Turn ship-shore power switch to "ship" position.
e. Observe A. C. voltage and frequency on meter panel, check for water discharge at generator exhaust port.
f. A.C. power is now available at main panel.

NOTE: OPERATE ENGINE ROOM BLOWER (IF NOT WIRED AUTOMATIC).

# IV. OPERATING PROCEDURES

## E. Electrical System

### 9. A.C. Generator Option (continued)

The generator is protected with cut-off switches for high temperature and/or low oil pressure. Refer to your Onan manual for trouble-shooting procedures, and to the wiring diagrams in your boat owner's manual.

The generator system has a separate fuel system from the tank to the unit, which includes an in-line fuel/water separator, fuel tank shut-off, and pick-up tube in the tank. The return line is connected to a tee fitting with the main propulsion engine's return line at the tank.

The sea water cooling system is also independent of the main system with its own gate valve and sea strainer.

Winterizing procedures will be found in the Onan owner's manual. The fresh water cooling system can be protected with an ethylene glycol type anti-freeze and is recommended for all season use.

When equipped with a $7\frac{1}{2}$ kw Onan generator, the generator control panel will have a source selector switch that provides three different functions.

The boat is wired with two independent 30 amp, 120 volt A.C. systems. These systems, referred to as #1 or "A" circuit and #2 or "B" circuit are wired from the shore power inlet through a pair of main breakers located in the engine room and to the source selector switch.

The forward shore power inlet receptacle on the cockpit coaming is #1 or "A" circuit. In normal use, the boat requires two 30 amp shore power connections to dockside power and in this application the selector switch would be set at the middle position reading #1 and #2.

In the event (while at dockside) only one 30 amp shore power service is available, the single cord must be connected to the forward inlet and the source selector switch set on #1 position.

This allows power to flow to both systems, but the owner must limit power to less than 30 amps combined, to prevent tripping the dockside power breaker.

When using the generator, the power is distributed equally to both panels with the source selector in the "generator" position. Refer to drawing #462-205 in the chart section of your owner's manual.

# IV. OPERATING PROCEDURES

## F. Plumbing System

### 1. Thru-Hull Connections

Below is a list of thru-hull penetrations and their locations. It is advisable to become familiar with the location and operation of each one, with the thought in mind to maintain quick access in the event of emergency.

Forward Head - access through cabinet door under sink.
- Toilet intake - 3/4" sea valve
- Toilet discharge - 1¼" sea valve
- Sink and forward shower discharge - 1¼" sea valve

Galley - access through cabinet door under sink.
- Galley sink drain - 1¼" sea valve

Engine Room:
- Raw water intake to engine - 1¼" sea valve
  located aft on port side of engine, near door.
- Aft cockpit drain and bilge pump - 1¼" sea valve
  located aft on port side of engine near door.
- Forward cockpit drain, shower pump and aft head sink - 1¼" sea valve
  located on starboard side of engine near aft bulkhead.

Aft Head - access through cabinet door under sink.
- Toilet intake - 3/4" sea valve
- Toilet discharge - 1¼"sea valve

Note: It is a good practice to close all sea valves when leaving the boat unattended. The only exception is the cockpit drain thru-hulls which also serve the bilge pumps. This is not only intended as a safety factor, but also insures that sea valves are maintained in working condition, in the event it becomes necessary to close them in an emergency situation.

Prop Shaft -- access through cabin sole drop-in panel in aft stateroom.
- See details on prop shaft stuffing box in "Maintenance Procedures" section.

Rudder Shaft - accessible through drop-in under aft berth.

Rudder Shaft Stuffing Box - see "Maintenance Procedures".

Engine Exhaust - not fitted with sea valve, access to thru-hull fitting is accessible under aft berth drop-in panel.

# IV. OPERATING PROCEDURES

## F. Plumbing System (continued)

### 2. Fresh Water System

A polyethylene-lined, fiberglass water tank, 75 gallon capacity, is located on the port side of the walk-thru area between the main cabin and the aft stateroom. An access door to inspect the fill and vent connections is located in the berth top in the walk-thru area. The main shut-off valve is located at the bottom forward corner of the tank and is accessible through the lower door at the navigator's station.

