



HURRICANE[®]

HEATING SYSTEM

*FROM
CALCUTT BOATS*

INSTALLATION AND OPERATION MANUAL

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THE LATEST TECHNOLOGY IN A DIESEL HOT WATER HEATING SYSTEM

HURRICANE®

The *HURRICANE®* heater has a stainless steel case which houses all the working components. The water jacket is made of copper and brass for efficient heat transfer and brazed together for durability and long life. It has a fully insulated water jacket for minimum heat loss. The burner and combustion tube are made of a special high temperature stainless steel to prevent premature warping or burnout.

The *HURRICANE®* heater utilises a low pressure fuel system. The built in fuel pump draws fuel from the fuel tank up to a zero pressure regulator where it stops. An air accumulator is installed inline between the fuel pump and the regulator to trap any air bubbles from passing through the nozzle causing nuisance shutdowns. The accumulated air can be periodically bled off through the bleeder valve. A small compressor delivers air to an air aspirating nozzle. This nozzle draws fuel from the zero pressure regulator, mixing it with air through a venturi. This process produces a very fine mist of fuel into the burner providing complete combustion and very low emissions. This low pressure system allows the use of a larger fuel orifice, less clogging, less wear and less maintenance. Ignition is accomplished by a low draw igniter, approximately 2 amps, for thirty seconds. A small fan provides outside air for combustion and a positive exhaust flow through the hull fittings. Combustion air is drawn from outside so the heater can be installed in an air tight compartment or in the engine room without the fear of starving the heater of air or back venting the heater with the engine running.

A main control panel times all the heater functions, monitors the operation of each component and provides a safety shutdown of the heater should anything go wrong. It provides space heating and domestic water heating zones.

A remote control panel is provided as standard equipment. The remote panel has an on/off reset switch and an LCD display for indication of normal or fault operations. A signal beeper on the remote panel serves as an audible indication of a fault causing a shutdown situation.

The *HURRICANE®* heater is very user friendly and easy to install. If access to the heater is unrestricted, any part can be removed and replaced within 30 minutes.

This publication was correct at the time of printing. ITR and Calcutt Boats have a policy of continuous improvement in their products and reserve the right to amend any specifications or procedures without prior notice.

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CHAPTER 1

1.1 INTRODUCTION AND TECHNICAL SPECIFICATIONS

Congratulations on the purchase of your new *HURRICANE*[®] heater.

This manual explains what you need to know for proper installation, operation and maintenance of your heater. Your local *HURRICANE*[®] dealer is available to help with installation and maintenance, and to answer your questions. See Chapter 7 for information on our warranty and customer service.

Technical Specification

Heat Rating	Water Connection	Exhaust Outlet	Water Capacity	Electrical Input	Fuel Flow	Min. Water Flow	Dimensions (h x w x d)
9.4 kW	0.75" dia	1.5" dia	3.8 litres	42 watts (10.5 to 15.0 volts DC)	0.75 lph	7.7 lpm	7" x 11" x 19"



1.2 FEATURES

Designed for the marine environment, the *HURRICANE*[®] heater features unique, state of the art technology. The special features of the *HURRICANE*[®] include:

- Fuel efficient burner which burns all grades of diesel fuel, stove oil, furnace oil and kerosene without any burner adjustment
- Zero smoke, no carbon build-up, no fouling or smell
- Copper and brass water jacket transfers more heat to the water and reduces the fuel consumption
- High temperature stainless steel burner and marine stainless steel jacket
- Quiet operation and low power consumption
- Insulated enclosure for retaining heat and minimising noise
- Sealed combustion—outside air is fan assisted to the combustion chamber and then exhausted outside, avoiding back pressure
- Completely modular and field serviceable (user friendly)
- All connections are easily accessible
- Electronically controlled. Safety features include four second shutdown in case of failure, LED digital readout on the electronic control panel for indicating faults, aquastats for monitoring water temperatures and a photodiode to monitor the flame
- Complete with remote control panel with ON/OFF reset button, LCD digital readout and a signal buzzer
- Jumper for constant pump circulation (automatic cycling when off)
- Air accumulator installed in fuel line to collect air bubbles and prevent them from reaching the burner and causing nuisance shutdowns

CHAPTER 2

2.1 COMPONENTS

Below is a description of the components that come with the *HURRICANE*[®] heater. Before you start the installation, make sure that you have all of the components and ARE FAMILIAR WITH ALL ASPECTS OF THIS MANUAL.

- **HEATER** - This includes a fuel pump, hourmeter (see below), air accumulator, combustion air fan, compressor, regulator, fuel and air nozzle, burner, combustion chamber and water jacket.
- **ELECTRONIC CONTROL BOARD** - This consists of a service switch, a jumper for a constant circulation pump, fuses, terminal connections, circuit board, a fault indicator LED digital readout from which you can monitor the entire operation of the heater. The circuit board allows for the connection of the room thermostat, the cylinder thermostat, the solenoid valve and the circulation pump.
- **HOURMETER** - The hourmeter will provide you with the accumulated operating hours for your *HURRICANE*[®] heater. Regular inspection and maintenance of the heater and its associated components should be performed to keep it in peak operating condition.
- **LCD READOUT REMOTE PANEL** - This panel will display the diagnostic explanation which will match up to the diagnostic code on the main board. A small buzzer will sound for 10 seconds to alert you of a fault.



- **WATER PUMP** - This pump circulates water through the central heating system.



- **HEADER TANK** - This tank is required to fill the heating system and allow for expansion of the water.



- **AIR SEPARATOR** - This is provided to remove any air from the water circulating in the heating system.



- EXHAUST SILENCER - Constructed of stainless steel and packed with ceramic insulation. The straight through design eliminates any backpressure and reduces exhaust noise.
- EXHAUST PIPE - This flexible stainless steel exhaust pipe and clamps are used to connect the silencer to the heater and to the hull fitting.
- AIR INTAKE FLEXIBLE TUBING - Connects the heater unit to the hull fitting.
- ROOM THERMOSTAT - This is mounted in the boat cabin and controls the heater.

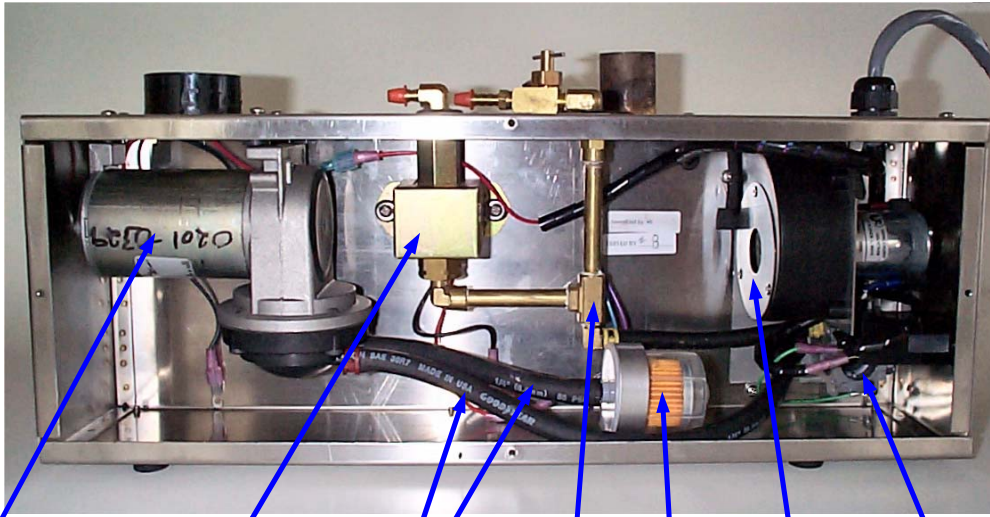


- CYLINDER THERMOSTAT - This is mounted on the calorifier (hot water tank) and controls the heater.



