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**Model: 3326**

Dual Chamber  
Water Jacket Incubator

**Manual No: 7013326**

**IMPORTANT!**

**Read This Instruction Manual**

Failure to read, understand and follow the instructions in this manual may result in damage to the unit, injury to operating personnel and poor equipment performance.

**NOTE:**

The material in this manual is for information purposes only. The contents and the product it describes are subject to change without notice. Forma Scientific, Inc. makes no representations or warranties with respect to this manual. In no event shall Forma Scientific, Inc. be held liable for any damages, direct or incidental, arising out of or related to the use of this manual.

MANUAL NO. 7999999				
Rev	ECN#	Date	By	Description
-		10/87		Standard manual

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Regardless of your needs, our professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 6:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

Thermo Electron Corporation  
Controlled Environment Equipment  
Millcreek Road, PO Box 649  
Marietta, OH 45750

International customers, please contact your local Thermo Electron distributor.

## UNPACKING LIST

Remove the packing box from the incubator. If the unit is to be moved by fork lift, leave the incubator on the skid until it has been moved to its designated location. A small box containing the following accessories is packed inside the incubator:

STOCK #	DESCRIPTION	QUAN.	PURPOSE
380284	3.8" Hose x 1/4 MPT Adapter	1	Fill & Drain
190028	Decontamination Kit	2	Maintenance
180001	Polypropylene Funnel	1	Fill & Drain
72017	Vinyl Tubing 3/8" ID	6	Fill & Drain

### ALSO PACKED WITHIN EACH INCUBATOR

224200	Stainless Steel Shelves	6
505072	Shelf Brackets	4
3113210	Stainless Blower Channel	1
3113220	Stainless Duct Sheet, Left	1
3113230	Stainless Duct Sheet, Right	1

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- 1.1 The Water Jacket: Key Features**
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## 1.1 THE WATER JACKET: KEY FEATURES

Forma's new water jacket design represents the best combination of economy, accuracy and reliability available in today's technology. Some of the SALIENT FEATURES include:

- A Door heater which automatically adjusts to ambient conditions to provide a condensate-free door for unhampered viewing of the product in the chamber without unnecessary door openings which might temporarily disturb temperature, humidity, and CO2 control.
- Ultra-flat, vibration-free shelves to provide optimal culturing conditions.
- Direct-set CO2, temperature, and alarm setpoints.
- Tamper-proof controls to prevent unauthorized or inadvertent adjustments.
- Digital readout of temperature and CO2 conditions in the chamber surrounding the product.
- Sealed chamber to minimize CO2 consumption.
- Sealed water jacket to minimize water evaporation.

The water jacket incubator also features EASE OF SERVICEABILITY by providing:

- Front access to all components so that the unit does not have to be moved for service repairs or routine maintenance.
- A slide-out control panel to allow easy access to electrical components.
- Plug-in CO2, and temperature/alarm modules to facilitate in servicing or replacement of a particular control module.
- Self-diagnostic switches in the control modules to ease in troubleshooting the system and determining where a particular problem originates.



The design of the water jacket also allows for EASE IN DISINFECTING or autoclaving with minimal unit down-time.

- There are no cracks or crevices on or around the chamber walls to harbor hidden or hard to reach bacterial growth.
- The stainless steel shelves, shelf channels, and duct sheets are easily removable without the use of tools for cleaning and disinfection of the entire interior.
- The blower wheel is disposable and easily replaced.

Great consideration has been given to the importance of PRODUCT PROTECTION through the addition of the following:

- An Add Water audible alarm and pilot light to alert the operator when the water level in the water jacket has become too low for efficient operation.
- An audible and visual CO<sub>2</sub> alarm which is activated when the CO<sub>2</sub> percent in the chamber deviates plus or minus 1% from CO<sub>2</sub> control setpoint.
- An overtemperature alarm system which is activated when chamber temperature overshoots control setpoint.

## 1.2 AUXILIARY EQUIPMENT

### 1) STAINLESS STEEL SHELF

The perforated shelf is square for easy installation. 22 shelf capacity. Minimum order of 1 shelf.

Catalog # 224200

2) TISSUE CULTURE SHELVES

These 11" x 16" stainless steel shelves for culture dishes are designed for stacking to increase incubator storage space. Minimum order of 6 shelves.

Catalog # 500171

3) FYRITE CO2 ANALYZER KIT

For checking chamber CO2 (0-20%) level in the chamber. Connects to the gas sample port on the control panel. Kit comes complete with aspirator, sampling tube, and carrying case.

