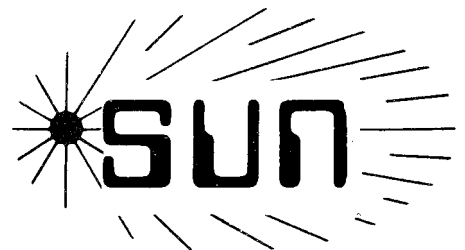
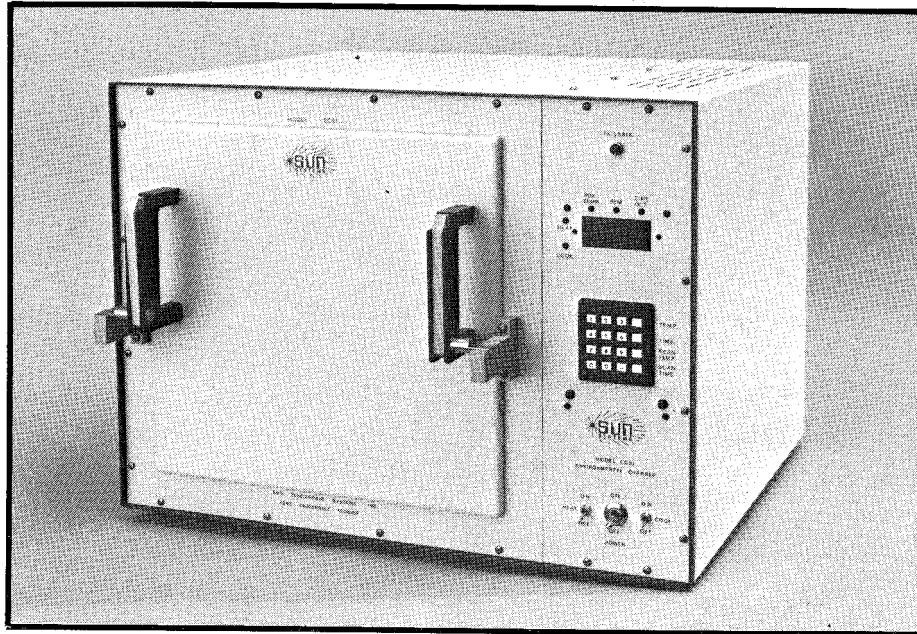


REV E, earlier

**MODEL EC0x  
ENVIRONMENTAL CHAMBER  
USER AND REPAIR MANUAL**



**MODEL ECOX  
ENVIRONMENTAL CHAMBER  
USER AND REPAIR MANUAL**

**Covers ECOA, ECO1, ECO2 and ECO3 Environmental Chambers**

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**REV. B  
FIRST EDITION**

0293

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## **SAFETY PRECAUTIONS**

Please take a moment to read the following cautions.

- CAUTION** - Disconnect all electrical power sources before attempting any type of access or service to the interior of the chamber to prevent electrical shock. Turn off expectorant supplies and disconnect expectorant supply hoses before attempting any type of access or service to the interior of the chamber.
- CAUTION** - Always operate the chamber with the case grounded to earth ground. Verify that the power outlet to be used has an earth ground and meets your local electrical codes. Do not operate the chamber from an upgrounded outlet without first providing an earth ground to the chamber case.
- CAUTION** - Verify that the source of electrical power is compatible with the manufactured configuration of the chamber indicated on the rear of the unit.
- CAUTION** - Avoid personal contact with the interior portions of the test chamber area to prevent burns from heat or cold.
- CAUTION** - Use personal protective equipment such as gloves, goggles, face shields, etc., when working with or in any environment containing liquid carbon dioxide or liquid nitrogen.
- CAUTION** - Avoid any personal contact of the skin or eyes with liquid carbon dioxide or liquid nitrogen or supply lines and vessels carrying these liquids. Exposure to these liquids or the vessels which carry them can cause frostbite.
- CAUTION** - Operate the chamber in an environment with good ventilation to air. If the chamber is to be installed in any enclosed area, connect the chamber exhaust port to outside air. Never use the exhaust port for test access to the internal temperature chamber.

## **SAFETY PRECAUTIONS**

- CAUTION** - Always follow the safety precautions supplied by the vendor for your liquid carbon dioxide or liquid nitrogen storage cylinders and vessels.
- CAUTION** - Verify that the correct type of expectorant source is connected to the chamber before operating the chamber at low temperature.
- CAUTION** - Do not use Contaminated Expectorants. Test the expectorant for cleanliness by discharging a small amount through a clean filter. Inspect for quantities of ice, oil, rust or water for contamination.
- CAUTION** - Do not leave liquid nitrogen trapped in a supply line as high pressures will be developed when the liquid absorbs heat and is transformed from a liquid to gas. Bleed the supply hose when not in use.
- CAUTION** - When operating the chamber at low temperatures for extended periods of time, operate the chamber at 200°C for an hour to dry any moisture which may accumulate in the fiberglass insulation material surrounding the test area of the chamber.
- CAUTION** - Avoid oil contamination of the fiberglass insulation material surrounding the test area of the chamber. Liquid oxygen may be formed in the insulation material when operating at low temperature. Liquid oxygen mixed with oil can be explosive.

## **LIMITED WARRANTY INFORMATION**

### **ECOX ENVIRONMENTAL CHAMBER**

SUN ELECTRONIC SYSTEMS, INC. WARRANTS THIS PRODUCT TO THE ORIGINAL PURCHASER TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP AND TO OPERATE WITHIN APPLICABLE SPECIFICATIONS FOR A PERIOD OF TWO (2) YEARS FROM THE DATE OF SHIPMENT, PROVIDED IT IS USED UNDER NORMAL OPERATING CONDITIONS. THIS WARRANTY DOES NOT APPLY TO SEALED ASSEMBLIES WHICH HAVE BEEN OPENED, OR TO ANY ITEM WHICH HAS BEEN REPAIRED OR ALTERED WITHOUT SUN SYSTEMS AUTHORIZATION.

RISK OF LOSS OR DAMAGE TO THE PRODUCT SHALL PASS TO THE CUSTOMER UPON DELIVERY, BY SUN SYSTEMS, TO THE CARRIER AT SUN SYSTEMS' PREMISES.

WE WILL REPAIR OR, AT OUR OPTION, REPLACE AT NO CHARGE ANY OF OUR PRODUCTS WHICH IN SUN SYSTEMS' JUDGMENT, ARE FOUND TO BE DEFECTIVE UNDER THE TERMS OF THIS WARRANTY. EXCEPT FOR SUCH REPAIR OR REPLACEMENT, SUN SYSTEMS WILL NOT BE LIABLE FOR ANY LOSS OR DAMAGE TO PERSONS OR PROPERTY CAUSED EITHER DIRECTLY OR INDIRECTLY BY USE OF THIS PRODUCT OR FOR ANY INCIDENTAL DAMAGES OR FOR ANY CONSEQUENTIAL DAMAGES, AS THOSE TERMS ARE DEFINED IN SECTION 2-715 OF THE UNIFORM COMMERCIAL CODE. BEFORE USING, PURCHASER SHALL DETERMINE THE SUITABILITY OF THIS PRODUCT VIA THIS DOCUMENT FOR HIS INTENDED USE AND PURCHASER ASSUMES ALL RISK AND LIABILITY WHATSOEVER IN CONNECTION THEREWITH. NO STATEMENT OF RECOMMENDATION NOT CONTAINED HEREIN SHALL HAVE ANY FORCE OR EFFECT UNLESS IN AGREEMENT SIGNED BY AN OFFICER OF SUN ELECTRONIC SYSTEMS, INC.

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## **Section 1 GENERAL INFORMATION**

Congratulations on your purchase of the ECOX Environmental Chamber !!

Your new chamber was manufactured under stringent quality control procedures to insure trouble free operation for many years of service. If you should encounter difficulties with the use or operation of your chamber, contact Sun Systems Customer Service Department between the hours of 9:00 and 5:00 EST, phone number (305) 739-7004.

As with all Sun Systems products, we would appreciate any comments, suggestions or criticisms that you may have or develop regarding your evaluation of this equipment. Please address your comments to:

**Product Service Manager**

---

**SUN ELECTRONIC SYSTEMS, INC.**

**1900 Shepherd Drive**

**Titusville, Florida 32780**

**TEL: (407) 383-9400 FAX: (407) 383-9412**

### **1.1 RELATED DOCUMENTS**

The Model ECOX Environmental Chamber is supplied with our Model TC01 Temperature Controller. The manual for the Model TC01 is shipped with each Model ECOX and along with this document, form the complete documentation required to operate and maintain the Model ECOX effectively and safely.