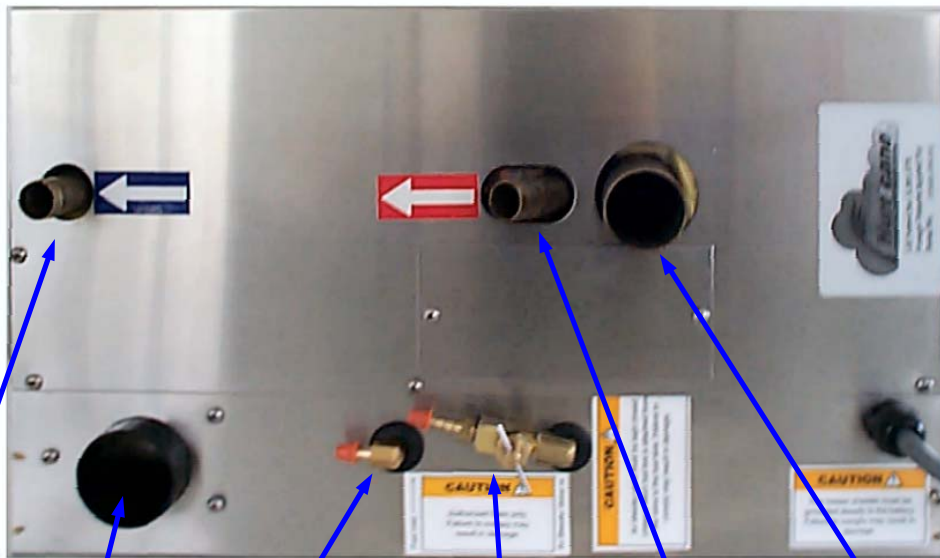
- SOLENOID VALVE - This isolates the cabin radiators when the room thermostat senses that the cabin has reached the desired temperature.





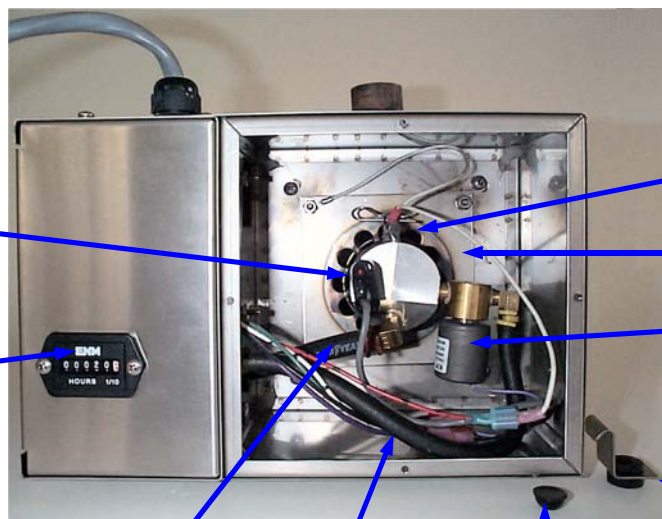
Compressor Fuel Pump Air Lines Air Accumulator Air Filter Fuel Regulator Combustion Fan

SIDE VIEW - COVER OFF



TOP VIEW

Water In Air In Fuel In Air Bleed Water Out Exhaust Out



Hourmeter Photo Diode Igniter Burner Assembly Solenoid Air Line Fuel Line Rubber Standoff Mounting Bracket

FRONT VIEW - COVER OFF

CHAPTER 3 - INSTALLATION

3.1 OVERVIEW

Installation of the *HURRICANE*[®] heater is best done with some mechanical aptitude and electrical knowledge. It is a central heating hot water system similar to that which you might have in your home. Critical factors include routing of the hot water pipes, purging of the water and fuel lines, installation of the electronic control box, among others.

3.2 MOUNTING THE HEATER

The heater's physical size allows it to be mounted in a very small area that may be difficult or nearly impossible to access. For normal servicing, access to the front, left side and top must be provided.

You must consider the weight of the heater (full of water) when selecting a mounting location and mounting equipment. Keep in mind the exhaust run from the heater which may limit the mounting location. Ensure that the exhaust system can be properly and safely routed to the outside.

The heater comes with rubber mounting grommets installed. A screw or bolt with a washer must be used through the centre of each grommet to secure the heater in place.

If the heater is going to be mounted in the engine compartment, check for adequate ventilation. When the engine is running, this area could be under negative pressure. Make sure that the air intake and exhaust system have no leaks and are well fastened to the heater, muffler and the hull fittings. Parts that may cause injury through accidental contact should be protected.

3.3 LOCATION/ELEVATION REQUIREMENTS

When planning space requirements for the *HURRICANE*[®] system, remember:

The header tank must be the highest elevation point in the system so that air can easily be expelled and water can flow directly down to the water pump. Mount the heater and all other parts of the system at a lower point than the expansion tank.

The water pump and air separator must be mounted at the lowest point or in a location that ensures that they will always be flooded and will not trap air. The pump must never be allowed to run dry.

3.4 EXHAUST SYSTEM

If the standards for mounting the exhaust system cannot be met, do not use this heater. Do not exceed these limitations. The exhaust system of this heater produces very little emissions of carbon monoxide, but caution must still be used. Do not operate the heater while in an enclosed shelter, unless there is adequate ventilation.

The exhaust pipe must be extended from the exhaust outlet of the heater, via the silencer, to a suitable through-hull spigot located as high above the waterline as possible and preferably mounted on the transom of the boat. This location lessens the chance of exhaust gases contacting combustible material (such as a pier) or the exhaust being obstructed by piers, other boats or the bank. Heavy duty clamps should be used to connect the exhaust components.

No more than 3.7 metres (12 feet) of exhaust tubing and no more than 360° of total bends should be used on the exhaust system. Do not use silencers that have any restrictions to flow.

Since the *HURRICANE*® heater can produce exhaust temperatures in excess of 200°C (400°F), the exhaust system must be properly installed, leaving suitable air spacing and using metal shields or insulation where required to protect combustible materials.

NEVER place any exhaust system parts close to combustible material or through a combustible wall or ceiling without fireproof protection.

3.5 EXHAUST INSULATION

The complete exhaust system should be lagged with a suitable material.

3.6 EXHAUST SILENCER

The silencer provided is a straight through design offering no resistance to exhaust flow. This is the only type that can be used in the *HURRICANE*® heating system. It must be tightly clamped in series with the exhaust piping.

3.7 HULL FITTINGS

Suitable spigots must be fitted to the hull for the connection of the exhaust outlet and the air intake. Make sure that these spigots are not placed where they can take on water. Also ensure that both spigots are situated on the same side of the boat. This will ensure that there will be an equal pressure on both for a balanced system.

3.8 AIR INTAKE TUBING

Air intake tubing of 2 inch diameter is supplied with the kit. The same rules apply as apply to exhaust runs, with a maximum of 12 feet.

1. Install tubing from the combustion air intake fitting on the heater to the hull spigot. If possible, the air intake tubing should follow a route parallel to the exhaust tubing.
2. The air entrance for the air intake shall be guarded, shielded or located to exclude rain, snow, debris and birds.
3. Secure both ends of the intake tube with properly sized hose clamps.