A reserve 125 gallon water tank is located on the starboard aft side of the engine room. This is connected to a pair of valves located under the galley sink to allow selection of either tank to feed the fresh water pump.

The pressure pump is located under the galley sink. A manually operated hand pump is installed at the galley sink for use under conditions of power or pump failure. This hand pump is connected to the electric pump inlet line with a tee connection and a gate valve, which is normally kept closed until such a need arises. The hand pump gate valve is located under the galley sink. There is an in-line strainer at the water pressure pump. This prevents foreign material from reaching the pump and should be checked periodically. Leaving manual pump gate valve open while operating pressure water system may cause air in the water lines.

The pressure water pump is activated by a switch on the D.C. panel and will run until the water pressure reaches 30 psi. When a faucet is opened and pressure water drops, it will automatically re-start at 16 psi. Upon closing the faucet, the pump will again shut off at 30 psi. If the pump cycles on and off by itself, it is an indication of a leak in the system.

When filling the fresh water system for the first time or whenever the system has completely run out of water, it will be necessary to run the pressure pump long enough to purge the air from the lines. Starting with the faucet closest to the pump, run the hot water side until a solid stream of water flows. It is important that the hot water heater is bled in this manner before turning on the A. C. breaker, as the heating element will be damaged if the tank is empty.

Operate each faucet in turn until air is out of the system, and "top off" the water tank.

The hot water heater also utilizes the engine cooling system to heat water while the boat is underway. The connecting lines and the heat exchanger must be bled when the engine cooling system is filled.

F. Plumbing System (continued)

3. Bilge Pumps

The aft bilge pump is a submersible type pump capable of removing 1400 gallons per hour. It is actuated by a switch on the pedestal in either the automatic position (via the float switch) or in the manual position, which overrides the float switch. It will run continuously until returned to "off" or automatic. The water is routed to the aft cockpit drain in the engine room.

The forward pump operation is similar, but is not a submersible pump.

4. Sump Pump

A sump pump is provided for each shower, one forward, and one aft. It is controlled by a switch in each head which must be turned on when using the shower. The circuit is protected by a 10 amp breaker on the D.C. panel.

5. Marine Heads

The marine head is manually operated, using sea water for flushing. The inlet and discharge sea valves should be checked to be open before using.

A decal is supplied with operating instructions which should be mounted on the bulkhead adjacent to the toilet. Further detailed instructions for winterizing, etc., found in the manual supplied by the head manufacturer are:

"To Operate Toilet: Inlet valve should be in open position. Before using, pump to wet inside of bowl. After using, pump until thoroughly cleaned. Pump a few more times to clean lines. If excess waste should cause water to rise in bowl, stop pumping until water recedes."

"To Winterize Toilet: Shut off intake valve. Pump until dry. Remove drain plug in base. Pump again to remove all water. Do not use anti-freeze."

"Do not put rags, matches, paper towels, or anything in bowl that will plug up valves."

# IV. OPERATING PROCEDURES

## F. Plumbing System (continued)

### 6. Holding Tanks

Holding tanks, for use in restricted waters, allow the heads to be used as needed. But, one must remember to minimize the amount of water pumped for flushing to extend the capacity of the tank. The holding tank is a flexible rubber/nylon tank, installed in a compartment as near to the head as possible. This location may vary depending on the model of the boat and related options.

It is connected to a "tee" fitting in the normal overboard head discharge system. To use the holding tank, rather than the overboard discharge, the sea valve at the thru-hull must be closed first and then open the holding tank shut-off valve.

The holding tank has a capacity of 15 gallons, enough for 30 average flushings. A deck plate provides for pumping out at dockside, and the system should be rinsed and re-pumped out. This can be done by pumping through the toilet or by a hose through the deck plate. Use of a commercial chemical toilet treatment and deodorizer is recommended.

