

Plasmatic Systems, Inc.
1327 Aaron Road
North Brunswick, NJ 08902
TEL: (732) 297-9107
FAX: (732) 297-3306

USER MANUAL FOR PLASMA-PREEN SYSTEM

TABLE OF CONTENTS

| | |
|---|----|
| I. INTRODUCTION | 3 |
| II. PLASMA-PREEN FEATURES | 3 |
| III. SYSTEM SETUP: WATER COOLED REACTOR | 4 |
| IV. PLASMA-PREEN CONTROLLER FRONT PANEL CONTROLS | 6 |
| V. SYSTEM SETUP BARREL REACTOR..... | 7 |
| VI. SAFETY INFORMATION | 7 |
| VII. AVOIDING POSSIBLE EXPOSURE TO EXCESSIVE MICROWAVE ENERGY..... | 9 |
| VIII. GROUNDING INSTRUCTIONS | 9 |
| IX. CARING YOUR PLASMA-PREEN SYSTEM | 10 |
| X. TROUBLE SHOOTING GUIDE | 11 |
| XI. PLASMA-PREEN APPLICATION GUIDE..... | 12 |
| XII. PLASMA-PREEN SYSTEM SPECIFICATIONS | 13 |
| XIII. SUGGESTED MAINTENANCE | 13 |
| XIV. PLASMA-PREEN CONTROLS..... | 14 |
| XV. PLASMA-PREEN CONTROL PANEL..... | 16 |
| XVI. FUNCTION AND USE OF THE ION TRAP | 17 |
| XVII. DIRECTIONS FOR SETUP AND USE OF THE WATER RECIRCULATING SYSTEM .. | 17 |
| XVIII. WATER TEMPERATURE MEASUREMENT | 18 |

I. INTRODUCTION

1. You are now the proud owner of a PLASMA-PREEN system. The PLASMA-PREEN is a plasma etching system capable of performing many functions in the plant or laboratory. See applications guide in Section X.
2. The PLASMA-PREEN system is manufactured from a microprocessor controlled microwave oven and uses the relevant digital control functions incorporated in the microwave oven. The PLASMA-PREEN system also has an additional analog power control feature added to provide a wider control range of plasma power.
3. The PLASMA-PREEN system operates by flowing a process gas (usually oxygen or argon) at reduced pressure (from 1 to 5 torr) through the process chamber and exciting the plasma discharge with the microwave energy from the microwave oven. This process produces ionized gas species and free radicals within the gas. These active species sputter and/or react with the work within the chamber. Since this process occurs in the gas phase at reduced pressure, little material is consumed or discharged. Reactions occur at the work surface (gas solid interface) and are subject to the geometrical constraints this arrangement introduces. For example, if two flat parts are bonded together the area attacked is the narrow bond line exposed to the plasma.
4. Much of the plasma power eventually is dissipated as heat. For processing heat sensitive components it becomes necessary to limit the average plasma power or to heatsink the work. Plasmatic Systems has therefore developed a water cooled unit for this purpose.
5. We feel confident that you will discover many applications for the PLASMA-PREEN system in your work that you may not have considered before.

II. PLASMA-PREEN FEATURES

| | |
|-----------------------------|--------------------------|
| Reasonably Priced | Reduces Effluents |
| High Power to 700 Watts | Safety Designed |
| Electronic Digital Controls | Ease of Use |
| Duty Cycle Control | Simplicity of |
| Analog Power Control | Maintenance |
| Process Memory | Reliability of |
| Water-Cooled Base Plate | Performance |
| 2.45 GHz Operation | Optional 50Hz 220V Power |
| | Available |