DO NOT allow the combustion air intake and exhaust system tubing to touch as the exhaust system can become very hot and could melt the combustion air intake tube.

3.9 FUEL SYSTEM

NEVER use petrol in your HURRICANE® heater. The HURRICANE® heater is designed to run on all grades of diesel fuel, furnace oil, stove oil or kerosene. Do not install the HURRICANE® heater in the same compartment where either petrol is stored or petrol equipment is operated.

We strongly recommend that a separate fuel supply line be extended from your fuel tank to the heater. If you must tee into an existing fuel line, splice it in close to the fuel tank - do not tee directly off the engine or genset. A check valve stops fuel siphoning back to its source. If in doubt, contact your *HURRICANE*® dealer for more information.

1. Use 1/4" copper tube for the fuel line to connect the fuel supply and filter to the heater. All fittings must be airtight and the lines purged of all air.

2. Install an inline fuel filter.
3. Install an inline shutoff valve to isolate the system for filter service and to allow shut-down.
4. Flush the fuel line to rid the system of any foreign material.
5. Connect the fuel line to the fuel pump built into the heater. The electrical wires for pump operation are pre-wired.

KEEP FUEL LINES AWAY FROM EXCESS HEAT

3.10 AIR ACCUMULATOR

Air in the fuel line is the single most common cause of heater shutdown. An Air Accumulator is installed to prevent air from reaching the burner and shutting it down. It must be regularly checked and bled where necessary. The need for constant bleeding is a sign of air leaks in the fuel line between the fuel tank and the heater.

The fuel bleed valve is located on top of the heater. You may add a short piece of hose so that when you bleed the system any fuel can be collected in a container.

3.11 ELECTRICAL SYSTEM

Your *HURRICANE*[®] heater and electronic control board are tested and operated together before shipping. Refer to the Wiring Schematic to see how the system is pre-wired. The remote panel contains a LCD diagnostic display and signal horn and allows you to turn the heater on and off remotely, and to reset the heater if a fault occurs.

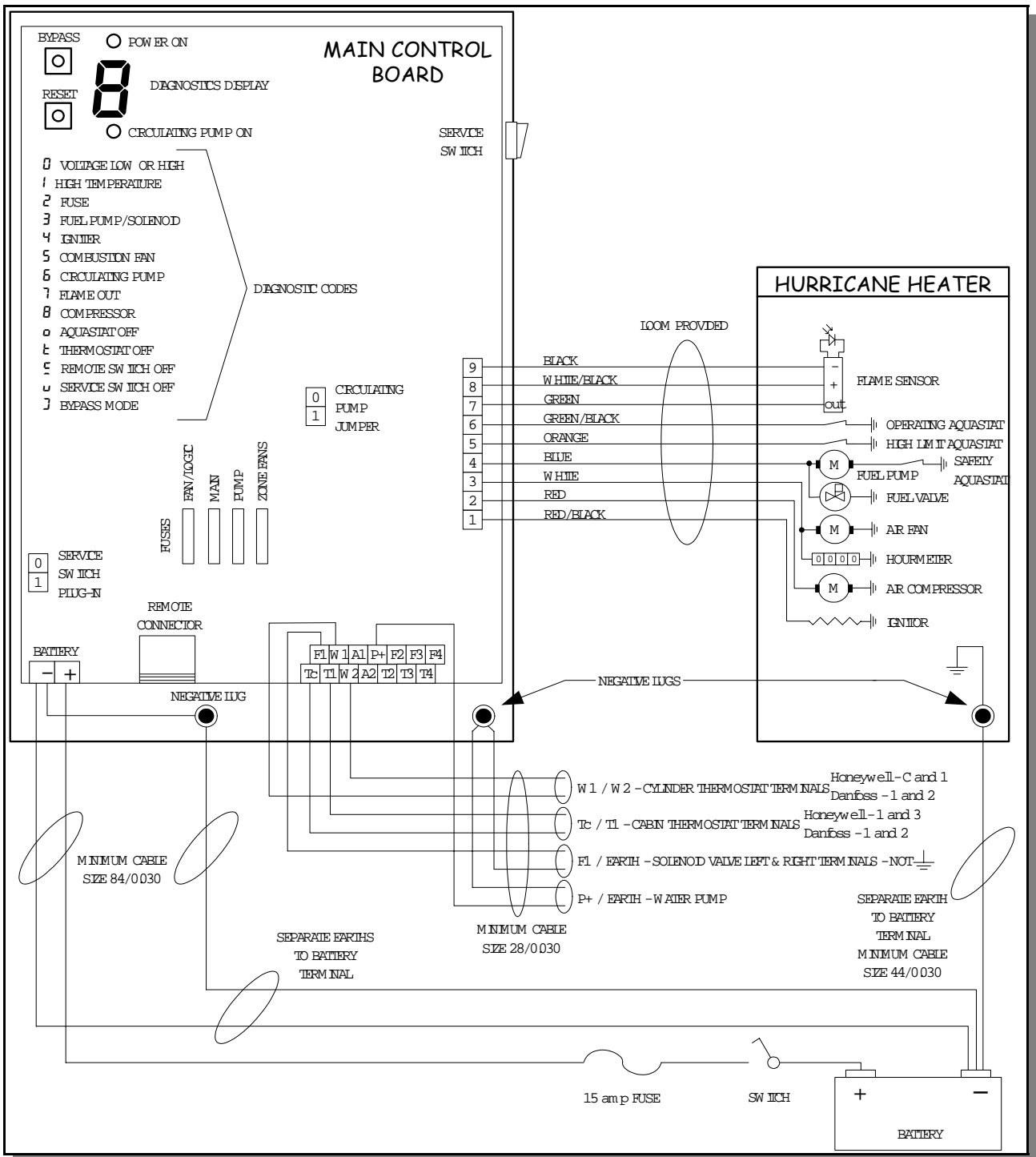
NEVER shut off the power to the heater using an inline battery or master switch, or disconnect the battery when the heater is running. Doing so will severely damage the heater and will not be covered under warranty.

3.12 CONTROL BOX

Located on the side of the box is the service switch and inside, located on the main board, the jumper for constant pump circulation which allows you to run the circulating pump, and test the system circulation, without turning the heater on. The service switch does not shut off the power to the control board. When disconnecting power leads from the board, turn off the power at the source, but not when the heater is running.

Mount the electronic control box close to the heater, but not too close to excessive heat. Ensure that the cable connections are easily accessible. The control box can be mounted in any position.

Wire the control box directly to the battery, through a fuse and master switch, using the cable sizes shown on the Wiring Schematic. The negative connection must be made to the negative lug on the main control box. Make a separate additional negative connection from the shell of the heater directly to the battery using a minimum of 44/0.030 cable. The thermostats, solenoid valve and circulation pump should be wired using the cable sizes shown on the Wiring Schematic.



WIRING SCHEMATIC

3.13 FUSES

The control box contains four fuse holders:

Fan/Logic -	5 amp	- Control Board and Combustion Fan
Main -	10 amp	- Main Operating Components
Pump -	5 amp	- Circulating Pump
Zone Fans -	5 amp	- Solenoid Valve

3.14 REMOTE PANEL

The remote panel controls the heater's operation. It has a combination ON/OFF/RESET switch, a LCD diagnostic display and a 10 second signal horn, which indicates system faults or shut-down. After fault is rectified, the system can be reset by switching the switch OFF and ON again. The remote indicator panel is connected to the control box using the cable supplied.

The heater's electronic control system will automatically purge or cool the combustion chamber when the service switch, remote switch, or room thermostat is turned off. This will not occur if the power supply is disconnected which will cause severe damage to the heater.