1.3 ECOX SPECIFICATIONS

TABLE 1.3-1 CHAMBER SPECIFICATIONS

| Model  | ECO0A  | EC01   | EC02  | EC03   |
|--|--|--|---|--|
| <b>Mechanical</b>  |  |  |   |  |
| Chamber Volume   | .37 ft <sup>3</sup><br>(0.010 m <sup>3</sup> ) | .7 ft <sup>3</sup><br>(0.020m <sup>3</sup> ) | 2.2ft <sup>3</sup><br>(0.062 m <sup>3</sup> ) | 3.0 ft <sup>3</sup><br>(0.085 m <sup>3</sup> ) |
| Test Chamber Dimensions<br>[Inches (Centimeters)]        | 10.0(25.4)W<br>8.0(20.3)H<br>8.0(20.3)D        | 12.0(30.5)W<br>9.75(24.75)H<br>10.25(26.0)D  | 20.0(50.8)W<br>12.0(30.5)H<br>16.0(40.6)D     | 20.0(50.8)W<br>12.0(30.5)H<br>22.0(55.9)D      |
| Overall Dimensions [Inches<br>(Centimeters)]             | 17.5(44.5)W<br>13.25(33.7)H<br>20.0(50.8)D     | 21.0(53.3)W<br>16.0(40.6)H<br>24.0(61.0)D    | 30.0(76.2)W<br>19.5(49.5)H<br>30.0(76.2)D     | 30.0(76.2)W<br>19.5(49.5)H<br>36.0(91.4)D      |
| Weight; Net/Shipping                                     | 38/55 lbs                                      | 49/68 lbs                                    | 80/100 lbs                                    | 98/115 lbs                                     |
| Interior Construction                                    | Stainless Steel                                | Stainless Steel                              | Stainless Steel                               | Stainless Steel                                |
| <b>Electrical</b>  |  |  |   |  |
| Power Option<br>Current Requirement<br>Plug / Receptacle |  |  |   |  |
| 100/115 VAC, 50/60 Hz, Single ø,<br>3 Wire               | 15 amp<br>5266-C / 5261                        | 15 amp<br>5266-C / 5261                      | 20 amp<br>5366-C / 5361                       | N/A  |
| 208/220 VAC, 50/60 Hz, Single ø,<br>3 Wire<br>4 Wire     | 10 amp<br>5666-C / 5661<br>2411 / 2410         | 10 amp<br>5666-C / 5661<br>2411 / 2410       | 15 amp<br>5666-C / 5661<br>2411 / 2410        | 15 amp<br>5666-C / 5661<br>2411 / 2410         |
| 240 VAC, 50 Hz, Single ø,<br>3 Wire                      | 10 amp<br>5666-C / 5661                        | 10 amp<br>5666-C / 5661                      | 10 amp<br>5666-C / 5661                       | 15 amp<br>5666-C / 5661                        |
| Power Requirement  | 1600 Watts                                     | 1800 Watts                                   | 2200 Watts                                    | 3000 Watts                                     |
| <b>Temperature Chamber<br/>Performance</b>               |  |  |   |  |
| Max empty Chamber Heat/Cool<br>Rate of change            | 0.5° C/sec<br>(30° C/min)                      | 0.5° C/sec<br>(30° C/min)                    | 0.25° C/sec<br>(15° C/min)                    | 0.25° C/sec<br>(15° C/min)                     |
| Air-Flow (CFM, Vertical)                                 | 60ft <sup>3</sup> /min                         | 60ft <sup>3</sup> /min                       | 150 ft <sup>3</sup> /min                      | 300 ft <sup>3</sup> /min                       |

## 1.2 EC0X DESCRIPTION

The EC0X is a high performance environmental chamber that offers integral IEEE-488, RS-232 and Keyboard control interfaces as standard features. The EC0X was expressly designed to work with computer controlled test setups without the need for additional interface hardware. In addition, the EC0X may be used in a complete standalone configuration through the use of the front panel keyboard.

The EC0X features liquid carbon dioxide(LCO<sub>2</sub>) or, optionally, liquid nitrogen(LN<sub>2</sub>) expectorant cooling for fast cycling between temperatures. The microprocessor based temperature controller in the EC0X allows the operator to program up to 10 time and temperature segments from the keyboard in local mode. The automatic cycling feature of the EC0X allows for programmed time and temperature segments to be repeated from 1 to 1800 times or continuously.

When operated from a test system host computer through the IEEE-488 or RS-232 interfaces, an unlimited number of time and temperature segments are supported. The EC0X command set fully supports remote control operations with single temperature, scan temperature, control and special commands. The PID coefficients used by the controllers algorithm may be modified by the user for specific applications.

The EC0X includes safety features consisting of a mechanical user adjustable failsafe thermostat, software upper temperature limit, short/open probe detection, a microprocessor hardware watch-dog timer, and IEEE-488 bus timeouts.

**TABLE 1.3-2 CONTROL SPECIFICATIONS**

**Control**

|  |   |
|--|---|
| Temperature Setpoint Range                 | LCO <sub>2</sub> -73°C to +300°C (LN <sub>2</sub> Option; -100°C to +300°C)   |
| Time at Temperature Range                  | 0.1 to 1800 minutes or continuous from IEEE-488 / RS232 Intf.,<br>1 to 1800 mins. from keyboard, (hrs. Optional)                    |
| Temperature Ramping Rate Control           | Not Controlled Locally  |
| Programmable Set Temps and Times           | 10 Programmable Set Temperatures and Times  |
| Absolute Error (not including probe error) | ±0.4°C  |
| Long Term stability (per month)            | ±0.3°C  |
| Temperature Resolution                     | 0.1°C or min from IEEE-488 / RS232 Intf., 1°C from Keyboard   |
| Line Voltage Sensitivity<br>(105-125 VAC)  | ±0.2°C @ 105-125 VAC  |
| Programmable Temperature<br>Loop Control   | 1 to 1800 Cycles of Programmable Set Temperatures and Set Times<br>or Continuous  |
| Temperature Control Technique              | PID Algorithm / Pulse Width Modulated   |
| Local Operation                            | 16 Key Keyboard / 4 Digit Display   |
| Remote Operation                           | Built-in IEEE-488 / RS232 Interfaces  |
| Additional I/O Capability                  | IEEE-488 to RS232 Transparent Mode, 2 Auxiliary Outputs,<br>1 Auxiliary Input   |
| Safety Features                            | Open/Short Probe Detection, Adjustable Over Temperature Thermo-<br>stat, Software Upper Temperature Limit, Hardware watch-dog timer |
| Convenience Features                       | Heat and Cool Enable / Disable Switches   |

**Input / Output Interfaces**

|                                     |  |
|-------------------------------------|--|
| IEEE-488 Bus Interface Application  | EC0X Remote Control  |
| Protocol                            | Talker / Listener  |
| Bus Address                         | 0-30, Switch Settable  |
| Interrupt Capability                | SRQ / Serial Poll  |
| RS-232 Serial Interface Application | EC0X Remote Control or IEEE Bi-directional Transparent Operation |
| Protocol                            | ASCII Character Oriented   |
| Data Rates                          | 300 - 9600 BAUD  |
| Front Panel Interface Application   | EC0X Local Control   |
| Manual Parameter Input              | 16 Key Keyboard  |
| Menu-Driven Visual Output           | 4 Digit Display  |
| Visual Indicators                   | Cool, Heat, Time-out, REM, BOX TEMP                              |
| Audible Alarm                       | Time-Out Indication  |

## 1.4 EC0X OPTIONS

### Power Options

Table 1.3-1 lists the plug and mating receptacle Hubble, Inc. part numbers required for the different A.C. power combinations under the **Electrical** section. These options are not field installable.

### Cooling Options

The standard EC0X without any options is intended to operate directly from liquid carbon dioxide. The carbon dioxide is to be provided from an industry standard 50 pound siphon type cylinder. The draw pressure from the cylinder is approximately 850 PSI at room temperature. A hose and fitting necessary to interface between the EC0X and LCO<sub>2</sub> cylinder is provided. No other valves or regulators are necessary. The lower temperature limit of LCO<sub>2</sub> is -73°C.

The capability for the delivery of low pressure LCO<sub>2</sub> from a 300 PSI dewwers vessel or bulk delivery system is an option. Extra Insulation is provided and a special nozzle assembly is used. Regular siphon cylinders should not be used with this option.

Chambers equipped with the LN<sub>2</sub> option are able to operate the chamber as low as -100°C in temperature. Liquid nitrogen is commonly supplied in either a dewwer's vessel or a bulk delivery system. Delivery pressure for both systems should be maintained between 80 and 100 PSI. A special solenoid valve and nozzle assembly is used. Due to the variation of hose requirements a standard hose is not supplied, but are available from Sun Systems as a separate item. Special injectors are available for lower pressure, consult factory.

### Time at Temperature Option

The EC0X can be set up for time in minutes or hours. The standard EC0X allows for a time at temperature range from .1 to 1800 **minutes** or continuous from the IEEE-488/RS-232 interfaces. For a time at temperature range from .1 to 1800 **hours** please specify at time of order.

### Port and Window Options

Access ports and window options are available. Access ports are normally located on the left side of EC0X and on the door. Common port sizes are 1", 2", and 3" diameter ports with plug. Standard window sizes are 4"x6" on the EC01 and EC0A, 6"x8" on the EC02 and EC03. Sun Systems supports special options to our customer's specifications.

## 1.5 EC0X COMPONENT IDENTIFICATION

Take a moment to become familiar with the major components of your EC0X environmental chamber by reviewing the following figures. Refer to the Figures when performing adjustments, routine maintenance or removal and replacement procedures.