III. SYSTEM SETUP: WATER COOLED REACTOR

1. Remove the bell jar and its contents from the inside of the PLASMA-PREEN unit. The PLASMA-PREEN is shipped with the vacuum tube (3/8" O.D. tube) and water tubes (1/4" O.D. copper tubes with brass fittings) disconnected. Reconnect the vacuum tube and water tubes to the appropriate fittings in the rear of the unit. If the unit was ordered without the PLASMA-PREEN gas control panel, reconnect the flowmeter assembly to the gas inlet (The silver colored fitting on the lower right side when facing the rear of the water cooled unit). Screw in the flowmeter brackets into the holes provided in the upper right side of the unit. Use one wrench inside the unit (5/8" for the brass water lines and 3/4" for the silver-colored vacuum line) and one outside the unit (9/16" for the brass water lines and 11/16" for the vacuum line) to tighten the fittings. Mount the bell jar, open side down, on the gasket and on top of the base plate.
2. Place the unit in any location, but be sure to leave at least one inch of clearance at the top and three inches on each side to assure proper ventilation and access to the controls.
3. Connect the PLASMA-PREEN System to a vacuum pump with a capacity of at least 3.0 CFM (85 l/m), capable of pumping down to 50 microns.
4. **ALCATEL MODEL VACUUM PUMP SET UP**
 1. Remove the pump from the box.
 2. Remove the plastic cap from the exhaust port (The port to the upper right of the sight glass near the front of the pump).
5. Locate the blue exhaust mist eliminator and screw it into the exhaust port until snug. **DO NOT OVER TIGHTEN!!**
 1. Locate the long vacuum hose inlet fitting assembly. Insert the "O"-ring and retainer between the inlet fitting on the end of the hose and the vacuum pump inlet port (Located to rear left top of the pump near the motor) using the clamp provided. Make certain the "O"- Ring is still wet with non-combustible pump oil to insure a proper vacuum seal. NOTE: The other end of the long vacuum hose is connected to the PLASMA-PREEN control unit.
 2. Fill the pump with 2.0 to 4lbs (0.9 to 1.8Kilo-grams) of KRYTOX 1525 supplied. Check the oil level in the pump. It should be somewhere between the "Min." and "Max." levels that are indicated at the side of the oil sight glass.
 3. The pump is ready for use.
 4. NOTE: Use only KRYTOX 1525 non-combustible vacuum pump oil.

6. For PLASMA-PREEN units purchased without a PLASMA-PREEN controller. Connect the process gas line to the bottom fitting on the flowmeter. If a gas manifold was purchased from Plasmatic Systems then connect a process gas to each of the manifold inlet fittings being used. Set the regulators at 10 PSI.
7. If a PLASMA-PREEN controller was purchased from Plasmatic Systems, Inc. See Figure 2.
 1. Connect one end of the short piece of vacuum tubing to the controller fitting marked "TO PLASMA-PREEN" on rear of the control unit and the other end of the tubing to the large left fitting (facing the front of the unit near the brass water lines) of the PLASMA-PREEN water cooled units or the bottom fitting of the barrel unit.
 2. The longer piece of vacuum hose connects the vacuum pump to the PLASMA-PREEN controller at the fitting marked "TO VACUUM PUMP".
 3. The gas inlet tube is connected to the top center rear gas fitting marked "MIX GAS OUT" and the large right fitting of the PLASMA-PREEN water cooled units or the top fitting of the barrel unit.
 4. **DO NOT** Plug the vacuum pump into any of the outlets in the rear of the PLASMA-PREEN controller.
 5. The process gases are connected to the rear gas fitting marked "GAS A" and "GAS B", one on the right side and one on the left side. NOTE: the flowmeter on the right controls the gas on the right side and the flowmeter on the left controls the gas flow on the left. The "GAS A" flowmeter controls gas "A" and the "GAS B" flowmeter controls gas "B".
 6. The regulators on the front panel of the PLASMA-PREEN controllers should be set for 5 PSI.
 7. If one of the process gas flowmeters is not being used it should be shut off at the needle valve.
8. Plug the domestic model into a standard 110 to 120 Volt 15 amp properly-grounded outlet. For the export model, plug the unit into a 220 Volt 50 Hz grounded outlet.
9. NOTE: If the unit has been stored in an extremely cold area, wait a few hours before plugging it in.
10. If the vacuum pump contains non-combustible oil DO NOT ADD ANY HYDROCARBON OIL TO THE PUMP. USE ONLY KRYTOX 1525.

11. Connect the water lines to a water source and drain. The water inlet and outlet tubes are interchangeable. The unit requires minimal water flow, about 0.3 Gal/min. or more.

IV. PLASMA-PREEN CONTROLLER FRONT PANEL CONTROLS

1. The left most electrical switch turns on any accessories plugged into the rear of the system in the UP position. **DO NOT PLUG THE VACUUM PUMP INTO THIS UNIT AS THE VACUUM PUMP REQUIRES TOO MUCH CURRENT.**
2. The center switch in the UP position turns on the gas flow into the PLASMA-PREEN unit.
3. The right switch in the UP position opens the solenoid, that is contained in the control box, between the PLASMA-PREEN unit and the vacuum pump. The down position opens up a solenoid that bleeds gas into the vacuum chamber and closes off the vacuum solenoid.
4. Between the two vacuum lines in the rear of the PLASMA- PREEN controller is a needle valve that controls the rate gas is bleed into the system. This is useful if small parts are being cleaned preventing them from blowing around during the vent cycle.