Lectra/San waste treatment system. This unit is an electrolytic chlorinator; and when used with a marine toilet, provides a flow-thru treatment that has been accepted as meeting the Federal requirements (Federal Register Vol. 41 - No. 147).

A salt feed tank is used for operation in fresh or brackish water, as the system is designed for use in salt water. Details on the adjustment and service will be found in the Lectra/San manual.

Operation of the unit is accomplished by:

a. Activate the "start" button.
b. Pump the "flush" handle 6-10 strokes.

After the treatment cycle (about $2\frac{1}{2}$ minutes), the unit will shut down. Toilet is now ready for next use. Note: The toilet can be used during the treatment cycle; but the flushing should not be done until the previous treatment cycle has been completed and the "operating" light off.

Maintenance and trouble-shooting information will be found in the manual supplied with the unit, as well as winterizing procedures and re-commissioning.

Do not operate unit without water in the treatment unit, as serious damage can occur.

F. Plumbing System (continued)

7. Optional Dockside Water Supply

As an added convenience, a dockside water supply may be installed. This allows the boat's fresh water system to operate without drawing from the tank or using the ship's D.C. power supply to operate the pump.

The water inlet fitting is mounted on the starboard cockpit coaming near the shore power inlet and is connected by means of a garden hose to the shore supply.

In the engine room, on the forward bulkhead, is a pressure regulator valve which maintains 40 psi or less to the fresh water system.

The electric pressure pump has a check valve in the outlet fitting which prevents water from flowing back to the boat's water tank.

CAUTION: Do not leave the boat unattended with the pressure water line "on". A failure in any of the yacht's water lines could result in sinking of the yacht.

# IV. OPERATING PROCEDURES

## G. Refrigeration

### 1. Ice Box

The ice boxes are one-piece molded fiberglass units insulated with a nominal three-inch thick surrounding of polyurethane foam. The inner surface is gelcoated with a sanitaryware formula which is non-toxic and will not "flavor" food.

The drains are connected directly to hand pumps located beneath the galley sink and is pumped overboard through a connection in the galley sink drain.

When the boat is to be idle for a prolonged period, it is advisable to flush the ice boxes and leave open to the air to prevent mildew or odor formation.

### 2. Icemaker Option (Icerette)

The icemaker operates on 110 volt A. C. shore power and uses water from the boat's fresh water system. The fresh water pump breaker must be on, and the 110 volt circuits must also be operational. There is a separate breaker on the 416 model electric panel.

The icemaker is connected to the water system through a shut-off valve located under the galley sink.

An "on-off" switch is located in the unit beneath the icemaker door.

It takes approximately 45 minutes for the unit to cycle when first started. During the initial start up, it is advisable to discard the ice cubes made for the first two or three hours. This is due to the possibility that dirt and foreign matter may have entered during manufacture. Read the owner's manual for details on temperature adjustments and trouble-shooting.

### 3. Refrigeration Option

A 12 volt refrigerator may be optionally installed, which operates on 110 volt shore power (via a battery charger) or 12 volt. D.C. when shore power if off.

The panel switch or breaker should be left in the "on" position, and the refrigeration controlled by the thermostat switch inside the cabinet.

Failure of the refrigerator to cool is generally caused by low battery voltage.

The owner's manual provided with the refrigerator gives detailed information on operation and trouble-shooting.

# IV. OPERATING PROCEDURES

## G. Refrigeration

### 3. Refrigeration Option (continued)

Another item to consider is the thermostat setting which should be kept at a level just low enough to keep the unit cold. This will minimize the amount of running time, and thus conserve battery power.

### 4. Grunert Refrigerator

Your "hold over" refrigeration system differs from conventional refrigeration in several ways. The evaporator plates are tanks which contain a mild anti-freeze solution. This solution freezes and melts at +26° (40° refrigeration ) or 0° (freezers) to provide a long cooling effect while not using A. C. power.

When the unit is first started, a long running cycle should be expected as all the solution must freeze before the unit begins to cycle. Once frozen, however, the unit will cycle normally and provide conventional refrigeration while at dockside.