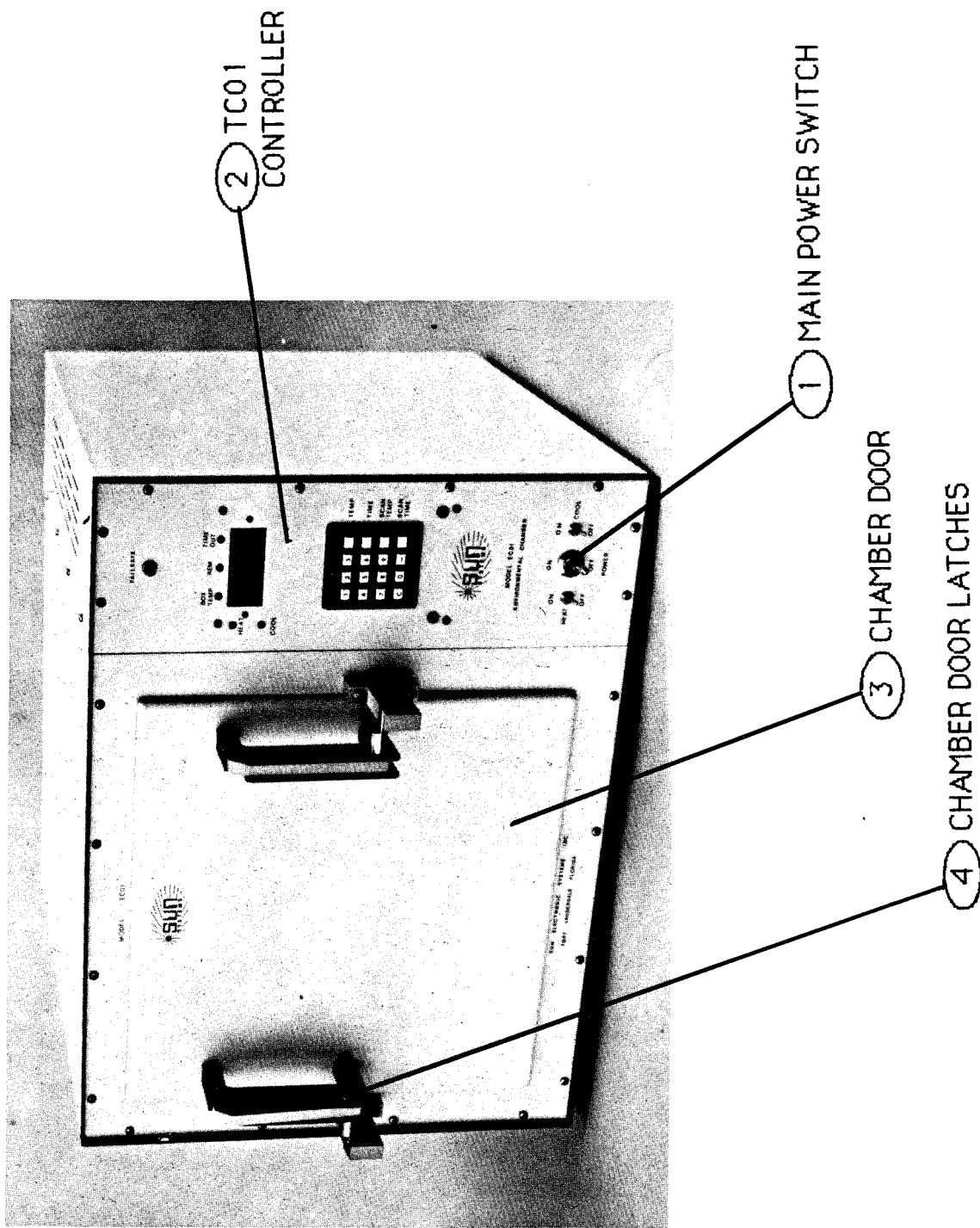


FIG 1.5-1 CHAMBER FRONT VIEW



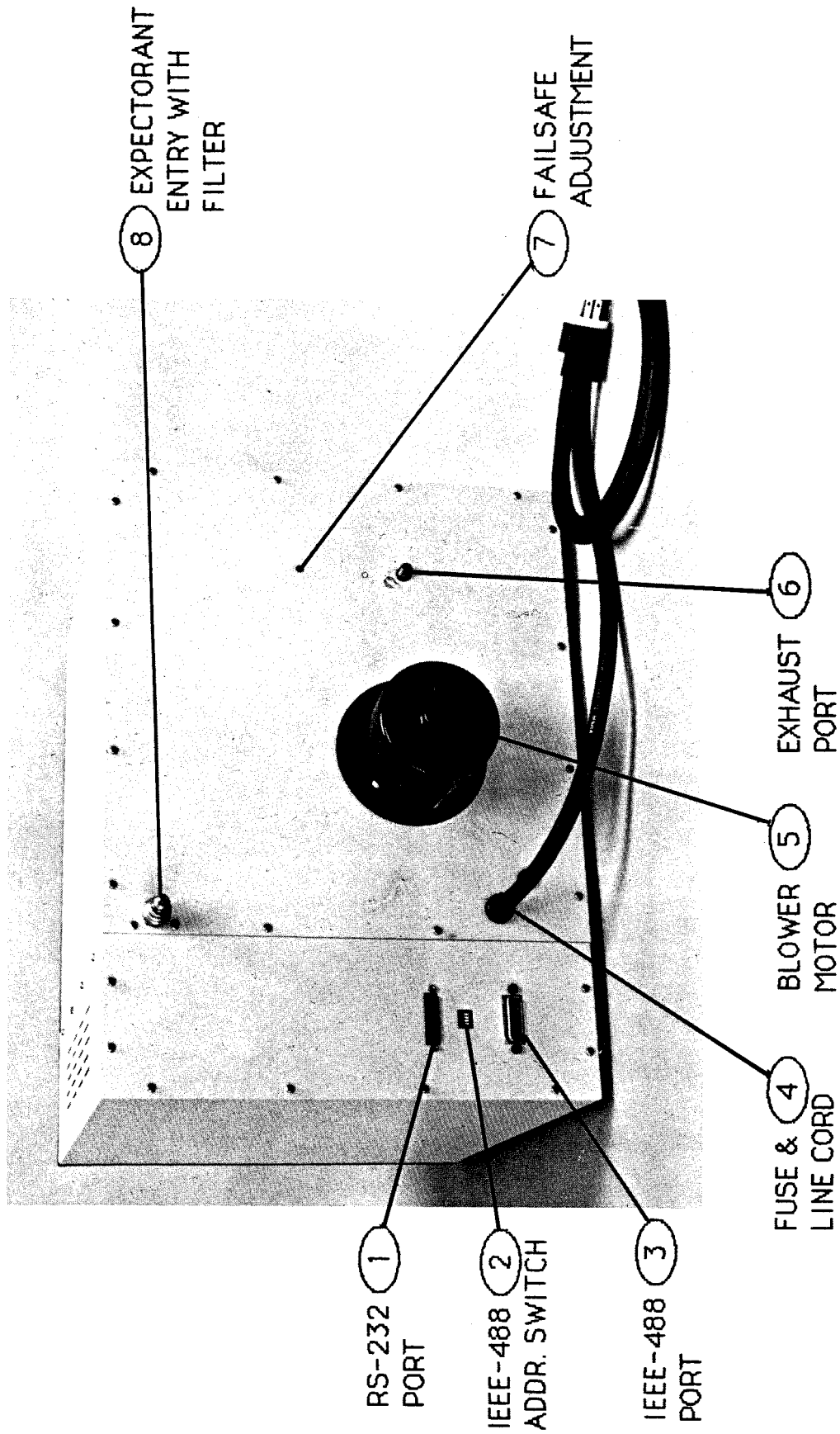


FIG. 1.5-2 CHAMBER REAR VIEW