Catalog # 220012

4) EXTRA FYRITE FLUID

For replacing Fyrite tester fluid. Three bottles per carton.

Catalog # 220031

5) DIGITAL THERMOMETER

Hand-held, the size of a pocket calculator, it features clear liquid crystal readout of temperature from -99.9 to +99.9 degrees C. Ideal for general laboratory use.

Catalog # 833227

6) TWO STAGE PRESSURE REGULATOR

Controls CO2 cylinder gas pressure. First stage reduces tank pressure to pre-set intermediate level. Second stage reduces pressure to recommended incubator inlet pressure. Permits stable CO2 flow on high or low demand through the entire cylinder supply.

Catalog # 965010

7) CO2 GAS GAURD

For use with automatic CO2 incubators only. Protects dual tank CO2 supply by automatically switching to another tank when one supply is exhausted. Audible alarm warns of tank depletion; reset button silences the alarm. Manual tank switchover included.

Model # 3030

8) REPLACEMENT CO2 FILTER

Disposable 99.97% HEPA filter to replace the inline CO2 filter when it becomes clogged.  
Catalog # 770001

9) DISINFECTION KIT

Includes parts needed for improved disinfection of the incubator. Includes disposable blower wheel, O ring for the CO2 sensor, and blower shaft seal.  
Catalog # 190028

10) LABORATORY DISINFECTANT

For use in and around the laboratory. Ideal for cleaning and disinfecting incubators, bio-freezers, glassware washers, baths, circulators, and other equipment. Protects against contamination, reduces chances of infection. Detailed literature is available in the supplement section at the back of this manual.

AMPHYL spray absorbs odors, minimizes contamination. Spraying action reaches hard to reach places. 12 (14 oz.) aerosol cans per case.

Catalog # 170002

O-SYL Disinfectant Detergent. A combination cleaner and disinfectant with a broad spectrum antimicrobial action. 6 (1 gallon) bottles per case.

Catalog # 170001

ROCCAL II Germicidal Sanitizing Agent. Bactericidal, kills mildew, prevents growth of fungi and bacteria in water jacketed incubators. 4 (1 gallon) bottles per case.

Catalog # 170003

11) HUMIDITY PAN

This humidity pan rests on the bottom shelf channels and is easy to remove for cleaning. Order an extra set of 2 shelf channels for mounting.

Catalog # 237001

12) HYGROMETER

For measuring chamber humidity. This instrument has a 4" dial and a range of 0 to 100% rh.

Catalog # 135010

13) GLASS THERMOMETER

For independently measuring chamber temperature. Range from 0 to 100 degrees C.

Catalog # 285722

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## SECTION 2 - SPECIFICATIONS

### Model 3326

#### 2.1 CAPACITY

Chamber Capacity: 5.7 Cubic Feet  
0.16 Cubic Meters  
Water Jacket Volume: 10.5 Gallons  
39.74 Liters  
Humidity Reservoir Capacity: 1.46 Gallons  
5.5 Liters  
Humidity Pan Capacity: 5 Liters

#### 2.2 WEIGHT

Net Weight Without Water: Approx. 360 lbs.  
Approx. 163.3 kgs.  
Net Weight With Water: Approx. 535.1 lbs.  
Approx. 242.7 kgs  
Shipping Weight: 550 lbs. Nominal  
249.4 kg Nominal

#### 2.3 DIMENSIONS

Exterior: 24.6" W x 82.2" H x 23.8" F-B  
62.5 cm W x 208.8 cm H x 60.4 cm F-B  
Interior: 18.6" W x 26.8" H x 18.8" F-B  
47.2 cm W x 68.1 cm H x 47.8 cm F-B

#### 2.4 CONSTRUCTION

Exterior: 18 Ga. Cold Rolled Steel  
Interior: 20 Ga. Stainless Steel Type 304 2-B Finish  
Insulation: 1-1/2" Fiberglass  
Inner Door Gasket: Silicone  
Outer Door Gasket: 4 Sided Molded Magnetic Vinyl  
Finish: Polyurethane Enamel  
Bristol Gray & Windsor Blue Trim



## 2.9 HEATERS

Chamber: 260 Watts  
Door: 5 Watt Continuous, 120 Watt Cycled  
Top (Cable): 6 Watts