When cruising away from shore power, the system should be run twice a day from the generator. To be assured of the longest hold-over possible, the eutectic solution in the plates should be completely frozen. The unit should have cycled with the cold control at normal (#5) or colder before turning off the unit at the thermostat.

On "spill over" systems with plates installed only in the freezer section, chilled air is supplied to the refrigerator section through automatic damper controls which are low on the refrigerator side of the dividing barrier. These can be adjusted for warmer or cooler temperatures in that section. The openings for these louvers through the divider should not be obstructed on either side of the barrier.

The finned condensor on the unit should be kept clean and, particularly on units that are air cooled only, must have adequate and free air circulation.

On units with auxiliary water cooling, the strainer should be checked regularly and cleaned periodically. The cooling water flow can be checked at the overboard fitting, which should be just above the water line. A spare set of pump impellers should be kept on hand.

Defrost evaporator or Sta-Cold plates when the frost or thickness exceeds 1/4". To defrost quickly, warm water or warm air from a heater or hair dryer may be used. When it is not desirable to completely warm up the refrigerated compartment, the plates may be scraped clear of frost with a plastic or wooden scraper.

G. Refrigeration

4. Grunert Refrigerator (continued)

When not operating the unit, open the cabinet doors or hatches to allow air circulation in the cabinet and to prevent mildew and odor.

A.C. sealed units do not require winter storage pump down. When securing the unit for a storage period, spraying the condensing unit lightly with CRC or a similar light oil is recommended. If the unit is subject to extremely damp conditions, use spray paint as required to prevent rust.

# IV. OPERATING PROCEDURES

## H. Optional Air Conditioning (Marinaire)

The air conditioning units are 110 volt operated and sea water cooled by remote mounted pumps.

A sea water inlet valve and strainer is located under the aft berth for the aft unit, and under the port settee for the forward unit. These valves must be opened before using the air conditioner, or damage to the pump impellor will result.

The sea strainers must be maintained and serviced the same as you would for the main engine.

Cooling water is discharged on the port side aft, and amidship (forward unit).

Pump operation may be checked by observing water discharge from these ports immediately after turning the control switch to "start" position. Allow unit to remain in the "start" position long enough to observe water flow. Switch to "run", at which time the compressor will start and cooling begins. The temperature is thermostatically controlled, and the fan speed is generally left on high until the desired temperature is reached. The fan may then be set to the desired level.

To winterize units, disconnect the pump connector plug, and drain sea water lines (sea valve closed) and sea strainer.

Remember to reconnect plug and lines before using "cooling" when warm weather returns.

Detailed instructions for servicing and trouble-shooting these units will be found in the Marinaire manual.

When the air conditioning option is requested on the O1-41 model, a second 30 amp shore power system is installed. The load is then divided between the two to prevent overloading of the boat's standard electrical system, as each unit is capable of drawing approximately 16 amps A.C.

# IV. OPERATING PROCEDURES

## 1. Alcohol Stove

Although a copy of the manufacturer's operating instructions is included in the owner's packet, we would like to bring some of the basic and important instructions to your attention:

### 1. Fueling

Always purchase a good grade of denatured ethyl alcohol for your stove. Before filling the tank, check to insure all burners are "closed" on the stove and the tank "outlet" valve is closed.

If any pressure remains in the alcohol tank, loosen the cap slowly until pressure reaches zero.

Remove the cap, partially fill the tank, allow it to remain about 3/4 full to provide a space for the air charge. Use a funnel to avoid spillage. Replace the tank cap and the alcohol container cap. Store remaining fluid in a safe place.

### 2. Operating

a. Pressurize the alcohol tank in accordance with the manufacturer's specifications (10 - 15 lbs pressure is generally sufficient). Open the tank outlet valve ("feed" line to stove) and check for signs of leakage at the tank and stove ends of this line.

b. Carefully open one burner control at a time, allowing alcohol to flow into the priming cup beneath the burner until the center section of the cup is about half filled. Do not overfill! Shut off burner control and light the priming alcohol. When the priming alcohol is consumed, open valve one quarter turn and light burner. Pre-heated burner produces vaporized alcohol and will ignite like a gas burner.

c. A flare-up at this time indicates insufficient pre-heating. If this occurs, shut the burner control off, allow the burner to cool, and repeat step (b).

d. Operate the burner as you would a gas stove. Flame intensity is controlled with the burner knob. Periodically check the tank pressure.