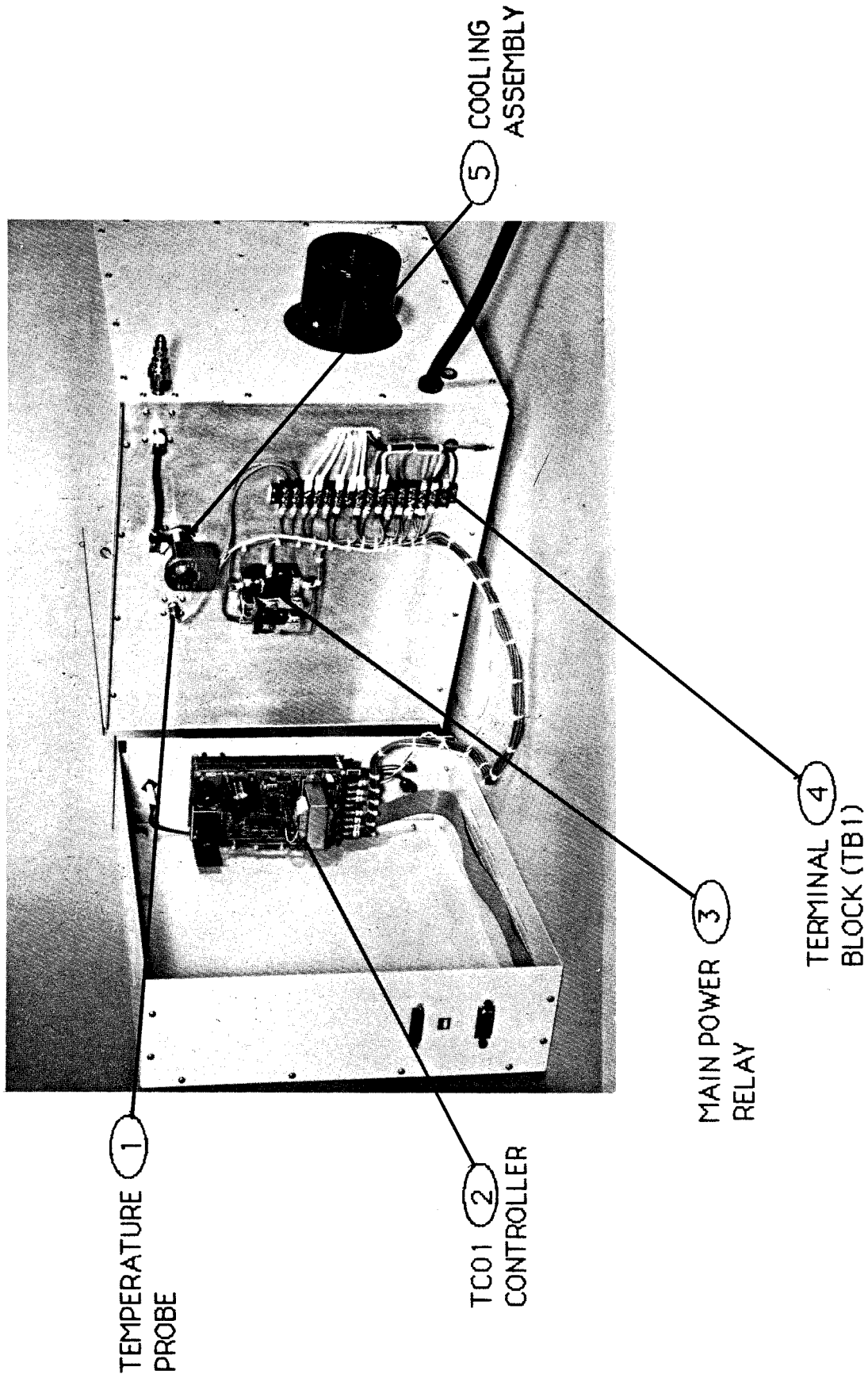


FIG. 1.5-3 CHAMBER CONTROLLER SECTION

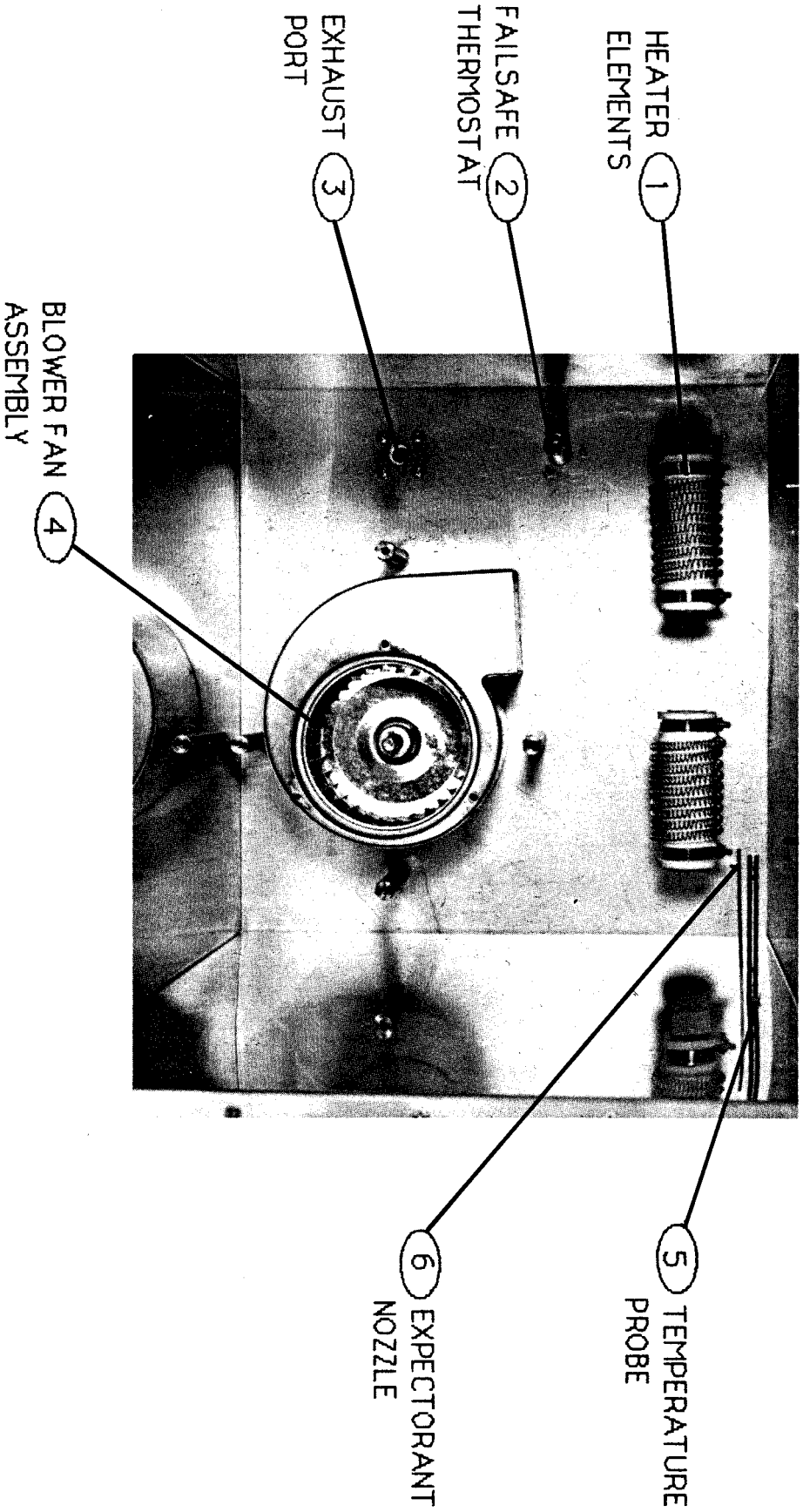
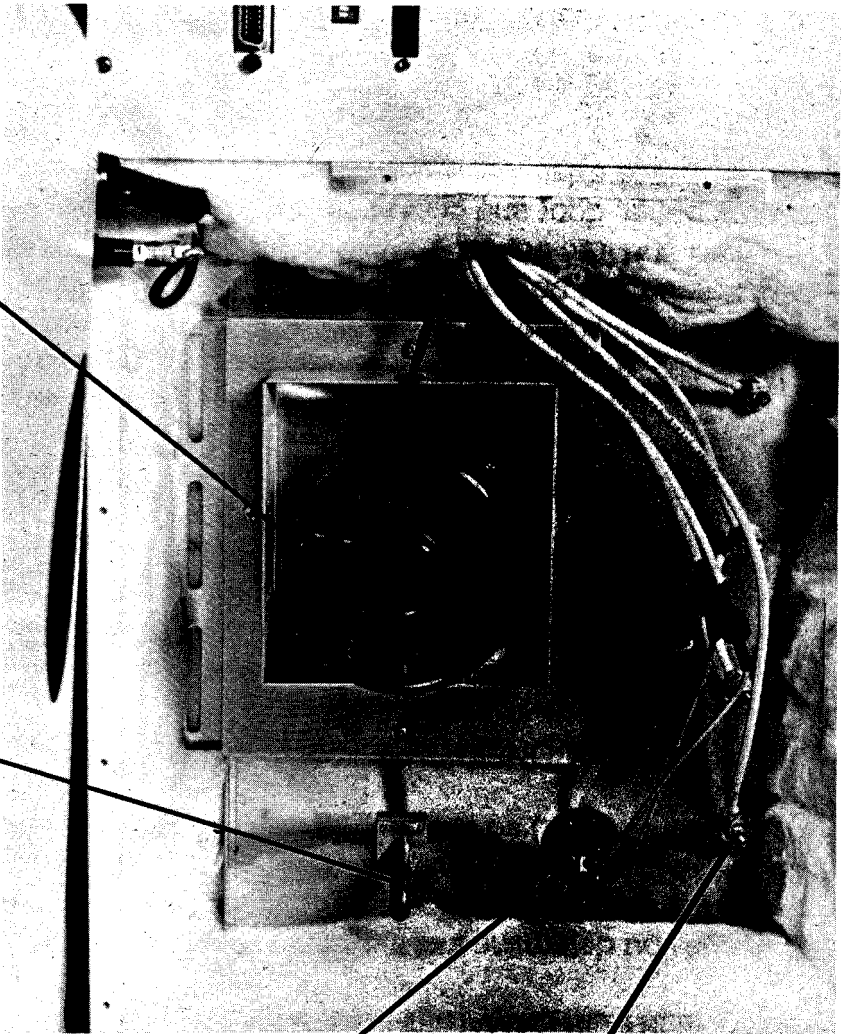