## 2.10 BLOWER

CFM: 7.5  
Wheel Material: Polypropylene  
Motor: 1/200 HP, 1700 RPM, 4 Pole  
Externally Mounted, Internally Removable

## 2.11 FITTINGS

Fill & Drain Port: 1/4" FPT  
Access Port: 1.250" Plugged  
CO2 Connection: 1/4" Serrated Fitting  
1/4" I.D. Tubing  
Sample Port: 1/4" O.D.  
1/4" I.D. Tubing

## 2.12 ELECTRICAL CHARACTERISTICS

Main: 90-130 VAC, 50/60 Hz, 8 FLA  
Circuit Breaker: 5 Amps  
Power Switch: 2 Pole  
Line Cord: Hospital Grade

## 2.13 PERFORMANCE DATA

- Temperature
  - ~ Range: 3 Degrees C above ambient to 30 Degrees C
  - ~ Control Tolerance: +/- 0.02 Degrees C at 37 Degrees C in 72 Degrees F Ambient
  - ~ Uniformity: +/- 0.2 Degrees C @ 37 Degrees C
  - ~ Recovery Rate After 10 Sec. Door Opening:  
Within 2 Minutes \*
  - ~ Recovery Rate After 20 Sec. Door Opening:  
Within 10 Minutes \*
  - ~ Heat-Up Time from Ambient to 37 Degrees C:  
10 Hours
- CO2
  - ~ Range: 0 to 20%
  - ~ Control Tolerance: Better than +/- 0.1%
  - ~ Consumption @ 5% CO2: 1.7 Liters/Hr.  
+ 7.2 Liters/15 Sec. Door Opening
  - ~ Recovery Rate After 10 Sec. Door Opening:  
Within 5 Minutes \*\*
  - ~ Recovery Rate After 20 Sec. Door Opening:  
Within 10 Minutes \*\*



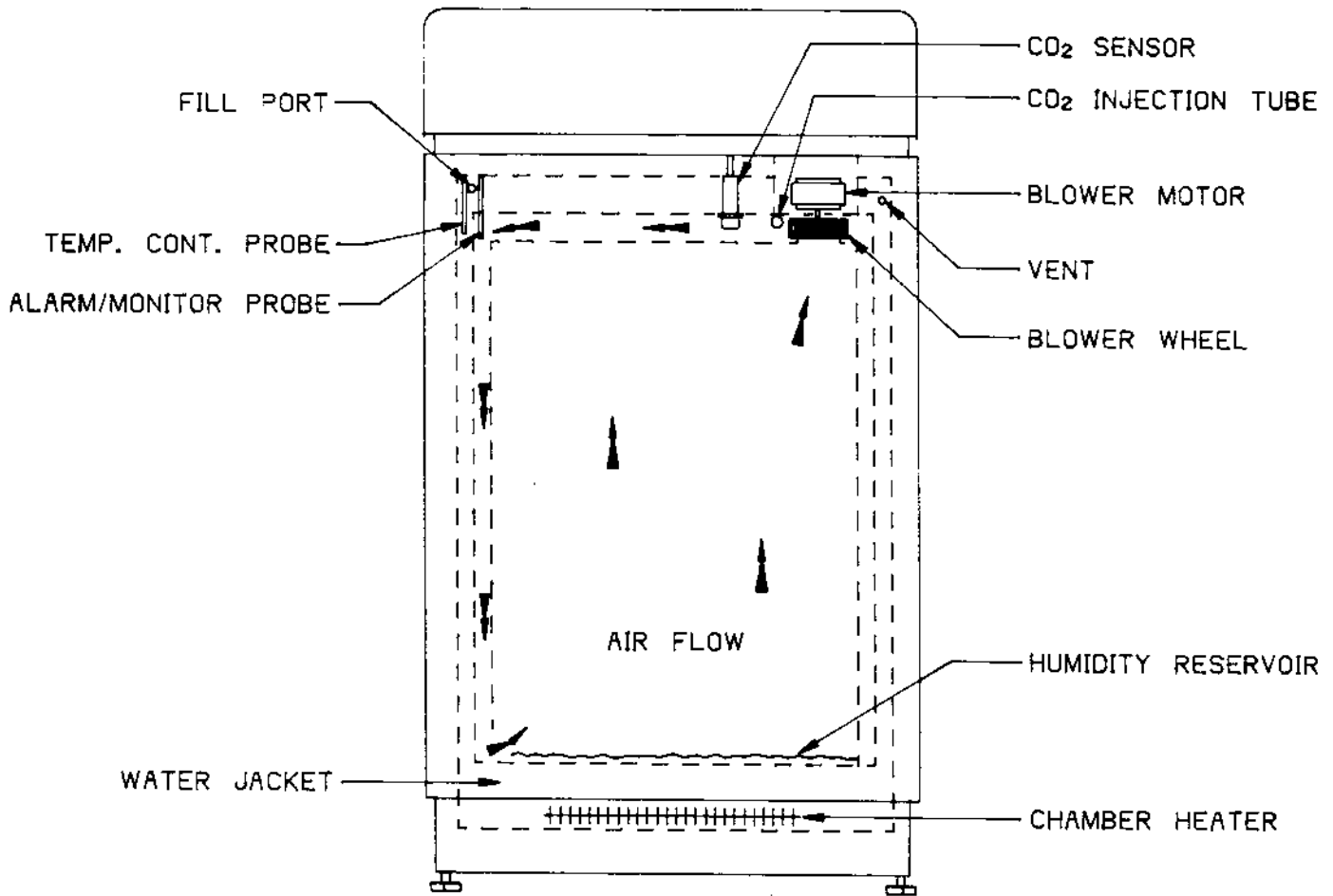
- Humidification
  - ~ Range: 98% at 37 Degrees C
  - ~ Recovery Rate After 10 Sec. Door Opening:  
Within 25 Minutes \*\*\*
  - ~ Recovery Rate After 20 Sec. Door Opening:  
Within 30 Minutes \*\*\*
  