3.15 THERMOSTAT WIRING

The terminals for the room and cylinder thermostats are located inside the main electronic control box. Use the recommended cable sizing as shown in the Wiring Schematic.

3.16 SOLENOID VALVE WIRING

The terminals for the solenoid valve are located inside the main electronic control box. Connect to the C1 & C2 terminals on the solenoid. Do not use the centre (earth) terminal. Use the recommended cable sizing as shown in the Wiring Schematic.

3.17 WATER SYSTEM

The *HURRICANE*[®] heater heats your boat by circulating hot water through the radiators and the domestic hot water tank (calorifier).

It is important that you observe the correct water flow into and out of the heater. These are clearly marked on the heater unit.

See Plumbing Schematic for the correct plumbing layout.

3.18 MOUNTING THE HEADER TANK

Mount the header tank at the highest point of the system and connect to the vent pipe of the air separator.

CAUTION: When the system is hot and running, the water in this tank is very hot.

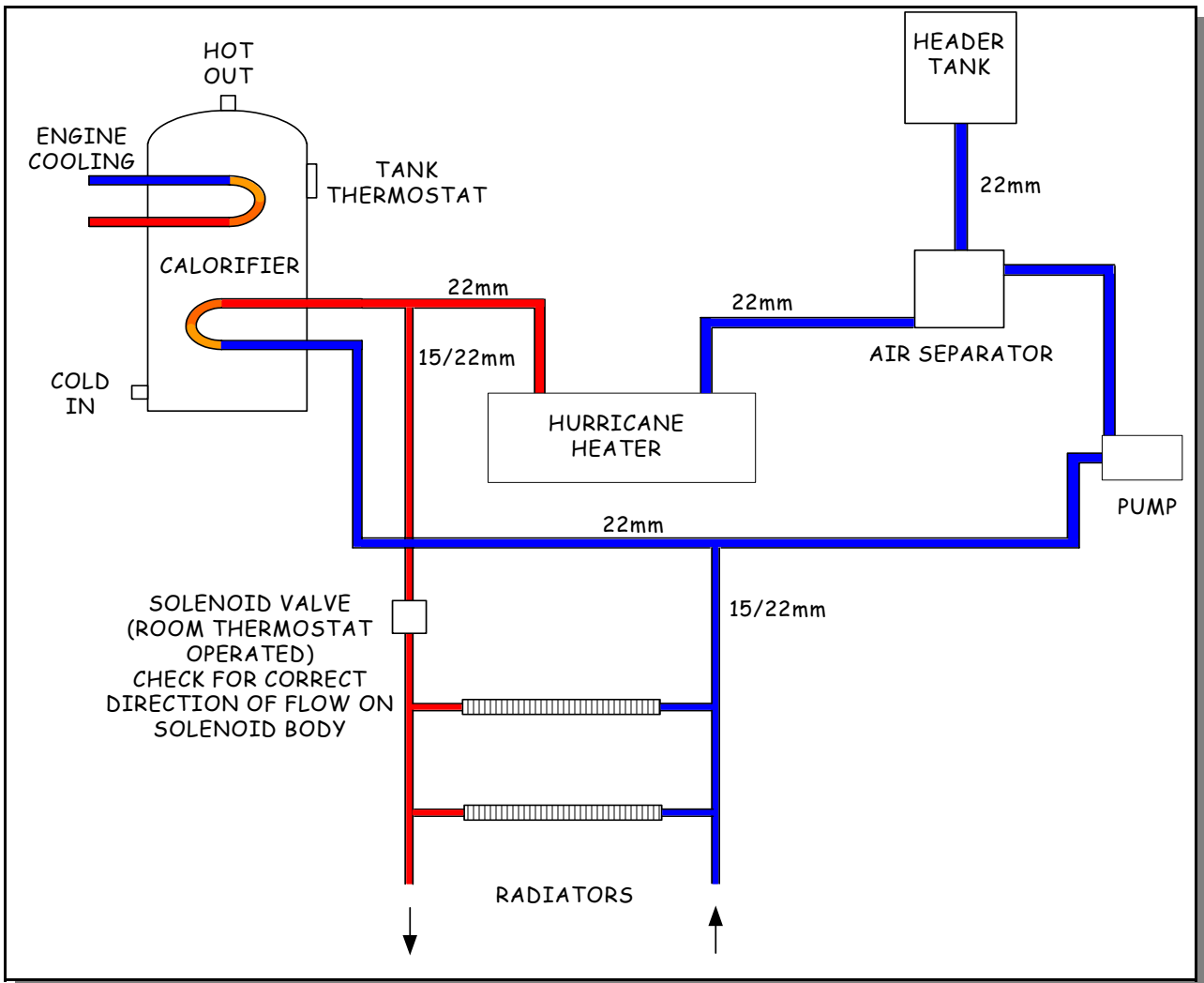
3.19 AIR SEPARATOR

The air separator must be mounted between the water pump and heater.

3.20 WATER CIRCULATION PUMP

Ensure that the pump is mounted at a lower point than the *HURRICANE*[®] heater and adjacent to the air separator.

The most sensitive part of the heater system is the water pump. NEVER let the pump run dry or the impeller will be damaged. This is not covered by the warranty.



PLUMBING SCHEMATIC

3.21 PLUMBING

It is recommended that all plumbing is carried out using normal domestic plastic plumbing pipe and fittings and 3/4" ID vehicle radiator hose pipe.

3.22 WATER FILLING PROCEDURE

After your system has been completely installed, filled with straight water, purged of all air, and operated for a period of time at normal operating temperatures, you should then double check all connections for leaks. If no leaks are found, the system can be drained and filled with a 50/50 mixture of antifreeze and water.

PRECAUTION: Where there is any chance of contamination of your domestic water when using a heating system, use antifreeze specifically intended for hydronic heating systems. Inhibited propylene glycol is recommended. Do not use automotive, ethylene glycol, or any undiluted or petroleum based antifreeze as they can cause severe personal injury.

Fill the system by adding the mixture to the header tank. When you are sure that sufficient water has been added to allow the pump to be switched on without it running dry, the pump can be turned on with the "Circ. Pump Override" jumper on the main control circuit board. When the jumper is on, the pump will run continuously (the Service Switch on the Control Box

must also be on).

Continue to add the mixture to the header tank to ensure that the level does not fall too low and allow air to be brought into the system. Check again for leaks and bleed any air from the radiators.

The level in the header tank should be maintained approximately one third full.

CAUTION: Make sure that you have a good, quiet circulation of water through the heater. Check the pump to make sure it does not run dry. If the heater has air pockets trapped in the water jacket when it is turned on, it could overheat and damage the unit. None of this is covered by warranty.

3.23 CHECKING WATER CIRCULATION

When the system has been purged of all air the pump should run smoothly and quietly. To determine whether water is circulating properly:

1. Listen for cavitation or bubbling sound from the pump. This means that air is left in the system and circulation is poor. Bleed the radiators again.
2. Remove the pump circulation jumper, which will return the pump to normal operational mode.
3. You should purge the air from the system again, through the radiator vents, after the first operation cycle of the heater, and once more after the first use of the boat. This is because any rocking motion may loosen any small air bubbles that are trapped in the system. Once the water system has been completely purged of air, you will probably not have to purge it again.

3.24 DOMESTIC HOT WATER HEATING

Domestic hot water is heated by passing the heater output through the hot water tank (calorifier). A cylinder thermostat is provided to attach to the calorifier in order to control the temperature. This wired to the main control board as shown in the wiring schematic.