FIG. 1.5-4 TEST CHAMBER WITH BAFFLE REMOVED



BLOWER  
MOTOR

1

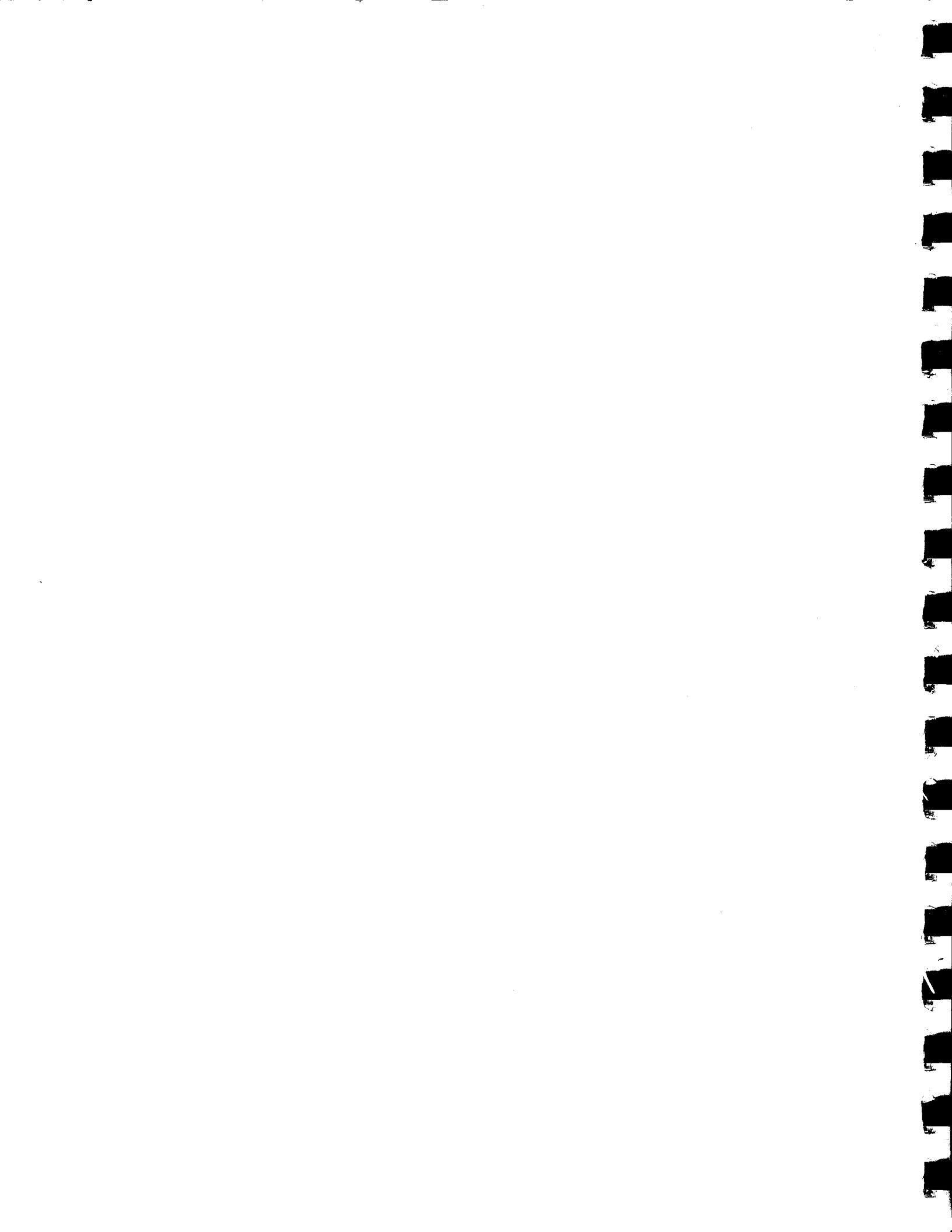
EXHAUST  
PORT

2

3 FAILSAFE  
THERMOSTAT

4 HEATER  
ELEMENT  
TERMINALS

FIG. 1.5-5 CHAMBER INTERNAL REAR VIEW



## **Section 2 RECEIVING, SAFETY AND INSTALLATION**

### **2.1 INITIAL INSPECTION AND UNPACKING**

Inspect the shipping container for obvious damage. If the shipping container is damaged, then a written note on the bill of lading describing the damage should be made while the delivery person is still on the premises. Unpack the EC0X per the instructions located in the packing list pouch. Save all carton and cushioning material in case the unit needs to be returned. Verify the contents of the carton matches that of the items listed on the packing slip.

### **2.2 LOST OR DAMAGED EQUIPMENT**

If you determine that the goods described on the packing slip are lost or damaged, first notify the transportation company to obtain the correct procedure for returning merchandise for repair or replacement. Then call Sun Systems for a return authorization number, ( see Sec. 6.2) so that we may best handle the merchandise when it is returned.

### **2.3 SAFETY CONSIDERATIONS**

Please take a moment, if you have not already, to read the safety precautions located in the beginning pages of this manual and distributed throughout this manual. If, for any reason, you do not fully understand the meaning of the cautions, please contact Sun Systems customer service before proceeding.

### **2.4 PREPARATION FOR USE**

The EC0X is factory wired for AC sources delivering 110, 208, or 240 VAC, at 50 / 60 Hz. A tag located on the back panel of the chamber indicates the proper voltage to be applied. Insure that the current rating of the service is sufficient to provide the necessary amounts of power required by the chamber. Install the chamber on a surface which is flat, rigid and free from shock and vibration. Orient the chamber in such a manner that the control panel, door and coolant connection are readily accessible. Insure that 2 inches of free air space exists between the rear of the blower motor and any other objects.

## 2.5 LIQUID CARBON DIOXIDE DELIVERY SYSTEMS

There are three common delivery systems available with the use of liquid carbon dioxide. They consist of a 50 pound, 850 PSI type K cylinder, a 350 pound, 300 PSI dewwars type vessel and 300 PSI bulk delivery systems.

Follow the recommendations of your LC0<sub>2</sub> supplier as to the correct methods to store and use your expectorant supply.

**Caution** - Use personal protective equipment such as gloves, goggles, face shields, etc., when working with or in an environment containing liquid carbon dioxide.

**Caution** - Avoid any personal contact of the skin or eyes with liquid carbon dioxide or supply lines and components carrying these liquids. Exposure to these liquids or the components which carry them can cause frostbite.

**Caution** - Operate the chamber in an environment with good ventilation to air. If the chamber is to be installed in an enclosed area, connect the chamber exhaust port to outside air. Never use the exhaust port for access to the internal temperature chamber for any means.

**Caution** - Always follow the safety precautions supplied by the vendor for your liquid carbon dioxide storage vessels.

**Caution** - Verify that the correct type of expectorant source is connected to the chamber before operating the chamber at low temperature.

**Caution** - Do not use contaminated expectorant. Test the expectorant for cleanliness by discharging a small amount through a clean filter. Inspect filter for quantities of ice, oil, rust or water.

### LC0<sub>2</sub> Installation Procedure

1. Connect one end of the 6 foot hose supplied with the unit to the S.A.E. 37° flare male fitting located on the rear of the chamber.
2. Connect the loose end of the hose to the LC0<sub>2</sub> siphon cylinder, vessel or bulk delivery system.
3. Insure all fittings are secure. Turn on the LC0<sub>2</sub> supply and inspect for leaks at the fittings.

## 2.6 LIQUID NITROGEN DELIVERY SYSTEMS

Chambers equipped with liquid nitrogen for the cooling expectorant can operate as low as  $-100^{\circ}\text{C}$  in temperature. Liquid nitrogen ( $\text{LN}_2$ ) is commonly supplied in either a dewver vessel or a bulk delivery system. Delivery pressure for both systems should be maintained at between 80 and 100 PSI.

**Caution** - Use personal protective equipment such as gloves, goggles, face shields, etc., when working with or in an environment containing liquid nitrogen.

**Caution** - Avoid any personal contact of the skin or eyes with liquid nitrogen or supply lines and vessels carrying these liquids. Exposure to these liquids or the vessels which carry them can cause frostbite.

**Caution** - Operate the chamber in an environment with good ventilation to air. If the chamber is to be installed in an enclosed area, connect the chamber exhaust port to outside air. Never use the exhaust port for access to the internal temperature chamber for any means.

**Caution** - Always follow the safety precautions supplied by the vendor for your liquid nitrogen storage vessels.

**Caution** - Verify that the correct type of expectorant source is connected to the chamber before operating the chamber at low temperature.

**Caution** - Do not use contaminated expectorant. Test the expectorant for cleanliness by discharging a small amount through a clean filter. Inspect filter for quantities of ice, oil, rust or water.

**Caution** - Do not leave liquid nitrogen trapped in a supply line as high pressures will be developed when the liquid absorbs heat and is transformed from a liquid to a gas.

### $\text{LN}_2$ Installation Procedure

1. The ECOX is equipped with a  $3/8"$ , SAE  $45^{\circ}$  flare male fitting (CGA 295) on the rear of the chamber. Connect the user supplied cryogenic supply hose to this fitting. A  $3/8"$  I.D. supply hose should be used for best chamber operation.
2. Connect the other end of the cryogenic supply hose to the  $\text{LN}_2$  supply.
3. Insure all fittings are secure. Turn on the  $\text{LN}_2$  supply and check for leaks.

## 2.7 ECOX CHAMBER INSTALLATION

Refer to Section 2-5 of the TCO1 User Manual supplied with this unit for initial installation and check-out.