- Energy Consumption @ 37 Degrees C in a 25 Degree C Ambient: 100 Watts per Hour/Chamber

- \* - to within 1/2 degree C
- \*\* - to 4.5% CO2 (setpoint 5% CO2)
- \*\*\* - to 97% RH

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SECTION 3 - OPERATION



WATER JACKETED INCUBATOR OPERATION  
Figure 3-1

## SECTION 3 - OPERATION

### 3.1 OPERATION (See Figure 3-1)

The water jacket is filled with approximately 10.5 gallons (39.7 liters) of water through the fill port located on the front of the unit. The water is then warmed by the chamber heater to provide an extremely stable way of heating the incubator. Not only does the water stay at a constant temperature with a minimum of heater on-time, but it also acts effectively as insulation from ambient temperature conditions.

Temperature control is maintained by a proportional, zero-switching device to provide uniform temperature throughout the chamber. An independent overtemperature controller assures product safety by assuming control at the overtemp setpoint should the primary controller malfunction. Should an overtemp condition develop, the monitor alarm system will alert the operator that a malfunction has occurred.

An internal blower gently circulates chamber air to prevent CO<sub>2</sub> stratification and minimize culture desiccation.

### 3.2 HUMIDIFICATION AND CO<sub>2</sub> (IMPORTANT!)

Forma has selected the thermal conductivity method of measuring CO<sub>2</sub>. When properly calibrated, the automatic CO<sub>2</sub> system provides stable, long term, CO<sub>2</sub> control. The thermal conductivity of the incubator atmosphere is affected not only by the quantity of CO<sub>2</sub> present, but also by the humidity level in the chamber. To accurately control CO<sub>2</sub>, the absolute humidity must be held constant, so any change in thermal conductivity is caused by a change in CO<sub>2</sub> concentration only. Inadequate humidification can cause the incubator humidity to fluctuate with ambient atmospheric changes and can affect the CO<sub>2</sub> calibration by as much as 1.5%. An easily removable can be ordered from Forma (see Section 1.2). This pan, with the water level maintained between the "ADD" and "FULL" lines, provides the optimum humidification in the incubator.

Temperature changes alone have little effect on CO<sub>2</sub> calibration, but they do cause large changes in absolute humidity, and those changes are reflected in changes in the CO<sub>2</sub> calibration. If either the temperature or humidity setpoints are changed, the CO<sub>2</sub> control must be zeroed for the new condition(s).