### 3. Shut Off

To shut off stove, turn control knob to the right, cutting off the flow of alcohol to the burner.

Release air pressure at the storage tank by loosening filler cap to avoid "flooding" of burner, should controls be accidentally opened when stove is not in use.

# IV. OPERATING PROCEDURES

## 1. Alcohol Stove (continued)

### 4. Miscellaneous

For the sake of safety, it's a good practice to keep a container of water or a wet towel within easy reach when using the alcohol stove. Never leave an operating stove unattended.

In an emergency, close the tank valve immediately!

General information and maintenance tips are outlined in your manufacturer's instructions. Please read them carefully before using your stove. Though alcohol is a relatively safe cooking fuel and easily extinguished with water, a thorough understanding and familiarity of the equipment is the best safety device and precaution.

Good cooking to you in your practice of the seafaring culinary arts!

# IV. OPERATING PROCEDURES

## J. Opening Ports and Hatches

### 1. Ports

The opening ports on your Out Island 41 are all plastic. This eliminates the corrosion problems associated with metal frames. The glazing is Lexan, an extremely tough plastic, which flexes but is almost impossible to break. A neoprene "O" ring is the primary seal between the glazing and the frame.

When dogging down the ports, it is not necessary to use more than "finger tightening" force. Excessive force, for example through the use of pliers, may damage the gasket. If finger tightening does not provide a complete seal, open the port and check the seating of the gasket. The usual causes for leaks through the portlights are shifted or damaged gasket and/or dirt on the gasket or lens surface.

The portlights have integral sill drains. If water collects in the lower recesses, check that the drain holes are free.

### 2. Hatches

The operation of the hatches is straightforward. The following precautions will prevent accidents and reduce the chance of damaging the hatches:

- Open and close hatches carefully. The thermoformed acrylic hatches can be damaged (at the hinge attachment) by slamming the hatch opened or closed.

- When the hatch is to be left open, be sure that all positioning devices are used.

- Before closing the hatches, be sure all obstructions (particularly fingers and heads) are clear.

- When dogging down the hatches, do not use excessive force. You should not need to use any tools for this purpose.

## K. Navigation Lights

Navigation, or "running" lights must be in accordance with the rules and regulations of the navigable water the yacht owner intends to use.

International rules and regulations are required to be observed on seagoing vessels. The Inland rules and regulations are for intracoastal waterways, with certain areas such as the Great Lakes and Western Rivers having special requirements and rules pertinent to their local areas.

Morgan Yacht has listed the following notes for your reference from the International rules. We suggest the owner of any vessel acquire a copy of the United States Coast Guard publications on the "Rules of the Road" for their intended areas of navigation.

In general, the navigation lights are required from sunset to sunset, weather conditions good or bad. It is suggested that in times of reduced visibility, from sunrise to sunset, navigation lights be operational.

If vessel is underway by use of power, and is under 150 feet in length, it is required to operate a forward light, white in color, 20 point angle (225 degrees), 5 miles visibility range; a stern light, white in color, 12 point angle (135 degrees), 2 mile visibility range; side lights, green to starboard, red to port, in color, 10 point angle ($112\frac{1}{2}$ degrees), 2 mile visibility range.

If vessel is underway by use of sail, it is required to operate its side lights (same specification as underway power) and stern light.

If vessel is anchored, it is required to operate its anchor lights, white in color, 32 point angle (360 degrees), 2 mile visibility range.

The yachtsman is encouraged to become familiar with the complete rules and regulations of the above mentioned situations, as well as other possible conditions of operation. Proper operation and use of navigational lights is important for the safety of the yachtsman and the future of boating. A diagram illustrating navigation lights installed on your Out Island 41 at the factory is given in the last section of this manual.