V. SYSTEM SETUP BARREL REACTOR

1. Open the door to the PLASMA-PREEN unit and remove the literature inside. Locate the inner chamber and place it inside the outer chamber within the unit. Connect the vacuum line to the bottom connector on left side of the unit in the rear. If the vacuum pump was purchased from Plasmatic Systems set it up as described in Section III-4 and III-8.
2. Connect the process gas line to the bottom fitting on the flowmeter. The top of the flowmeter connection or the "MIXED GAS OUT" of the Plasma-Preen controller should be connected to the top gas inlet connection on the left hand side (If facing front).
3. Plug the domestic unit into a standard 110 to 120 Volt 15 amp/60 Hz properly-grounded outlet. For the export unit, plug it into a 220 Volt 50 Hz grounded outlet.
4. NOTE: If the unit has been stored in an extremely cold area, wait a few hours before plugging it in.
5. To insure proper air flow, DO NOT remove the feet from the bottom of the unit.

VI. SAFETY INFORMATION

1. A microwave oven is one of today's safest appliances. Each microwave oven meets the safety performance standards for emissions set by the United States Department of Health and Human Services.
2. To reduce the risk of burns, electric shock, fire, injury to persons or exposure to excessive microwave energy:
3. Read all instructions before using this equipment.
4. Read and follow the specific , AVOIDING POSSIBLE EXPOSURE TO EXCESSIVE MICROWAVE ENERGY, SECTION THAT FOLLOWS THIS SECTION.
5. Install the unit to allow sufficient air circulation around the rear of the unit. Install the unit on a stable base where it will not fall or get wet. If the unit is water cooled make certain the water lines are tight and secure.
6. THIS UNIT MUST BE ELECTRICALLY GROUNDED. Connect it only to a properly grounded outlet. See GROUNDING INSTRUCTIONS, Section VII.
7. DO NOT run the unit with the bell jar at atmospheric pressure or without gas flowing through the reaction chamber (no load condition) unless using the timer feature. While short periods of no load operation will not damage the unit, this procedure is not recommended.

8. DO NOT operate the unit if it has a damaged cord or plug, if it is not working properly, or if it has been damaged or dropped. Electrical shock, fire or other hazard may result.
9. The unit should be serviced by qualified service personnel.
10. DO NOT cover or block any openings on the oven, or fire may result.
11. DO NOT use the unit outdoors, for damage to the unit or electrical shock may result.
12. DO NOT immerse the chord or plug in water, for electrical shock may result.
13. Keep the cord away from heated surfaces, or electrical shock may result.
14. See door surface cleaning instructions in "Cleaning your PLASMA-PREEN unit" Section VIII.
15. Should materials inside the unit catch fire, keep the door closed, turn the unit off and disconnect the power from the unit by pulling out the plug or shutting off the main power to the unit at the fuse box or circuit- breaker.
16. DO NOT use the unit for storage. Do not leave paper products, books or other combustibles inside the unit when it is not in use for. A fire may start if the unit is accidentally turned on.
17. DO NOT run the unit with metal parts external to the vacuum chamber.
18. CAUTION: BE CERTAIN THE VACUUM CHAMBER IS AT ATMOSPHERIC PRESSURE BEFORE ATTEMPTING TO OPENING THE DOOR TO THE PLASMA-PREEN UNIT.
19. The PLASMA-PREEN unit has a built in light filter which filters 90% of the light. DO NOT look at the glowing plasma, at close range, for extended periods of time as eye strain may result.
20. Treat the vacuum chamber as you would any large piece of glass.
21. DO NOT use incompatible gases (such as hydrogen and oxygen mixtures) in the reaction chamber.
22. DO NOT run the water-cooled unit at full power in the CW mode for more than 15 minutes at a time without a water flow. This will prevent over heating of the baseplate and gasket.
23. CAUTION: The glass vacuum chamber can become HOT when operating at pull power at 100% duty cycle. TAKE PROPER PRECAUTIONS WHEN HANDLING THE HOT GLASS.

24. When using the analog power control TRY NOT TO RUN AT SETTINGS BETWEEN 80 and 99 (100 or full power is OK). This will prolong the life of the analog power control unit.