### **Section 3 THEORY OF OPERATION**

The ECOX is designed such that air flows vertically in the test chamber. The circulated air enters the blower in the lower rear of the chamber and is forced up and over two heating elements. It then proceeds across the top interior of the chamber past the expectorant nozzle and the temperature probe used by the temperature controller. The front of the air baffle then redirects the air flow down to the interior of the chamber.

Heat and cool operation is controlled by the TCO1 temperature controller from readings received from the temperature probe. Section 3 of the TCO1 Users Manual fully describes the operation of the temperature controller.



## **Section 4 USER ADJUSTMENTS**

The ECOX supports user adjustments for the setting of the IEEE - 488 bus interface address, RS - 232 baud rate select, temperature controller calibration, PID coefficient modification and mechanical failsafe thermostat adjustment.

### **4.1 IEEE-488 INTERFACE ADDRESS SELECT**

The IEEE-488 address switch is located on the rear panel of the ECOX. Consult Section 3-5 in the TCO1 Users Manual.

### **4.2 RS-232 INTERFACE BAUD RATE SELECT**

The factory setting for the RS-232 BAUD rate is set at 2400 BAUD. The RS-232 baud rate may be modified by moving hardware jumpers located on the TCO1. To gain access to the TCO1, follow the repair procedures in Section 6-3 of this manual. Consult Section 4-3 in the TCO1 Users Manual.

### **4.3 TEMPERATURE CONTROLLER CALIBRATION**

Consult Section 4-2 in the TCO1 Users Manual for an RTD type probe, Section 4-2.2.

### **4.4 PID COEFFICIENT MODIFICATIONS**

PID coefficients may only be modified from the IEEE-488 or RS-232 interfaces. The coefficients are not saved when the power is removed from the ECOX. Permanent modified PID coefficients may be programmed in ROM by Sun Systems at your request. Consult Section 3-3.4 in the TCO1 Users Manual for systems using the RS-232 interface and Section 3-4.4.3 for systems using the IEEE-488 interface.

## 4.5 FAILSAFE ADJUSTMENT

The mechanical failsafe provided with the chamber is a safety device to prevent the chamber from inadvertently overheating. You will need to determine the maximum temperature that you can allow the chamber to reach. This temperature is set to +155°C from the factory. To change this temperature, perform the procedure listed below. If this maximum temperature is ever reached in your chamber, the failsafe light on the front of the chamber will light and the circuit breaker on the rear of the chamber will trip, thus removing power from the heaters.

- STEP 1:** Locate the failsafe adjusting hole on the rear of the EC0X and displace any insulation material which may block access to the failsafe adjusting screw.
- STEP 2:** If the desired trip point is higher than +155°C, the failsafe adjusting screw must be turned counterclockwise until it stops. This sets the failsafe at the highest value available and will not trip the circuit breaker. If the desired trip point is lower than +155°C, it is not necessary to adjust the screw at this time.
- STEP 3:** Set the chamber temperature to the desired trip point temperature and set the wait time to 10 minutes. For example, if the desired trip point is +155°C, the following keystrokes from the front panel would be necessary:

155 TEMP  
10 TIME

To set the trip point for a temperature other than +155°C, replace the 155 with the desired trip point.

- STEP 4:** After the chamber is at the set point for 10 minutes, the buzzer will sound and the Time Out LED will light on the front panel. the failsafe can now be set.
- STEP 5:** Using a small blade screwdriver, slowly adjust the screw clockwise to lower the failsafe trip point until the heater circuit breaker on the rear of the unit trips. The failsafe lamp on the front panel will illuminate. When this occurs, stop turning the screw clockwise and turn the screw 1/4 of a turn counterclockwise and reset the heater circuit breaker to restore normal operation. If the circuit breaker does not reset, adjust the failsafe slightly more in the counterclockwise direction until the circuit breaker remains on and the chamber functions normally.

## **Section 5 MAINTENANCE**

The ECOX was designed to be virtually trouble and maintenance free. However, to prolong your chambers useful product life and to maintain it at its optimum working condition, Sun Systems recommends performing routine maintenance to the blower motor and expectorant filter on a semi-annual basis.

### **5.1 BLOWER MOTOR INSPECTION AND CLEANING PROCEDURE**

This procedure is to insure proper air flow is received by the blower motor assembly.

STEP 1 - Position the chamber such that access is allowed to the rear of the chamber.

STEP 2 - Clean the intake of the blower motor with a brush or vacuum/brush combination.

STEP 3 - Reposition the chamber insuring that at least 2 inches of free air space exists between the rear of the blower motor and any other objects.

### **5.2 EXPECTORANT FILTER CLEANING AND INSPECTION**

This procedure is necessary to insure proper working order of the cooling system.

STEP 1 - Position the chamber such that access to rear of the unit is possible.

STEP 2 - Turn off the expectorant supply and remove the expectorant supply hose from the rear of the chamber. The hose connects to the filter assembly.

STEP 3 - Remove the filter back section and then the filter itself.

STEP 4 - Remove any contamination from the filter. If need be, tap the filter lightly as not to damage the filter.

STEP 5 - Replace the filter and filter back section.

STEP 6 - Reconnect the expectorant supply hose and turn on the expectorant supply. Check for leaks around the fittings.



## **Section 6 FAULT ANALYSIS AND REPAIR**

The ECOX was designed and built to provide years of service with a minimum amount of systems down time. Should the chamber malfunction, attempt to isolate the fault using the fault isolation tables in Section 6.1. Follow the recommended repair procedures included in the tables. If return for repair of the chamber or any sub-assemblies is indicated, please follow the return material authorization procedure outlined in Section 6.2. In some cases, repair can be facilitated on site using the repair procedures detailed in Sections 6.3 and on.

In any case, call Sun Systems and we will gladly assist you in the correction of the malfunction.

### **6.1 FAULT ANALYSIS CHARTS**

The following fault isolation charts are included to assist the user to identify common problems which may occur with the ECOX chamber. Some of the faults can be corrected quickly and easily by following the corrective measures illustrated in the charts. If, however, the problem persists, call Sun Systems for assistance.



**TABLE 6.1-1 FAULT ISOLATION**

| <u>FAULT SYMPTOM</u>  | <u>PROBABLE CAUSE</u>                             | <u>CORRECTIVE MEASURE</u>  |
|---|---|--|
| NO RESPONSE WHEN MAIN POWER SWITCHED ON   | FAILSAFE BREAKER IN OFF POSITION                  | CHECK AC OUTLET AND CIRCUIT BREAKER                                  |
|   | MAIN POWER FUSE BLOWN                             | REMOVE FUSE AND INSPECT<br>REPLACE IF BLOWN                          |
| CHAMBER BLOWS FUSE UPON POWER ON  | BROKEN HEATER ELEMENT MAKING CONTACT WITH CASE    | REPLACE HEATER ELEMENT   |
| CONTROLLER DISPLAYS A TEMPERATURE OF +321°C   | PROBE DISCONNECTED                                | RE-CONNECT PROBE   |
|   | OPEN TEMPERATURE PROBE                            | REPLACE PROBE  |
| CONTROLLER DISPLAYS A TEMPERATURE OF -103°C   | SHORTED TEMPERATURE PROBE                         | REPLACE PROBE  |
| CHAMBER DOES NOT HEAT   | CONTROLLER HEAT SWITCH NOT IN ON(UP) POSITION     | TURN HEAT SWITCH ON  |
|   | FUSE F2 BLOWN ON TC01 POWER SUPPLY BOARD          | INSPECT FUSE & REPLACE   |
|   | CONTROLLER FAILURE                                | RETURN FOR REPAIR  |
|   | HEATER ELEMENT FAILURE                            | REPLACE HEATER ELEMENT   |
| CHAMBER SLOW TO HEAT  | SINGLE ELEMENT OPEN                               | REPLACE HEATER ELEMENT   |
| BLOWER FAILS TO OPERATE   | FAILSAFE THERMOSTAT HAS TRIPPED                   | ADJUST FOR PROPER OPERATION  |
|   | DEFECTIVE MAIN POWER RELAY                        | REPLACE RELAY  |
|   | FAULTY BLOWER MOTOR                               | REPLACE BLOWER MOTOR   |
| CHAMBER FAILS TO COOL (WITH NO AUDIBLE SOUND FROM THE COOL SOLENOID)                                  | CONTROLLER COOL SWITCH NOT IN THE ON(UP) POSITION | TURN SWITCH ON   |
|   | FUSE F3 BLOWN ON TC01 CONTROLLER                  | INSPECT AND REPLACE FUSE   |
|   | TC01 CONTROLLER FAILURE                           | RETURN FOR REPAIR  |
|   | COOL SOLENOID FAULTY                              | REPLACE SOLENOID   |
| CHAMBER FAILS TO COOL OR COOLS SLOWLY (WITH AUDIBLE SOUND FROM THE COOL SOLENOID OPENING AND CLOSING) | EXPECTORANT DELIVERY SYSTEM FAULTY                | CHECK EXPECTORANT FILTER<br><br>VERIFY EXPECTORANT DELIVERY PRESSURE |
|   |   | WRONG EXPECTORANT DELIVERY SYSTEM FOR OPTION ORDERED                 |
|   |   | IMPROPER CONNECTION TO DELIVERY SYSTEM. REQUIRES LIQUID TO CHAMBER   |

## 6.2 RETURN MATERIAL AUTHORIZATION PROCEDURE

In the event the chamber or a module within the chamber is in need of repair, call Sun Systems at (305) 739-7004 for a Return Material Authorization (RMA) number and an estimate for the turnaround time for the repair. The RMA number is valid for 30 days and must be indicated on the outside shipping label. It is also helpful if a brief explanation of the problem accompanies the unit. After securing the RMA number, ship the unit, freight prepaid, to:

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**SUN ELECTRONIC SYSTEMS, INC.**  
**1900 Shepherd Drive**  
**Titusville, Florida 32780**  
**TEL: (407) 383-9400    FAX: (407) 383-9412**

Equipment in transit is the sole responsibility of the rightful owner. After repair, and unless otherwise specified, units will be returned FOB via a 2 day air transportation carrier.