# IV. OPERATING PROCEDURES

## L. Lightning Protection

Your yacht was not provided with a lightning protection system during construction at Morgan Yacht. The reasons are as follows:

1. We are not aware of a procedure for lightning protection which is proven reliable under all conditions. We are aware of situations where yachts with elaborate lightning protection systems have sustained serious damage from a direct lightning strike.

2. If the builder were to assert that the yacht were lightning protected, it could instill a false sense of confidence in the owner/operator, leading to less than prudent actions when lightning threatened.

3. Lightning systems are "out-of-sight, out-of-mind", except when lightning threatens. Generally, they are not checked and maintained on a regular basis. A defect in the system (i.e. a break in a ground line) could, in some cases, increase the risk of personal harm and damage to the yacht, as compared to a yacht with no protection. The reason for this is that many lightning protection systems distribute the high voltage throughout the yacht before allowing it to exit through the ground.

4. It is impossible for Morgan Yacht to control changes you, the owner, may make to the yacht, which could affect the lightning protection system.

You, the owner, must decide whether you wish to equip your yacht with lightning protection, and if so, the method of doing so. For your guidance, a copy of ABYC recommendations is attached. The following suggestions and comments are also offered:

1. Keep the system as simple as possible. This will facilitate both installation and inspection/maintenance. Perhaps a single oversize ground (battery cable) from the mast base to the engine, coupled with external shroud grounds (see 2 below), will maximize reliability.

2. ABYC recommends straight line wire runs, which is virtually impossible within the yacht. For grounding the shrouds, a battery cable, which clips to each shroud and extends outside the yacht to the water, can minimize the number of bends required. This method has the added advantages of keeping the power surge outside the boat and allowing easy and routine inspection. The obvious disadvantage is that the clip-on cables are not a permanent installation and may not be in place when an unexpected lightning strike occurs.

3. Use only top quality materials and go oversize where possible.

# IV. OPERATING PROCEDURES

## L. Lightning Protection (continued)

4. Keep all permanent attachment points and connections where they are readily available for inspection, yet protected from damage or inadvertent disconnection.

Factory installed metal tanks, 110 volt systems and major metal components are grounded to the engine. The engine is grounded via the shaft and prop to the water. The purpose of the internal grounding is for static charge control and accidental shorts in the internal systems -- not to provide lightning protection. However, you can incorporate the ground lines present in a lightning protection system you may wish to add.

By far the most important consideration regarding lightning is observing common sense safety precautions when lightning threatens. The key considerations are listed in paragraph 7 of the attached ABYC recommendations.

# RECOMMENDED PRACTICES AND STANDARDS COVERING LIGHTNING PROTECTION

PROJECT E–4 (ADOPTED NOV.3, 1959) ABYC E–4–70

1.0 *SCOPE*

1.01 WHEREIN standards and recommended practices outline the means whereby all types of craft can be afforded a high degree of protection against lightning.

2.0 *GENERAL PRINCIPLES*

2.01 In view of the wide variation in structural design of boats, the following basic guides should be considered and used in designing and installing a lightning protection system for any given craft: (See Fig.1.)

2.1 A grounded conductor, or lightning protective mast, will generally divert to itself direct hits which might otherwise fall within a cone-shaped space, the apex of which is the top of the conductor or lightning protective mast and the base is a circle at the surface of the water having a radius of approximately two times the height of the conductor. The probability of protection is considered to be 99.0 percent for the 60 degree angle shown in the illustration. The probability of protection can be increased to 99.9 percent by increasing the height of the mast so that the 60 degree angle becomes 45 degrees.

2.2 To provide an adequately grounded conductor or lightning protective mast, the entire circuit from the top of the mast to the ground should have a conduction equivalent to a No.8 A.W.G. copper conductor and the path to ground followed by the conductor should be effectively straight.

2.3 If there are metal objects of considerable size within a few feet of the grounding conductor, there will be a strong tendency for sparks or side flashes to jump from the grounding conductor to the metal object at the closest point. To prevent damage from such side flashes an interconnecting conductor should be provided at all places where they are likely to occur.