VII. AVOIDING POSSIBLE EXPOSURE TO EXCESSIVE MICROWAVE ENERGY.

1. DO NOT attempt to operate the PLASMA-PREEN unit with the door open since open-door operation can result in harmful exposure to microwave energy. It is very important not to defeat or tamper with the safety interlocks.
2. DO NOT place any object between the unit front face and the door or allow soil, cleaner or residue to accumulate on sealing surfaces.
3. DO NOT operate the unit if it is damaged. It is particularly important that the oven door close properly and that there is no damage to the: (1)door (bent), (2)hinges and latches (broken or loosened), (3)door seals and sealing surfaces (4) the fittings in the rear of the unit (removed or loose).
4. The unit should not be adjusted or repaired by anyone except properly qualified service personnel.

VIII. GROUNDING INSTRUCTIONS

1. The PLASMA-PREEN system must be grounded and connected to the same ground as the vacuum pump. In the event of an electrical short circuit, grounding reduces the risk of electrical shock by providing an escape wire for the electric current. This unit is equipped with a chord having a grounding wire with a grounding plug. The plug must be plugged into an outlet that is properly installed and grounded.
2. WARNING: Improper use of the grounding plug can result in a risk of electrical shock.
3. Consult a qualified electrician or serviceman if the grounding instructions are not completely understood, or if doubts exist as to whether the unit is properly grounded.
4. If it is necessary to use an extension cord, use only a 3-wire extension cord that has a 3-blade grounding plug, and a 3-slot receptacle that will accept the plug on the unit. The marked rating of the extension cord should be equal to or greater than the electrical rating of the unit.
5. CAUTION: The glass vacuum chamber can become HOT when operating at pull power at 100% duty cycle. TAKE PROPER PRECAUTIONS WHEN HANDLING THE HOT GLASS, ESPECIALLY UNDER VACUUM. **DO NOT OPEN THE DOOR WHEN THE BELL JAR IS UNDER VACUUM. THE POSSIBILITY OF IMPLOSION**

ALWAYS EXISTS WITH GLASS UNDER VACUUM ESPECIALLY IF THE GLASS IS HOT.

6. When the run is finished, shut off the vacuum pump and vent the bell jar immediately by turning the vent valve towards the back of the unit. If the bell jar is not vented immediately oil may suck up from the vacuum pump and contaminate the system. PLASMA-PREEN units shipped without the Control Panel are equipped with a vent valve. The vent valve has a 0.013" diameter flow-constricting orifice to prevent small parts from flying around inside the bell jar during the venting operation. The gas flow is automatically shut off when the vent valve is in the vent position.
7. After the system reaches atmospheric pressure (about 20 seconds) open the door and the bell jar may be lifted.
8. Load the system with the work to be cleaned and repeat the above steps. Adjust the time, duty cycle, analog power and thermal resistance to the heat sink based on the effects of the plasma on the work.

IX. CARING YOUR PLASMA-PREEN SYSTEM

1. DO NOT USE abrasive cleaners, cleaning pads or steel wool, as they can scratch or dull the unit door.
2. Clean the interior and exterior of the unit with a damp cloth. DO NOT USE SOLVENTS as they may damage or discolor the plastic components.
3. Make certain that nothing is blocking the door and the sealing surfaces.
4. The bell jar may be removed and cleaned as you would any glass object. Soap and water works well. Be sure to rinse thoroughly as traces of soap on the inside may cause the glass to weaken in an oxygen plasma. Avoid solutions containing hydrofluoric acid as it may weaken the glass.
5. The rubber gasket can also be cleaned with a damp cloth. Do not use sharp objects as they might cut the rubber and prevent the formation of the vacuum seal. Should the unit become contaminated, it can be cleaned by operating it empty, at full power, for 15 minutes preferably using oxygen as the process gas.

X. TROUBLE SHOOTING GUIDE

1. Unit stops by itself- Line voltage too low or the unit is improperly grounded.
2. Nothing happens when the numbers are pushed- Remember to press the pads firmly and to press CLOCK before entering time setting. Press CLEAR PAD and start over.
3. Plasma appears concentrated in one corner of the bell jar- Check the vacuum connections and the vacuum tubing for leaks. Check vacuum pump oil for contamination.
4. Vacuum pump starts noisily- Normal operation pump oil is cold and has a high viscosity.
5. Vacuum pump does not settle down or gas can be felt exiting from the pump- The vent valve is in the vent position (for PLASMA-PREEN systems without the control panel), the bell jar is not fitting snugly against the rubber gasket. Vent the system, readjust and try again.
6. Work is getting too hot- Heat sink the work better in the (water cooled unit only) and/or reduce the power or duty cycle.
7. No reaction is occurring or the reaction is very slow- Increase the work temperature by placing a piece of glass between the work and the heatsink (water-cooled unit only) and/or increase the analog power or duty cycle.
8. Solder on the work is sputtering or smearing- Reduce the process temperature, use the ion trap (Section XVI) and/or reduce the power.
9. The vacuum baseplate is getting hot- Check the water flow and water temperature.