### 6.3 TEMPERATURE CONTROLLER SECTION REMOVAL AND REPLACEMENT

The temperature controller section (TCO1) is located on the right side of the chamber when viewed from the front. Follow the procedure outlined below for the removal and replacement of the TCO1 controller section.

**STEP 1 -** Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that all of the components of the chamber have reached ambient temperature.

#### CONTROLLER SECTION ACCESS

**STEP 2 -** Position the chamber on its left side as viewed from the front. Remove the (4) 6 32 screws located on the exposed bottom of the chamber. Return the chamber to its normal position.

**STEP 3 -** Remove the (4) 6-32 screws located on the top of the chamber.

**STEP 4 -** Remove the (2) 6-32 screws that are just above and below the expectorant filter assembly.

**STEP 5 -** Carefully separate the controller chassis from the chamber section being careful not to stress the wiring harness or probe connections.

#### TEMPERATURE PROBE REMOVAL

**STEP 6 -** Locate the temperature probe mounting area on the chamber side mounting wall. Loosen the nut attached to the probe and allow it to slide down the probe wires.

**STEP 7 -** Loosen but do not remove the (4) #2 phillips head screws on the probe hold down fitting. Gently grasp the exposed stainless steel sheath of the probe and pull the probe out of the probe hold down fitting.

#### TCO1 CONTROLLER SECTION REMOVAL

**STEP 8 -** Disconnect the (2) quick disconnect terminals for the failsafe lamp located inline near the TCO1 controller

**STEP 9 -** Disconnect terminals 1-4 & 6-8 from the rear of the TCO1 temperature controller. The controller section is now in the configuration recommended for return for repair.

**REPLACEMENT -** Reverse steps 2-9.

## 6.4 HEATER ELEMENT REMOVAL AND REPLACEMENT

The heating elements are located behind the air baffle located inside the test chamber area. Follow the procedure below for removal and replacement of a heating element.

STEP 1 - Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating elements and the interior of the chamber have had time to reach ambient temperature.

### REMOVE AIR BAFFLE

STEP 2 - Remove the (3) 6-32 screws and the (4) 8-32 screws located around the blower intake on the rear wall of the interior of the test chamber.

STEP 3 - Remove the (2) 6-32 screws located on the ceiling of the test chamber and remove air baffle.

### REMOVE CHAMBER BACK PLATE

STEP 4 - Remove the (14) #6 screws located on the perimeter of the chamber back plate and carefully pivot back plate away without stress to the line voltage and fuse wiring.

### HEATER ELEMENT REMOVAL

STEP 5 - Carefully remove the fiberglass insulation from the heater mounting area. Remove the 6-32 nut and flat washer from each side of the heater element. Remove the wired ring terminals from the heater element mounts.

STEP 6 - Remove the next 6-32 nut and beveled washer from both mounting sides.

NOTES: When re-installing, always place the wide part of the bevel washer towards the ceramic insulator. Tighten the nut finger tight plus 3/4 of a turn or use 4 inch pounds of torque.

STEP 7 - Stand to the side of the chamber. While supporting the two ceramic insulators from falling with one hand, reach inside and grasp the heater element and pull towards the front of the chamber.

REPLACEMENT - Defective heater elements are replaced with new ceramic insulators and a new heater element. Reverse steps 2 thru 7 for installation.

## 6.5 COOLING MODULE ASSEMBLY REMOVAL AND REPLACEMENT

The cooling module consists of the nozzle, cool solenoids and associated plumbing necessary to deliver the expectorant to the test chamber. Earlier versions of the ECOX did not use this module approach. In that case, the individual cool solenoids and nozzle are removed separately from the associated plumbing.

STEP 1 - Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the components which carry the expectorant have had time to reach ambient temperature.

### CONTROLLER SECTION ACCESS

STEP 2 - Follow the steps required to gain access to the controller section as outlined in Section 6.3.

### COOLING SOLENOID VOLTAGE DISCONNECT

STEP 3 - Locate and follow the two wires attached to the cool solenoids and disconnect the two wires from terminal block TB1-15 and TB1-16.

### COOLING MODULE REMOVAL (For ECOX Units with a Module Cooling Assembly)

STEP 4 - The cooling assembly has a 6" nozzle which protrudes into the top of the test chamber area. Carefully remove the (4) 8-32 screws which hold the cooling assembly on to the mounting plate in a perpendicular fashion.

### COOLING SOLENOID REMOVAL

STEP 5 - To remove the cool solenoid and nozzle, disconnect the coolant supply line fitting to the cool solenoid without attempting to bend the supply line away from the cool solenoid. Loosen, but do not remove, the (4) hold down screws on the cool solenoid. Rotate the cool solenoid counter clockwise to clear the coolant supply line and remove from the mounting plate in a perpendicular fashion.

REPLACEMENT - Reverse steps 2 thru 5

## 6.6 FAILSAFE THERMOSTAT REMOVAL AND REPLACEMENT

The failsafe thermostat is located internally on the rear of the chamber. If replacement of the failsafe thermostat is deemed necessary, follow the procedure below.

STEP 1 - Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating elements and the interior of the chamber have had time to reach ambient temperature.

### REMOVE CHAMBER BACK PLATE

STEP 2 - Remove the (14) #6 screws located on the perimeter of the chamber back plate and carefully pivot back plate away without stress to the line voltage and fuse wiring.

### FAILSAFE THERMOSTAT REMOVAL

STEP 3 - Carefully remove the strip of fiberglass insulation which covers the local of the failsafe thermostat. Locate the thermostat and disconnect the (2) wires attached in line to the thermostat utilizing quick disconnect terminals.

STEP 4 - Remove the (3) #6 screws which hold the thermostat to the rear wall of the test chamber and remove the thermostat.

REPLACEMENT - Reverse steps 2 thru 4. Calibrate the thermostat under the procedures described in Section 4.5.

## 6.7 BLOWER MOTOR REMOVAL AND REPLACEMENT

If a faulty blower has been determined, perform the following procedure for removal and replacement.

STEP 1 - Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating and cooling elements and the interior of the chamber have had time to reach ambient temperature.

### CONTROLLER SECTION ACCESS

STEP 2 - Follow the steps required to gain access to the controller section as outlined in Section 6.3.

### REMOVE AIR BAFFLE

STEP 3 - Remove the (3) 6-32 screws and the (4) 8-32 screws located around the blower intake on the rear wall of the interior of the test chamber

STEP 4 - Remove the (2) 6-32 screws located on the ceiling of the test chamber and remove air baffle.

### REMOVE CHAMBER BACK PLATE

STEP 5 - Remove the (14) #6 screws located on the perimeter of the chamber back plate and carefully pivot back plate away without stress to the line voltage and fuse wiring.

### BLOWER MOTOR REMOVAL

STEP 6 - From inside the test chamber, remove the blower wheel by loosening the set screw which holds the wheel to the motor shaft.

STEP 7 - Locate and follow the two wires connected to the blower motor back to the terminal block located in the controller section and remove from TB1-1 and TB1-2. Feed wires thru access hole in chamber side plate and let hang near blower motor.

STEP 8 - Remove the (4) 8-32 screws which secure the blower motor adapting plate and remove the blower motor in a perpendicular fashion.

REPLACEMENT - Reverse steps 2 thru 8.

## 6.8 MAIN POWER RELAY REMOVAL AND REPLACEMENT

The main power relay is located on the chamber side plate internal to the controller section. Follow the procedure below for removal and replacement of the main power relay.

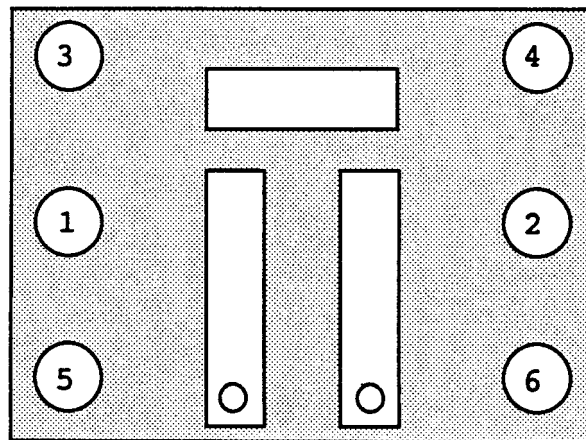
**STEP 1** - Remove all electrical power from the chamber, i.e., unplug the chamber from the line voltage. Turn off the expectorant supply and disconnect expectorant supply hose from the chamber. Insure that the heating and cooling elements and the interior of the chamber have had time to reach ambient temperature.