2.4 Large metallic objects within the hull or superstructure of a boat should be interconnected with the lightning protective system, or the bonding system, to prevent a dangerous rise of voltage due to a lightning flash. Items which are not part of the electrical system of the boat may be independently grounded, provided it is not practical to interconnect with the lightning protective or bonding systems.

2.5 Since a lightning conductor system is expected to remain in working condition for a long period of time with relatively little attention, the mechanical construction should be strong and the materials used should offer high resistance to corrosion.

3.0 *INSTALLATION RECOMMENDATIONS*

3.1 *Lightning Protective Mast* – A lightning protective mast should be of adequate height (Section 2.1.) and should be mechanically strong in order to withstand exposure to use and weather If the mast is of non-conducting material, the associated lightning or grounding conductor should be essentially straight, securely fastened to the mast, should extend at least 6 inches above the mast, should preferably terminate in a sharp point and should meet the requirements of Section 3.3.

3.2 *Radio Antenna* – A radio antenna may serve as a lightning protective mast provided it is equipped with transmitting type lightning arresters or means for grounding during electrical storms. The grounding of metal rod type radio antennas constitutes sufficient protection for wooden boats, without masts and spars, provided the following conditions are met:

3.21 All conductors in the grounding circuit of the antenna are at least No.8 A.W.G. copper or equivalent in accordance with Section 3.31.

3.22 A line drawn from the top of the antenna downward toward the water at an angle of 60° to the vertical does not intercept any part of the boat. (Section 2.1).

3.23 Antennas with loading coils are considered to end at a point immediately below the loading coil unless this coil is provided with a suitable gap for by-passing the lightning current.

3.24 Non-conducting antenna masts with *spirally* wrapped conductors are not considered suitable for lightning protection purposes.

3.3 *Materials* – The materials used in the making of a protective system should be resistant to corrosion. No combination of metals should be used that forms a galvanic couple of such a nature that in the presence of moisture or direct submersion, corrosion is accelerated. Except for the use of conducting materials which are otherwise part of the structure of the boat, only copper should be used as the conductor. Where copper is used, it should be of the grade ordinarily required for commercial electrical work, generally designated as being of 98 percent conductivity when annealed.

3.31 *Copper Conductor*

Copper conductor should weigh at least 50 lbs. per thousand feet.
Copper cable conductors should be of a diameter not less than No.8 A.W.G. The size of any wire of a cable should be not less that No.17 A.W.G. The thickness of any copper ribbon or strip should be not less than No. 20 A.W.G. (0.032 inch).

Where other materials are used the gauge should be such as to give conductivity equal to or greater than No.8 A.W.G. copper cable.

3.32 *Joints*

Joints should be mechanically strong and should be so made that they have an electrical resistance not in excess of that of 2 feet of conductor.

3.4 *Interconnection of Metallic Masses*

3.41 *Interconnection or Grounding* – Metallic masses aboard boats which are a permanent part of the boat, or are permanently installed within or about it, should with the exception of those of comparatively small size, be made a part of the lightning-conductor system by interconnection with it (see Paragraph 2.4.) or independently grounded, or both, depending upon their location with respect to the lightning conductors and their surroundings, as more fully described in Sections 3.42 to 3.44, inclusive.

*Note: The object of interconnecting the metal parts of a boat with the conductor is to prevent damage from side flashes especially in the case of rather extensive metal objects that are near by. The main principle to be observed in the prevention of such damage is to pick out on a boat the places where side-flashes are most likely to occur and provide metallic paths for them.*

3.42 *Exterior Bodies of Metal* – Metal situated wholly on the exterior of boats should be electrically connected to the grounding conductor at its upper or its nearest end, and, if of considerable length, should be also grounded or electrically connected to the conductor at its lower or its farthest end.

*Note: Exterior metal bodies on boats include any large masses such as horizontal handrails on cabin tops, smoke stacks from galley stoves, davits or metal signal masts.*

3.43 *Interior Bodies of Metal* – Metal situated wholly in the interior of boats which at any point comes within 6 feet of a lightning conductor should be electrically interconnected with it. The bonding required to prevent *electrolysis* should be considered adequate.