XI. PLASMA-PREEN APPLICATION GUIDE

| INDUSTRY | FEATURE | BENEFIT |
|------------|--|--|
| Electronic | Argon Plasma Cleaning Without Iontrap (Between 5 and 10 min) | Wire Bond Pads Pd-Ag Die Attach Pads Gold Plated Parts Solder Preforms Epoxy Bleed Preparation for Soldering Photoresist Removal Oxidizable Metal Surfaces Gold or Aluminum Wire Removal of Some Metal Oxides |
| | Argon Plasma Cleaning With Iontrap (~15 to 30 min) | Devices with Sensitive Chips Laser Diode Facets Ceramics with Soft Solder PC Boards with Soft Solder |
| | Oxygen Plasma Cleaning (5 min @ full power) | Photoresist Removal Bare Ceramic Substrates Removal of Plastic Encapsulants for Failure Mode Analysis Glass Parts Metal Oxide Parts Gold Plated Parts Silicon Gallium Arsenide Indium Phosphide Preparation of Plastics for Gluing |
| Optical | Oxygen Plasma Cleaning (5 to 15 min) | Glass, Si or GaAs Optics Finger Prints Epoxy Residues Oil Residues Lapping Compound Binders Parts will Pass the "Water Break Test" After Cleaning |

XII. PLASMA-PREEN SYSTEM SPECIFICATIONS

The PLASMA-PREEN system comes in three versions. The first is a barrel type reactor. The second is a water cooled unit with a reaction chamber size of 8" x 6" x 2". The third is a larger water cooled unit with a reaction chamber size of 9" x 7" x 3". System specifications of these units are described below

| | | |
|------------------------------|---------------------------------|---|
| Barrel Reactor System | PLASMA-PREEN I | |
| Chamber | Barrel | |
| Diameter | 4.1" | |
| Length | 6.0" | |
| Material | Pyrex (Quartz on Special Order) | |
| | | |
| Water Cooled Systems | PLASMA-PREEN II | |
| Model No. | 862 | 973 |
| Chamber | Rectangular | Rectangular |
| Dimensions | 8" x 6" x 2" | 9" x 7" x 3" |
| Cooling Along | 8" x 6" side | 9" x 7" side |
| Material | Pyrex & Aluminum | Pyrex & Aluminum |
| External w x h x d | 28" x 12" x 13" | 28" x 12" x 13" |
| Shipping Weight | 65 pounds | 80 pounds |
| | | |
| Power | Electrical | 115V ac 15 Amp service grounded or 220V ac 50Hz |
| | Plasma | Variable 100 to 750 Watts |
| Frequency | 2.45 Ghz | |
| Duty Cycle adjustment | From 10% to continuous | |
| Flow meter Standard | (5 cu-ft./Hr. at STP) | |
| Utilities required | Vacuum pump | Water and Drain |
| Gas Supply | Oxygen | Argon |

XIII. SUGGESTED MAINTENANCE

1. Change the vacuum pump oil on a regular basis to remove accumulated contamination.
2. Keep the unit clean especially around the front door seal area.
3. If the bell jar becomes dirty, clean in any manner appropriate for glassware. If soap is used thoroughly rinse to remove all traces as interaction with the plasma will weaken the glass.
4. Additional bell jars and gaskets are available from Plasmatic Systems, Telephone (732)-297-9107 or FAX: (732)-297-3306.

XIV. PLASMA-PREEN CONTROLS

The ANALOG POWER CONTROL KNOB is located on the right hand side of the unit. It is equipped with an indicator dial where 100 corresponds to 100% power and 0 corresponds to about 100 watts of power. **TRY TO AVOID RUNNING THE ANALOG CONTROL UNIT AT SETTING BETWEEN 80 AND 99** (100 or full power is OK). This will prolong the life of the analog control unit. See the next page for a layout of the PLASMA-PREEN touch pad control panel.

Some of the microwave oven functions are not used in the PLASMA-PREEN system. These functions are indicated by an asterisk (*) symbol.