- 1. Fill Port & Vent
- 2. Power Switch
- 3. Circuit Breaker
- 4. Variable/37C Switch, Temp Control, Heat Light
- 5. Gas Sample Port
- 6. Setpoint Adjustment Tool
- 7. CO<sub>2</sub> Power Switch
- 8. CO<sub>2</sub> Controller & Digital Display
- 9. CO<sub>2</sub> Alarm Light
- 10. Set/Silence Button
- 11. Alarm Disable Switch (Not Shown)
- 12. CO<sub>2</sub> Inject Light
- 13. CO<sub>2</sub> Zero Adjustment
- 14. Alarm/Monitor Module
- 15. Overtemp Light
- 16. Add Water Light

Fig. 2

## SECTION 3 - OPERATION

### 3.3 CONTROL PANEL (See Figure 3-2)

#### 1) FILL PORT AND VENT

The fill port has been located at the front of the unit to facilitate filling and draining of the water jacket without having to move the unit. When the water enters the water jacket during filling, the air that was present in the jacket exits through the vent. Under no circumstances should the vent be plugged.

#### 2) POWER SWITCH AND PILOT LIGHT

The main power switch controls the ON/OFF power to the unit. The power pilot light is activated when the power switch is on, and the unit is receiving power.

#### 3) CIRCUIT BREAKER (RESET)

The 5 amp circuit breaker for the incubator (labeled "Reset") can be pushed to reset the incubator power supply within a few seconds after the breaker has tripped. If it trips a second time, the unit should be checked by a qualified electrician.

#### 4) VARIABLE/37C SWITCH, TEMP CONTROL, AND HEATER PILOT LIGHT

When the Variable/37C switch is set to the 37C (up) position, chamber temperature will automatically be maintained at +37 degrees C. If necessary, the 37C control can be recalibrated via the calibration screw located at the lower left side of the temperature control dial. See Section 6.4 for recalibration instructions for the 37 degrees C setting.

When the switch is set to the Variable (down) position, control is assumed by the temperature control potentiometer. The numbers (0 to 60) around the control knob indicate the setpoint value in degrees Centigrade. Any value between +5 degrees C above ambient temperature and 50 degrees C may be selected. The heater pilot light will be activated whenever the heater is energized.

## SECTION 3 - OPERATION

### 5) GAS SAMPLE PORT

A sample port for checking CO<sub>2</sub> percentage by independent means (e.g. Fyrite or similar CO<sub>2</sub> measuring device). See Sections 6.7 - 6.9 for detailed instructions on the proper use of the Fyrite.

**IMPORTANT!** THE SAMPLE PORT SHOULD NEVER BE CAPPED, AS IT SERVES AS A VENT FOR THE INCUBATOR CHAMBER.

### 6) SETPOINT ADJUSTMENT TOOL

A small screwdriver, located directly above the sample port, has been provided for setting the CO<sub>2</sub> and overtemp setpoints. Pull out on the knob to release the screwdriver.

## 3.4 CO<sub>2</sub> MODULE (See Figure II)

### 7) CO<sub>2</sub> POWER SWITCH

The CO<sub>2</sub> power switch controls the electrical power to the CO<sub>2</sub> system, and it must be ON when the incubator is to be operated with CO<sub>2</sub>. The switch should be turned on as soon as power is applied to the unit to allow the CO<sub>2</sub> system to warm up.

### 8) CO<sub>2</sub> CONTROLLER AND DIGITAL DISPLAY

The LCD digital readout on the CO<sub>2</sub> module continually displays the percent of CO<sub>2</sub> in the chamber. The setpoint is displayed when the CO<sub>2</sub> set/silence button is pushed.

CO<sub>2</sub> setpoint is changed by pushing the CO<sub>2</sub> set/silence button and rotating the CO<sub>2</sub> setscrew to the desired percentage.

### 9) AUDIBLE CO<sub>2</sub> ALARM AND PILOT LIGHT

The audible CO<sub>2</sub> alarm and pilot light are activated when the percent CO<sub>2</sub> deviates from setpoint by plus or minus 1% (nominal) for longer than approximately four minutes.

## SECTION 3 - OPERATION

### 10) SET/SILENCE PUSH BUTTON

When pushed, the set/silence button will silence the CO<sub>2</sub> alarm and de-energize the alarm light. The alarm will remain deactivated until another alarm condition occurs. This button must be pushed to set or display the CO<sub>2</sub> setpoint.

### 11) ALARM DISABLE SWITCH

**NOTE:** It is necessary to pull the CO<sub>2</sub> module out slightly to gain access to the alarm disable switch.

When the switch is in the DISABLE position, the CO<sub>2</sub> alarm is completely disabled. When the switch is set to the NORMAL position, the alarm system is operative and can be silenced via the set/silence button.