*Note: Interior bodies of metal include engines, water and gasoline tanks, control rods for steering gear or reversing gear. It is not intended that small metal objects such as compasses, clocks, galley stoves, medicine chests, and other parts of the boat's hardware should be grounded.*

3.44 Metal which projects through cabin tops, decks or sides of boats above the sheer should be bonded to the nearest lightning conductor at the point where the metal emerges from the boat and should be grounded at its lower extreme end within the boat. Spotlights and other devices projecting through cabin tops should be solidly grounded regardless of any other type of lightning protection. Personnel should refrain from operating this gear when lightning is in the immediate vicinity.

3.45 Radio transmitter antenna should be (1) equipped with means for grounding during electrical storms or (2) the transmitter and antenna should be protected by transmitting type lightning arresters.

3.5 *Ground Connection* – A ground connection for a boat may consist of any metal surface which is normally submerged in the water and which has an area of at least one square foot. Propellers and metallic rudder surfaces may be used for this purpose. The ground plate as required by FCC for radio transmitters should be considered adequate. A steel hull itself constitutes an adequate ground.

3.6 *Vessel with Metal Hulls* – If there is an electrical contact between metal hulls and metal masts or other metallic superstructure no further protection against lightning is necessary. Boats with non-conducting or ungrounded objects projecting above the metal masts or superstructure should have these objects grounded in order to protect them.

4.0 *PROTECTION OF SAILBOATS*

4.1 *Sailboats* – Sailboats with metallic standing rigging will be adequately protected provided that all rigging is grounded, so that the mast and rigging meet the requirements of Section 3.1 and 3.3.

4.2 *Open Day-Sailers* – Open sailboats will be adequately protected if the shrouds and back stays or preventors are grounded. These should be electrically connected at the lower end and grounded to a copper plate on the hull or to a metal rudder, or center board or keel. *For the protection of personnel,* it is recommended that any continuous metallic track on the mast and boom be connected at the lower or forward end of the grounding system. *For protection of the boat only,* it is necessary to ground but one pair of shrouds.

4.3 *Cruising Sailboats* – All stays and all sail tracks should be grounded on cruising sailboats since it is assumed that persons will be in proximity of fore-stays as well as after-stays. Grounding of other objects on cruising boats should be in accordance with the foregoing paragraphs.

5.0 *PROTECTION OF POWER BOATS*

5.01 Power boats may be adequately protected by a grounded radio antenna or other suitably grounded lightning protective mast as specified in Section 3.1., provided the height of the mast meets the requirements for the specified cone of protection. Interconnection and grounding of metallic masses should be in accordance with this specification.

5.1 Where the size of the boat is such as to render the use of a single mast impractical, additional lightning protective masts should be erected to form overlapping cones of protection. It is recommended that the provisions of the United States Department of Commerce Handbook No.46 "Code for Protection Against Lightning" be followed.

6.0 *PROTECTION OF SMALL BOATS*

6.01 Small boats may be protected by means of a temporary lightning protective mast which may be erected under lightning conditions. Grounding provisions may be made by means of flexible copper wire and a submerged ground plate of approximately one square foot in area.

7.0 *SUGGESTED PRECAUTIONS FOR PERSONNEL*

7.01 Inasmuch as the basic purpose of protection against lightning is to insure the safety of personnel, it is appropriate that the following precautions be listed in this report.

7.1 One should remain inside a closed boat, as far as practical, during a lightning storm.

7.2 One should avoid making contact with any items connected to a lightning conductive system and especially in such a way as to bridge between these items. For example, it is undesirable that an operator be in contact with reversing gear levers and spotlight control handle at the same time.

7.3 No one should be in the water during a lightning storm.

7.4 If a boat has been struck by lightning, compasses and electrical gear should be checked to determine that no damage or change in calibration has taken place.

ZONES OF PROTECTION

FIGURE 1