1. DISPLAY. -Displays time of day, time during processing functions, power level being used, process mode and instructions.
2. *popcorn
3. *chicken.
4. TIME COOK Energizes the Plasma-Preen system for a selected amount of time using 100% duty cycle
5. REMINDER Can be used like an alarm clock
6. NUMBER PADS. Touch these pads to enter process time, time of day and power level.
7. EXPRESS COOK. Touch the number 1 through 6 pad for 1 to 6 minutes of processing time at 100% duty cycle. For example, touch 2 then START for 2 minutes of processing time.
8. POWER LEVEL. Touch this pad before changing to another duty cycle.
9. SOUND Touch the SOUND pad to change the intensity of the beeper.
10. TIMER Uses no microwave energy functions as a timer.
11. *beverage
12. *potato
13. *vegetable
14. *defrost auto/time
15. DELAY START. Allows you to program the Plasma-Preen system to begin operation at a preset time of day-up to a 12-hour delay.
16. START PAUSE. After all selections are made, touch this pad to start the microwave power.
17. HELP Touch this pad and the pad that you want help about. The display will describe how to use the selected function.

18. CLEAR/OFF. When touched, it shuts off the microwave energy and erases all settings except time of day. When held for 3 seconds the Lock-Out feature will be activated. To deactivate, press and hold the CLEAR/OFF pad for 3 seconds.
19. ADD 30 SECONDS. Press this pad to add 30 seconds of process time, to add 30 seconds to the process time as it's counting down or for an "instant on" for 30 seconds.
20. AM PM Sets AM or PM time of day. Also sets display scrolling speed.
21. CLOCK. Touch this pad to enter time of day or check time of day during processing. To set the clock, first touch CLOCK pad and then enter time of day, then press AM or PM. For example, if the time is 1:30PM, touch number pads 1, 3 and 0 and "1:30" will appear in the display, touch "PM". Then touch START or CLOCK pad. To reset or change time, simply repeat above process.

XV. **PLASMA-PREEN CONTROL PANEL**

Error! No topic specified.

* Denotes functions not used in the PLASMA-PREEN system.
(also indicated by lower case letters)

POWER LEVEL or DUTY CYCLE To reduce the duty cycle depress the POWER LEVEL pad and one numeric pad . The duty cycle is based on a 30 second time interval. i.e. a 50% duty cycle is 15 seconds on and 15 seconds off.

The following chart gives the percent duty cycle each Number Pad stands for:

| | |
|------------------|--------|
| automatic = 100% | |
| 9 =90% | 4 =40% |
| 8 = 80% | 3 =30% |
| 7 =70% | 2 =20% |
| 6 =60% | 1 =10% |
| 5 =50% | |

XVI. FUNCTION AND USE OF THE ION TRAP

The ion trap is made from perforated aluminum sheet. Work to be processed is surrounded by the iontrap within the vacuum chamber. This has two effects: First is the neutralization of the ionic portion of the plasma. Second is to shield the work from residual microwave radiation by acting as a Faraday cage. The use of the ion trap causes less damage to the work, makes for milder reaction conditions and reduces process reaction rates by 50%. The use of the ion trap is indicated when process power and temperature reduction still cause damage to the work.

XVII. DIRECTIONS FOR SETUP AND USE OF THE WATER RECIRCULATING SYSTEM

1. Locate the water tank in a convenient location near the PLASMA-PREEN II system. The location can be on the floor under the bench on which the PLASMA-PREEN is located.
2. Fill up the tank to within 1 inch of the top (2.5cm). An algaecide like that used in swimming pools may be added to suppress the growth of algae (Use about 1 teaspoon).
3. Attach one of the water lines of the recirculating system to one of the copper tubes of the PLASMA-PREEN system and the other water line to other copper tube of the PLASMA-PREEN system. Fit the top to the water tank.
4. Plug in the water pump into a 115V/60Hz outlet (220V/50Hz if so equipped) and the water recirculating system is ready for operation.

XVIII. WATER TEMPERATURE MEASUREMENT

1. Read the water temperature using the supplied thermometer. Note the setting either degrees Fahrenheit or Centigrade..
2. Under no circumstances should the water temperature exceed 120 deg F. or 48 deg C. as damage to the water pump and/or the PLASMA-PREEN gasket may result.
3. This will give about 2 hours of continuous operation with the water in the tank initially at room temperature (70 deg F.).
4. NOTE: The water in the tank serves as the system heatsink and must be given an opportunity to cool between runs.
5. CAUTION: Check the water level periodically and refill when the level drops 2 inches (5 cm.) below the top of the water tank.