### CONTROLLER SECTION ACCESS

**STEP 2** - Follow the steps required to gain access to the controller section as outlined in Section 6.3.

### MAIN POWER RELAY REMOVAL

**STEP 3** - Disconnect all wires connected to the (6) terminal positions of the main power relay as illustrated in Figure 6.8-1.



**FIG. 6.8-1 MAIN POWER RELAY TERMINAL CONNECTIONS**

**STEP 4** - Remove the (2) 8-32 screws which hold the relay to the chamber side plate and remove the main power relay.

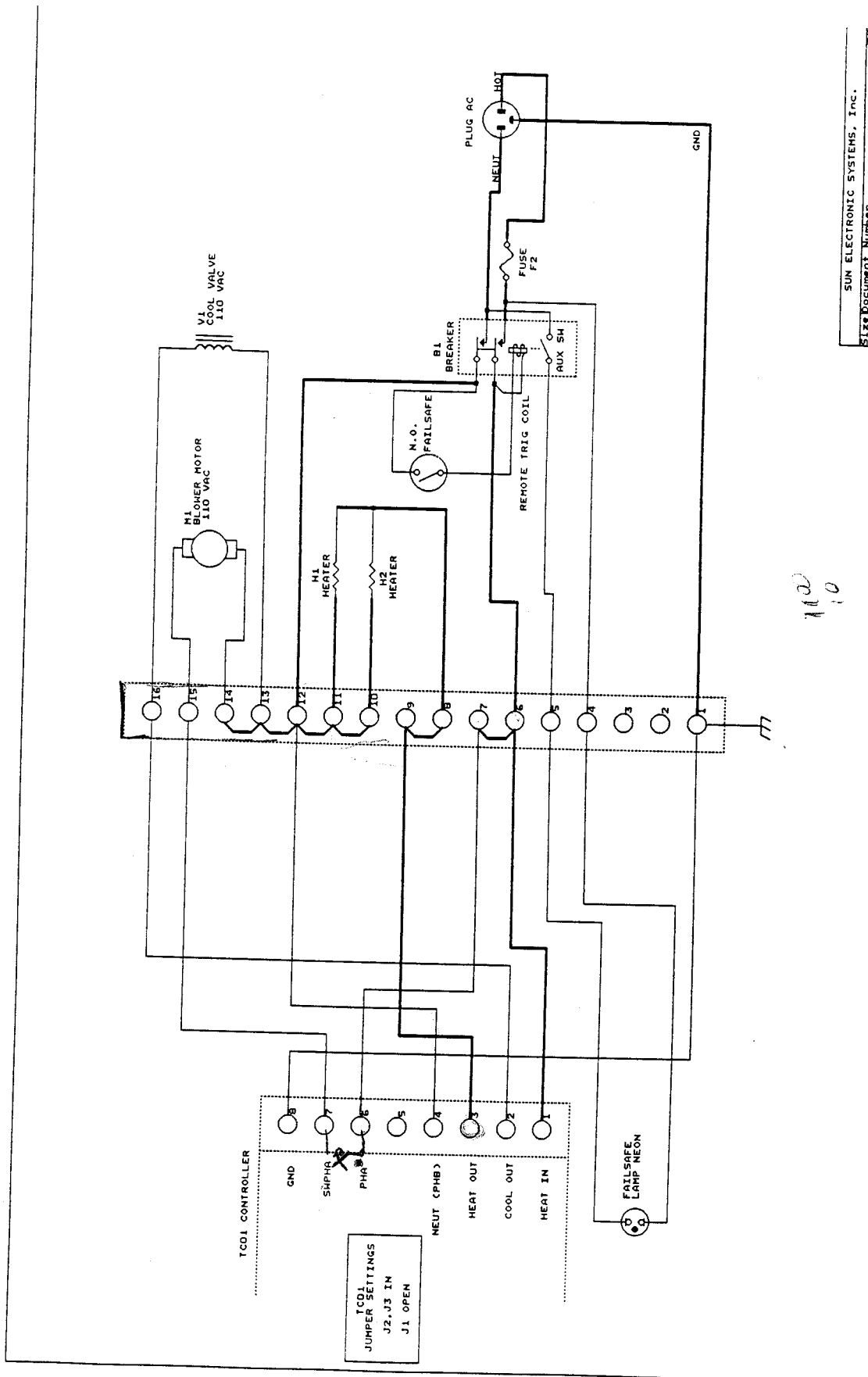
**REPLACEMENT** - Reverse steps 2 thru 4.



## 6.9 ECOX WIRING DIAGRAMS

The following figures illustrate the three different configurations of electrical wiring in the ECOX environmental chamber. Changes to the electrical wiring of the ECOX should be made at the factory.

FIG. 6.9-1 EC0X 100-120 VAC

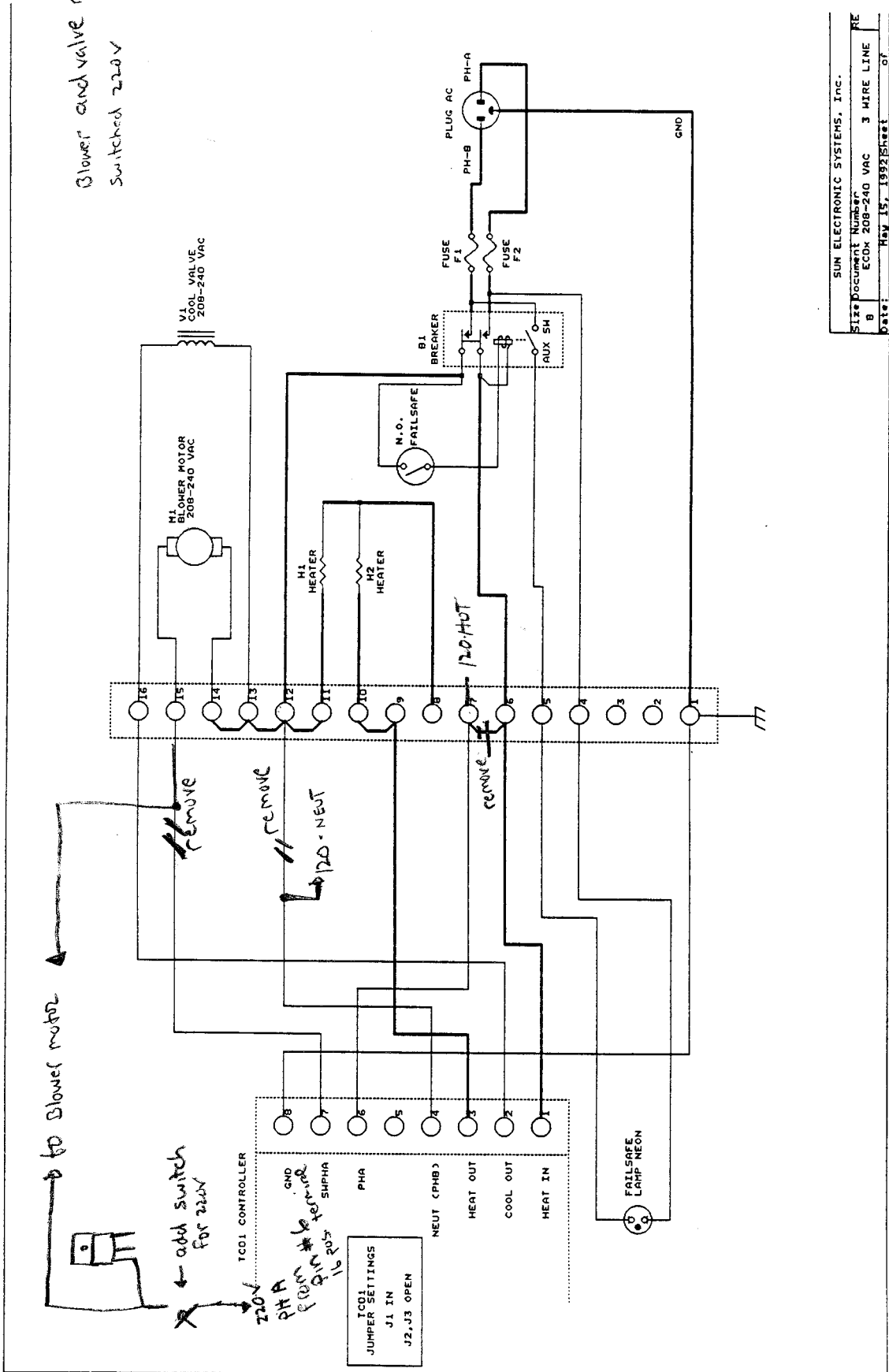


SUN ELECTRONIC SYSTEMS, Inc.  
 Size Document Number EC0X 100-120 VAC  
 B  
 Date: Mar 15, 1955

102  
10

FIG 6.9-2 ECOX 208-240 VAC, 3 WIRE

Blower and valve need  
switched 220V



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|                  |                 |       |    |
|------------------|-----------------|-------|----|
| Size             | Document Number | B     |    |
| ECOX 208-240 VAC | 3 WIRE LINE RE  |       |    |
| Date:            | REV 15, 1992    | Sheet | of |