3.25 PROTECTING HYDRONIC HEATING SYSTEMS

The advantage of closed hydronic heating systems is that as long as there are no leaks, (i.e. no need for constant water top-up), the fill neutralises (that is, it reaches equilibrium). The long term result is minimal scale build-up and insignificant corrosion since after operating for a period of time, most oxygen has been "starved" out of the boiler fill water. While boiler fill water treatments have their place, leak prevention is the single most important preventative maintenance item.

Causes of Scale:

Tap water is the most typical source selected for boiler fill water. Water contains dissolved solids such as magnesium and calcium which when heated becomes much less soluble and forms scale. Scale comes out of solution in the largest amounts when the temperature is highest in the system (i.e. the boiler heat exchanger). As the scale builds up, noise and cold spots develop since scale plugs up water channels and acts as an insulator that impedes proper heat transfer.

Acidity and Corrosion:

Corrosion is the result of metal oxidising (that is, metals acting with oxygen-rich boiler fill water). The acidity of any liquid (including water) is a good indicator of how much corrosion will actually take place. As a rule of thumb, boiler fill water should have a pH greater than 7 and

less than 10.5. The key to preventing corrosion is to make sure that the heating system is free of leaks and there is no need to replace it with fresh, oxygen rich boiler fill water. Corrosion inside a hydronic heating system stops quite quickly as the fill water stabilises and becomes oxygen-starved. The pH should be measured at least annually.

Since most hydronic systems are comprised of different metals (e.g. iron, copper, etc.), and since boiler fill water is an electrolyte (that is, it will conduct electrical current), electro-chemical reactions (“galvanic” reactions) can take place. As the fill water stabilises, however, it becomes a very weak electrolyte, so galvanic corrosion rarely becomes a problem—as long as the system remains leak-free.

Preventative Treatments:

Corrosion and scale inhibitors are relatively inexpensive. Ideally they should be applied, once only, at the time of a new installation or whenever a system has been completely drained. Boiler water treatment specialists almost unanimously agree that the prevention of leaks and the elimination of the need for frequent boiler water make-up are top priorities for hydronic systems.

CHAPTER 4 - OPERATION

Before the initial start of your *HURRICANE*[®] heater, be sure that all components have been properly installed according to the instructions laid out in this manual.

4.1 STARTING THE HEATER

1. Turn on the ON/OFF control switch on the remote indicator panel.
2. Turn up the room thermostat to a setting higher than room temperature.
3. Start the heater by switching the service switch to ON. This switch is on the side of the electronic control box.

4.2 SIGNS OF NORMAL OPERATION

When the heater is operating normally:

- The igniter will glow and the combustion air intake fan and the circulating pump begin to run. Whenever the pump is running, the green LED at the bottom of the LED display will be on.
- A few seconds later, the fuel pump starts delivering fuel to the regulator, the compressor turns ON, the fuel valve opens and fuel is drawn to the air aspirating nozzle. The fuel is atomised and sprayed into the combustion chamber to start combustion.

After the ignition period (about 10 seconds), the igniter shuts OFF and the burner continues to operate. The burner will operate until all the thermostats are satisfied, or until the heater reaches its normal water operating temperature of 180°F. Once the normal operating temperature is reached, the burner itself will cycle off and the combustion fan will operate for an additional two minutes to purge the burner. If a room thermostat or domestic water thermostat is not satisfied, the circulating pump will continue to operate. If a thermostat cannot be satisfied by the residual heat in the system, and the water temperature drops, the burner will restart and cycle until all thermostats are satisfied. Once this happens, the heater will go through the two minute purge and the circulating pump will cease. The circulating pump will operate if the remote switch and the room or the domestic water thermostat are on. If the water hose leaving the outlet of the heater does not warm up immediately after the pump comes on, water is not circulating properly and air may be in the system. Turn the heater OFF immediately and check water circulation, see section 3.23.

4.3 STOPPING THE HEATER (FOR SEASONAL PURPOSES)

Turn OFF the ON/OFF control switch on the remote panel. The room thermostat or the remote

NEVER shut off the power to the heater using an inline battery or master switch, or disconnect the battery when the heater is running. Doing so will severely damage the heater and will not be covered under warranty.

indicator panel ON/OFF switch can be turned ON or OFF at any time, without harming the heater. The heater will automatically run through the purge cycle, which takes about two minutes.

4.4 STOPPING THE HEATER (FOR MAINTENANCE)

1. Turn OFF the ON/OFF switch on the remote panel.
2. Turn OFF the service control switch on the electronic control box.
3. Wait until the heater has completed its purge cycle and turned itself OFF.
4. Disconnect the power supply.

4.5 RESETTING A FAULT

When a fault occurs and has been corrected, you can reset the fault by switching the service switch on the side of the main control box or the remote control switch OFF, then ON again. This will reset the fault and the diagnostic code.

4.6 DOMESTIC WATER OPERATION

If your hot water tank (calorifier) is connected to the *HURRICANE*[®] heating system, it will cycle the heater and the water pump.

4.7 ELECTRICAL NOISE

Noise is unwanted electrical signals, which produce undesirable effects in the electronic circuits of the control system and we must be aware of techniques to minimise the electrical noise on these controllers.

The majority of problems stem from crude wiring practices and techniques, which allow 'coupling' or the transfer of electrical noise into the control circuit from the noise source. One common symptom is that the system is erratic, i.e., evidence of the problem does not appear consistently. Even worse, it may give several different indications of a problem.

Low power level controllers that use electronic logic, especially those using integrated circuits, are more sensitive to noise. A typical noise source is any piece of equipment that can cause or produce very rapid or large amplitude changes in voltage or current when turned ON and OFF.

Noise sources:

- Loose connections.
- Switches and relay contacts operating inductive loads such as motors, coils and relays etc.
- All welding machinery.
- Heavy current carrying conductors.
- Fluorescent and neon lights.

The sensor input and power output lines, as well as the power source line, all have the potential to couple or link the control circuit to a noise source.

Common Impedance Coupling occurs when two circuits share a common conductor. An example would be operating multiple, separate loads and the return lines from all are connected together and run back to the power source with one conductor. The best way to prevent this is to use independent leads for each return circuit and terminate them all at the same physical point. Safety ground (chassis ground), should NEVER carry return currents.

Magnetic (Inductive) Coupling generally appears where there are wires running parallel or in close vicinity to each other. This is especially true when the wires from several different circuits are bundled together in order to make the system wiring appear neat.

Electrostatic (Capacitive) Coupling is a function of the distance the wires run parallel with each other, the distance between the wires and the diameter of the wire. The best way to eliminate these is to run separate leads from separate circuits in separate bundles, taking special care to keep AC* (high power lead) wires separated from DC (low power level) wires. If it is at all possible, twisted lead pairs and shielded cables should be used.

Electromagnetic (Radiation) Coupling occurs when the control circuit is very close to a high energy source that is capable of magnetic or electrostatic induction of a voltage. A common source of such radiation is an inverter, alternator, generator, motor transformers, fluorescent lights, radio, TV, and navigation equipment.

* Note that special attention should be given to the AC power line because it is a source of unusual types of noise-related problems in control circuits.

CHAPTER 5 - TROUBLESHOOTING

5.1 OVERVIEW

The electronic board consists of a flash micro controller programmed to monitor the timing and safety function of the heater. Each time the board is energised by a call for heat, it will check its own circuits for any problems. Should a problem exist, the board will shut down and display a code **7** (flame out). This is indicative of a defective board. To confirm, use the by-pass mode (see section 5.17).

You can easily monitor HURRICANE heater's operation by checking the electronic control box. Refer to Wiring Schematic to see how the electronic control box is wired. Any fault or problem will be immediately picked up by the control board and a LED diagnostic code indicator will light up to pinpoint the fault. Once the fault has been corrected, it can be reset by switching the service or remote switch OFF then ON again. The diagnostic codes are described below.

5.2 POWER ON (GREEN)

The POWER ON indicator is lit whenever the service switch on the control box is ON.

If the power light does NOT come on, check for a blown fuse.

5.3 BURNER ON

No diagnostic code will be displayed on the main board or the remote panel when the burner is ON and operating normally.

5.4 - SERVICE SWITCH OFF

The service switch is switched OFF.

- The burner will shut down if it is running.
- The diagnostic code **u** will be displayed.
- The control board will purge the system with the combustion fan and circulating pump for two minutes. At the end of the purge period, the system will power down and will go into a low power consumption mode (10mA max). There will not be any display or LEDs lit.

5.5 - REMOTE SWITCH OFF

The remote panel is switched OFF.


- The burner will shut down.
- The diagnostic code **E** will be displayed.
- The control board will purge the system with the combustion fan and circulating pump for two minutes.

If the remote switch is put in the ON position, the control board will resume operation. If there is no diagnostic code displayed:

1. Make sure the service switch is ON.
2. Make sure the remote switch cable is plugged into the control box and remote switch.
3. Make sure the remote rocker switch is working.
4. Check the cable continuity.


5.6 - HEATER CYCLING (NORMAL OPERATION)

The operating aquastat installed on the water jacket has been satisfied.

- The burner will shut down.
- The diagnostic code will  be displayed.
- The control board will purge the burner with the combustion fan for two minutes and then stop. The circulating pump will run until the last thermostat is satisfied, then purge for two minutes and stop.
- To maintain the system temperature the operating aquastat will cycle the burner off at 185°F (85°C) and on again at 150°F (65°C).
- If the heater cools and fails to resume operations and the diagnostic code continues to be displayed, the aquastat is faulty or has an open connection.


5.7 - THERMOSTATS OFF (NORMAL OPERATION)

All thermostats are satisfied.

- The burner will shut down.
- The diagnostic code will  be displayed.
- The control board will purge the burner with the combustion fan and circulating pump for two minutes. When any thermostat calls for heat, the heater will resume normal operation.
- If the heater fails to resume operations check the thermostats and their connections.


5.8 - VOLTAGE LOW OR HIGH

The battery or power supply voltage is below 10.5Vdc or about 15.5Vdc.

- The burner will shut down.
- The diagnostic code will  be displayed.
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the combustion fan and circulating pump for two minutes while it is checking if the voltage fault is still present. If the voltage fault has cleared, the control board will reset the alarm and restart the burner. If the condition has not cleared by the end of the purge period, the diagnostic code will continue to be displayed. The control board will continue to check the voltage every half hour until the voltage fault has cleared and then restart the burner.
- To manually reset the fault, switch the service switch or the remote panel switch OFF then ON again.

5.9 - OVERHEAT

The high temperature limit has been reached.

- The burner will shut down
- The diagnostic code  will be displayed
- The buzzer will sound for 10 seconds
- The control board will purge the system with the combustion fan and circulating pump for two minutes while it is checking if the overheat condition exists. If the condition exists, the diagnostic code will continue to be displayed
- To restart the burner, first check the circulating pump, the level of the coolant and the movement of the coolant whilst the circulation pump is running. Then reset the fault after the water has cooled down by switching the service or the remote panel switch OFF then ON again. If it does not reset, check for a faulty aquastat and proper ground.

5.10 2 - FUSE BLOWN

One of the fuses on the control board has blown.

- The burner will shut down.
- The diagnostic code 2 will be displayed.
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the combustion fan and circulating pump for two minutes while it is checking for a blown fuse. If a blown fuse exists, the diagnostic code 2 will continue to be displayed.
- In order to restart the burner, replace any blown fuses with one of the proper size. Then reset the fault by switching the service switch or the remote panel switch OFF then ON again.

5.11 3 - FUEL PUMP/SOLENOID

The fuel pump or fuel solenoid has shorted.

- The burner will shut down.
- The diagnostic code will 3 be displayed.
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the combustion fan and circulating pump for two minutes.
- In order to restart the burner, check the fuel pump and solenoid for a short circuit. Then reset the fault by switching the service switch OFF then ON again.

The remote panel switch does not reset short circuit faults.

5.12 4 - IGNITER

The igniter is open or shorted.

- The burner will shut down.
- The diagnostic code 4 will be displayed.
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the combustion fan and circulating pump for two minutes .
- In order to restart the burner, check the igniter and connections. Then reset the fault by switching the service switch or the remote panel OFF then ON again if the igniter is **open**, or by the service switch only if the igniter is **shorted**.

The remote panel switch does not reset short circuit faults.

5.13 5 - COMBUSTION FAN

The combustion fan is open or shorted.

- The burner will shut down.
- The diagnostic code 5 will be displayed.
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the circulating pump for two minutes .
- In order to restart the burner, check the combustion fan. Then reset the fault by switching the service switch or the remote panel OFF then ON again if the combustion fan is **open**, or by the service switch only if the combustion fan is **shorted**.

The remote panel switch does not reset short circuit faults.

5.14 **6** - WATER PUMP

The water pump is shorted.

- The burner will shut down.
- The diagnostic code **6** will be displayed
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the combustion fan for two minutes .
- In order to restart the burner, check the water pump. Then reset the fault by switching the service switch OFF then ON again.

The remote panel switch does not reset short circuit faults.

5.15 **7** - FLAME OUT

The flame went out or did not ignite.

- The burner will shut down.
- The diagnostic code **7** will be displayed.
- The control board will try to restart the burner two more times. After three unsuccessful ignition attempts, the buzzer will sound for 10 seconds.
- The control board will purge with the combustion fan and the circulating pump for two minutes. The diagnostic code will continue to be displayed.

The single most common reason for flame out faults is when air gets into the fuel system.

This is normally caused by loose fittings or when your fuel supply is teed off a fuel line used by your engine or generator. As air circulates and passes through the nozzle, it interrupts the fuel and shuts down the burner. When this happens, it may be necessary to reset the fault a few times to ensure all air has passed through the system. If the burner resumes normal operation, you must find the source of the air leak, otherwise this fault will continue to occur. An Air Accumulator has been installed to collect the air before it reaches the nozzle. Check regularly and bleed if necessary. Air which is collected is an indication of a leak somewhere in the fuel system.

1. Check the fuel supply. The fuel pump will chatter if there is no fuel or when air is passing through the pump. Check the Air Accumulator for air and bleed if necessary. Check connections between the fuel tank and fuel pump and the regulator and nozzle for air leaks. Find source of air entry and repair. Make sure the nozzle or fuel filter is not clogged.
2. Check the air line hoses for any restriction of air flow through the compressor. Restrictions may be caused by a crimped hose, a clogged air filter, or a loose or leaking air hose from the compressor outlet to the nozzle. Check the air filter inlet for any obstructions.
3. Make sure the air pressure of each compressor with the nozzle installed is at 8 to 9 psig.
4. Check for negative pressure in the area around the heater. When the engine is running, it can draw air back through the heater's exhaust pipe. All intake air and exhaust connections must be tight.
5. Check for restrictions or leaks in the combustion air intake hose or exhaust pipe.
6. Check for open circuit on fuel pumps/solenoid and compressor.

To restart the burner, check the fuel supply, check for air in the fuel line and clean the nozzle. Then reset the fault by switching the service switch or the remote switch OFF then ON again.

5.16 **8** - COMPRESSOR

The air compressor has shorted.

- The burner will shut down.
- The diagnostic code **8** will be displayed.
- The buzzer will sound for 10 seconds.
- The control board will purge the system with the circulating pump for two minutes .
- In order to restart the burner, check the air compressor. Then reset the fault by switching the service switch OFF then ON again.

The remote panel switch does not reset short circuit faults.

5.17 **3** - BYPASS MODE

The bypass mode is a service feature to be used by **authorised service personnel only**. The bypass mode overrides the remote switch, voltage fault, fuse blown fault, flame out fault, open igniter fault, open fan fault and thermostats. All these safety devices will be bypassed for five minutes.

- While in the bypass mode, the diagnostic code **3** will be displayed and the power ON LED will flash rapidly.
- If the heater cycling aquastat is satisfied or the overheat limit is reached, the burner will stop and purge for two minutes while displaying the diagnostic codes, heater cycling; C, or 1 for overheat, and the Power ON LED will flash slowly. You will have to wait for the heater to cool before continuing in the bypass mode. The bypass mode will timeout in five minutes. After the first three minutes running, it will automatically purge for the last two minutes.

5.18 WATER PUMP ON (GREEN)

The green light located directly under the LED digit on the main board will come on whenever the circulating water pump is energised.

5.19 REMOTE PANEL

The remote panel consists of an ON/OFF reset switch, an LCD diagnostic display, and fault buzzer. The diagnostic display matches the main control board codes as explained previously in this section. The small buzzer will sound for 10 seconds to alert you to a fault.

5.20 FLAME SENSOR MODULE

The flame sensor consists of a sealed module with a photodiode aimed at the flame, a red LED indicator light and 3 wires, white (+), black (-) and green (signal) connected to the main board. Under normal operating conditions whenever the burner ignition begins, the red LED will flash once indicating the white and black wires are connected and the module is receiving power and working properly. Once the burner is ignited, the LED will begin to flicker like the flame. If for any reason the flame is extinguished, the flickering will stop and the board will shut down the heater. If the green (signal) wire is disconnected, the board will shut down. If all the wires are properly connected with module flashing and the board still shuts down, diagnostic code **7** (flame out), the board may be defective.

5.21 REDUCED OUTPUT

The heater may run without faulting, but at a reduced output. If this is noticed, it could be caused by the following:

1. High altitude.
2. Dirty nozzle.
3. Defective regulator.
4. Too small a nozzle.
5. Poor water circulation.
6. Ash deposit in combustion chamber.

5.22 SMOKEY, SMELLY EXHAUST

The heater may run without faulting, but you may experience signs of soot, exhaust smoke and/or a pungent smell. This is usually caused by the wrong fuel to air mixture. This can be affected by the following:

1. Low voltage.
2. High altitude.
3. Dirty compressor air filter.
4. Low compressor air output.
5. Restricted combustion air flow (intake hose/exhaust hose/combustion chamber).
6. Low combustion fan output (defective motor/wrong rotation/dirty fan blade).
7. Partially clogged grooves in nozzle distributor.

5.23 A SILENT KILLER

The American Boat and Yacht Council Inc. states:

Section 5.111: “where heater is installed in an engine or bilge space, 100% fresh air shall be supplied for combustion.

Section 6.1: burners shall be of the mechanical draught type which employs a power driven fan, blower or other mechanism supplying air for combustion.”

This means 100% fresh combustion air must be mechanically delivered through a sealed duct directly to the heater from outdoors. This is the recommended procedure no matter where the heater is installed. When combustion air is drawn from an unventilated heat space, the heater flame will become increasingly yellow as the oxygen in that space is consumed. An oxygen-starved flame produces excessive carbon monoxide (CO), some of which can easily escape the exhaust. Even with one porthole barely open, air doesn't circulate enough.

Carbon monoxide is a colourless, odourless, tasteless gas, produced any time you burn a carbon-based fuel such as gasoline, wood, charcoal, kerosene, propane or diesel. It disperses freely in the air and can accumulate in enclosed spaces or air pockets. Boaters are especially vulnerable to the dangers of CO because boats typically have diesel engines, as well as fuel-burning appliances, and their enclosed spaces tend to accumulate CO. Because CO is a cumulative poison, it can have fatal effects even at low concentrations. It is absorbed by your lungs like oxygen and attaches to your red blood cells. When your blood can no longer transport sufficient oxygen to the brain and other tissues, you essentially asphyxiate. Any device that burns fuel creates CO, so your cooking stove and heater are both potential sources, especially if poorly ventilated.

The exhaust systems are under constant attack from water, gases, vibration and normal wear. Inspect every exhaust system aboard your boat on a routine basis. Start with a visual inspec-

tion. Check each joint for discolouration, carbon build-up, stains, water leaks or signs of damage. Inspect all metal parts for corrosion. Check that clamps are in good condition and secure. Ensure that all ventilation systems are in good working order and not blocked. An untuned, poorly running engine or heating appliance produces excessive CO. Make sure it is tuned up, maintained and runs smoothly. It should never produce black smoke.

Section 2.1: “All components including frames, fuel filters, solenoid valves, fuel pumps, blowers, shall be of a type suitable for the application, i.e. resistant to corrosion in salt atmosphere, capable of proper operation under conditions of vibration, shock and the pitch and rolling action of the boat. Refer to applicable ABYC standards. Gravity hot water, gravity hot air and high pressure steam systems are not recommended for boat use.”

Make sure the heater you intend to buy is constructed of corrosion resistant material including the internal parts like the burner, combustion chamber, and water jacket. Parts made of steel or even painted steel will corrode and are very expensive to replace besides being dangerous to your health. All the major parts of the “Hurricane Heater” are constructed of corrosion resistant materials.

CHAPTER 6 - MAINTENANCE

6.1 THE FIRST FEW WEEKS

Once your *HURRICANE*[®] heater has been installed to approve standards and workmanship, and you have test operated it a few times, your *HURRICANE*[®] heater requires little maintenance.

About two weeks after your *HURRICANE*[®] heater has been running, you should conduct a general inspection of the entire system. Check for any leaks in the exhaust, fuel or water systems. Tighten all clamps.

6.2 ADDING ANTIFREEZE

Once the system has been filled with water and purged of all air during the installation procedure, you need to operate the heater at normal temperatures and then check for water leaks. If you do not find any, add antifreeze to lubricate the pump and prevent the water system from corroding or freezing in cold weather. See Chapter 3 “Water Filling Procedures”.

PRECAUTION: *Where there is any chance of contamination of your domestic water when using a heating system, use antifreeze specifically intended for hydronic heating systems. Inhibited propylene glycol is recommended. Do not use automotive, ethylene glycol, or any undiluted or petroleum based antifreeze as they can cause severe personal injury.*

IT IS VERY IMPORTANT THAT YOU NEVER USE WATER ONLY AS A COOLANT.

We recommend that you add a mixture of 50% water and 50% antifreeze. NEVER use more than a 50/50 mixture, since the added viscosity of the antifreeze solution will cause circulation problems. Your antifreeze/water mixture should be changed every three years. Antifreeze does wear out and can become very acidic.

A coolant conditioner can be added to the system to keep the coolant alkaline and not acidic, see Chapter 3. These inhibitors also prevent the coolant from forming calcium scales. Conditioners maintain water stability and prolong heater life. If a conditioner is not added to your system check the pH level yearly.

6.3 EXHAUST SYSTEM

While the exhaust system is made of a high quality stainless steel material, it is still affected by the marine environment. Check the general condition of the pipes every so often for possible leaks and corrosion. Service as required and replace corroded pipes immediately.

6.4 NOZZLE

Nozzle problems such as clogging will result in a poor flame, small and blue. Carefully disassemble. Hold the nozzle and turn stem clockwise. Clean distributor orifice and air slots of any debris using solvent and high pressure air. Check O-rings for nicks and replace if in doubt. A leaking O-ring will allow air into the fuel causing popping of the flame.

This should be done by a trained service engineer.

6.5 FUEL LINES AND FILTER

You should check your filter every season to determine if it needs replacement. The frequency depends largely on the quality of the fuel you've been using.

6.6 COMBUSTION CHAMBER

The quality of the fuel varies and some ash is left in the chamber after combustion. The burner and combustion tube must be removed and the combustion chamber vacuumed cleaned every 1000 hours. If this is neglected, the exhaust will be restricted and will cause the combustion chamber to burn out. The exhaust pipe should be checked and vacuumed, if required.

This should be done by a trained service engineer.

6.7 CHECKING HOSES AND TUBES

Every so often, check all water hoses and tubes for leaks or weak points. Tighten all clamps and replace any sections of worn hose immediately.

The most sensitive part of the heater system is the water pump. NEVER let the pump run dry or the impeller will be damaged. This is not covered by the warranty.

6.8 ELECTRICAL SYSTEM

The electronic control panel should not normally require servicing, except for the following:

- Make sure that all connections are secure.
- Periodically do a voltage test to ensure that you are getting 12 volts from the battery.
- Check for corrosion of wires.

MAINTENANCE ITEM	MAINTENANCE FREQUENCY	SERVICE REQUIRED
FUEL/WATER HOSES	SEASONALLY	INSPECT FOR LEAKS AND WEAK POINTS
HOSE CLAMPS	SEASONALLY	INSPECT FOR CORROSION, TIGHTEN IF LOOSE
COMBUSTION CHAMBER AND EXHAUST	1000 HOURS	VACUUM CLEAN
FUEL FILTER	SEASONALLY	INSPECT FOR CLEANING OR REPLACEMENT
NOZZLES—DISTRIBUTOR ORIFICE, AIR SLOTS & O RINGS	1000 HOURS	CLEANING AND INSPECTION FOR WEAR AND DAMAGE
EXHAUST SYSTEM	SEASONALLY	INSPECT FOR LEAKS AND CORROSION
COOLANT MIXTURE	12 MONTHS 36 MONTHS	pH LEVEL FOR ACIDITY REPLACE
ELECTRONIC CONTROL PANEL	SEASONALLY	VOLTAGE TEST / INSPECT FOR CORRODED WIRES
AIR COMPRESSOR FUEL PUMP COMBUSTION FAN MOTOR	SEASONALLY	INSPECT FOR LEAKS, CORROSION AND WEAR

MAINTENANCE SCHEDULE

CHAPTER 7 - WARRANTY AND SERVICE

7.1 WARRANTY

The *HURRICANE*[®] water jacket is warranted to be free of defects in materials and workmanship under design usage and service conditions for three (3) years from the date of completion of the installation or three thousand (3,000) hours of operation, whichever comes first. All other accessories, components supplied or installed in the heater shall be covered by warranty for a period of two (2) years or two thousand (2,000) hours of operation, whichever comes first. Warranty replacement parts are covered for the remainder of the Heater's warranty or ninety (90) days, whichever is the greater.

This warranty does not apply to damage or failure of the Heater, or the vessel or vehicle into which it was installed, due to improper installation, assembly, maintenance, or abuse, accident or the use of parts not supplied by International Thermal Research or Calcutt Boats.

7.2 INSTALLATIONS

The purchaser and installer are advised that specific rules and regulations may be in effect with respect to the installation of the *HURRICANE*[®] heater. It is the installer's responsibility to review and comply with all such rules and regulations.

Non-standard installations, that is, those requiring a departure from the published installation instructions, should not be undertaken without first having consulted with and obtained the written approval of International Thermal Research or Calcutt Boats.

Coverage for warrantable parts will, at the discretion of International Thermal Research or Calcutt Boats, be made to the claimant in the form of repair, replacement or credit.

Systems that are not installed to the published installation instructions (unless with written approval) will be limited to a 90 day warranty measured from the date of completion of the installation and so registered, or 250 hours of operation, whichever comes first.

7.3 NOT COVERED UNDER WARRANTY

This warranty will not apply to:

- Any parts or products which are no longer within the manufacturer's warranty period.
- Normal wear and tear of parts, including but not limited to, filters, nozzle, fuses, igniter, and carbon brushes.
- Parts or products which malfunction due to improper installation, including but not limited to malfunctions causing inadequacies in; air, fuel or coolant flow, voltage due to wiring, shock or vibration.
- Any progressive damage to the engine, vessel, or vehicle arising out of failure of the Heater unit.
- Heaters which have been modified or use non-standard parts not approved by International Thermal Research or Calcutt Boats.
- Heaters that have been abused, damaged, vandalised, or received improper maintenance.
- Travel time and expenses by Calcutt Boats.
- Diagnosis or repairs when caused by problems not directly related to the Heater or due to empty fuel tanks or poor fuel quality, fuel additives, acidic water, and electrolysis.
- Running the system dry or without appropriate preservatives (antifreeze), causing damage to the heat exchanger, pump seal, etc.
- Exposing the Heater to an environment detrimental to its effective operation (such as ex-

- cessively wet, dirty, or hot areas).
- Other products not supplied as part of the Heater kit.
- Any products or parts which have been used in a manner contrary to the published instructions.

PLEASE FOLLOW THE RECOMMENDATIONS INCLUDED IN THIS MANUAL

74 OWNER'S RESPONSIBILITIES

Before the expiry of the warranty, the Owner must give notice to Calcutt Boats of failures, if any, considered to be warrantable and deliver the defective Heater to Calcutt Boats. The Owner is responsible for all repairs made to the engine, equipment, vessel, or vehicle in which the Heater is installed, other than the *HURRICANE*[®] heater system. The Owner is responsible for lodging, meals, and other incidental costs incurred by the Owner as a result of a warrantable failure. The Owner is responsible for "down time" expenses, and all business costs and losses resulting from a warrantable failure.

INTERNATIONAL THERMAL RESEARCH AND CALCUTT BOATS ARE NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES

75 RETURNS

To obtain warranty service, the owner must:

- Contact Calcutt Boats for instructions to repair or return the warranty item.
- Provide a full description of the problem.
- When returning the product for repair under warranty, pack securely, show the serial number of the Heater on the outside of the packing, and send prepaid and insured.
- Provide written details of the problem, date of installation, proof of purchase, and a return address.

After repair or replacement of products still under warranty, Calcutt Boats will return the products at their own expense.

76 CUSTOMER SERVICE CALLS

International Thermal Research and Calcutt Boats warranty the Heater product and the Heater installer warranties the installation. Normal service calls are at the owner's expense.

Check the TROUBLESHOOTING CHAPTER of this manual to see if your problem is addressed.

When calling with a service problem, please have the following information at hand:

- The model number and serial number of your heater and main electronic control board.
- If your heater is already installed, ensure that you are familiar with the design and installation set-up.
- Have ready a detailed description of the problem and keep this manual handy to refer to.

OWNER NOTES

<i>HURRICANE</i> [®] Serial No:	
Installation Date:	
Installed by:	