### 12) CO<sub>2</sub> INJECT LIGHT

The CO<sub>2</sub> inject light is activated whenever there is a demand for CO<sub>2</sub> to meet setpoint requirements. Since the CO<sub>2</sub> inject light is independent of the CO<sub>2</sub> alarm, it will continue to signal a need for CO<sub>2</sub> when the CO<sub>2</sub> alarm is set to either the defeat or silence position.

### 13) CO<sub>2</sub> ZERO ADJUSTMENT

The CO<sub>2</sub> zero adjustment is used for zeroing the CO<sub>2</sub> controller to specific control conditions. It is the ONLY user calibration adjustment on the CO<sub>2</sub> module. All internal adjustments are for qualified service personnel ONLY.

## 3.5 ALARM/MONITOR MODULE (See Figure II)

### 14) OVERTEMPERATURE CONTROLLER AND PUSH TO SET BUTTON

The overtemperature setpoint is displayed when the PUSH TO SET button on the module is pushed. Overtemp control point is adjusted by pushing the set button and rotating the setscrew on the module to the desired setpoint.



## SECTION 3 - OPERATION

### 15) OVERTEMP ALARM AND PILOT LIGHT

The overtemperature audible alarm and pilot light are activated in the event of an overtemp condition. Once the alarm has been activated, it can only be silenced by the temperature in the chamber returning to normal or by readjusting the overtemp setpoint to a value above the chamber temperature.

### 16) ADD WATER PILOT LIGHT AND AUDIBLE ALARM

The add water pilot light and audible alarm are activated whenever the water level in the water jacket is low. The alarm will be deactivated only when approximately 1 liter of water has been added through the fill port. See Section 4.9.

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## SECTION 4 - INSTALLATION & START-UP

### 4.1 LOCATION

Locate the unit on a firm, level surface capable of supporting the unit with water (See weight specifications, Section 2.2.). The incubator should be placed in a somewhat remote area of the laboratory, away from any centrifuges, sonicators, doors, windows, and air-conditioning or heating ductwork that might produce drafts. To help prevent microbial contamination, the incubator should also be removed from areas of excessive personnel traffic.

### 4.2 PRELIMINARY DISINFECTING

Immediately prior to installing the duct sheets and the shelves, (REMOVE THE CLEAR SHIPPING PLASTIC FROM THE SHELF BRACKETS AND DUCT SHEETS) disinfect all interior surfaces (including both door gaskets) by washing them down with Roccal II (5 ml/liter) or an equivalent laboratory disinfectant. Rinse the surfaces with distilled water. Also disinfect the CO<sub>2</sub> sensor and the blower wheel, taking care not to saturate the sensor.

The duct sheets and shelves must be washed with the same disinfectant solution and rinsed with distilled water prior to their installation in the chamber. When you are satisfied that all surfaces are clean, proceed with the installation as noted.

For the complete disinfection process, refer to Sections 5.2 and 5.3 of this manual.

### 4.3 INSTALLING THE SHELF BRACKETS TO THE DUCT SHEETS

NOTE: Remove the clear plastic film from the shelf brackets and duct sheets.

- 1) Locate the plastic bag containing the 10-32 x 5/8" pan head phillips screws and wing nuts (20 each).
- 2) With the duct sheet in a vertical position, align and mount the shelf brackets to the unflanged side of the duct sheets.

NOTE: Install wing nuts on flanged side of duct sheets. Refer to the assembly drawing on the following page.

#### 4.4 INSTALLING THE DUCT SHEETS

NOTE: Left duct sheet has large notches in both the top and bottom edges. The right-hand duct sheet is notched in the top edge only.

- 1) Carefully put the right duct sheet into the incubator chamber with the flanges toward the wall.
- 2) Put the left duct sheet into the chamber, with square notch at the top and flanges toward the wall.

NOTE: Allow the top of the left-side duct sheet to lie diagonally across the chamber, resting upon the right-side duct sheet.

- 3) Hook the blower channel into the top opening of the right duct sheet. The channel should be positioned so the round opening will align with the blower when it is slid into place.
- 4) While supporting the blower channel, slide the left duct sheet up until it is vertical, making sure that the blower channel lines up into the slot on both duct sheets.

#### 4.5 INSTALLING THE SHELVES

The shelves may be placed at any level in the chamber. Slide the shelf into the shelf bracket at the desired level.

NOTE: An empty shelf must be in the top position of the incubator to obtain optimum resistance to contamination. This shelf must always remain empty.

#### 4.6 LEVELING

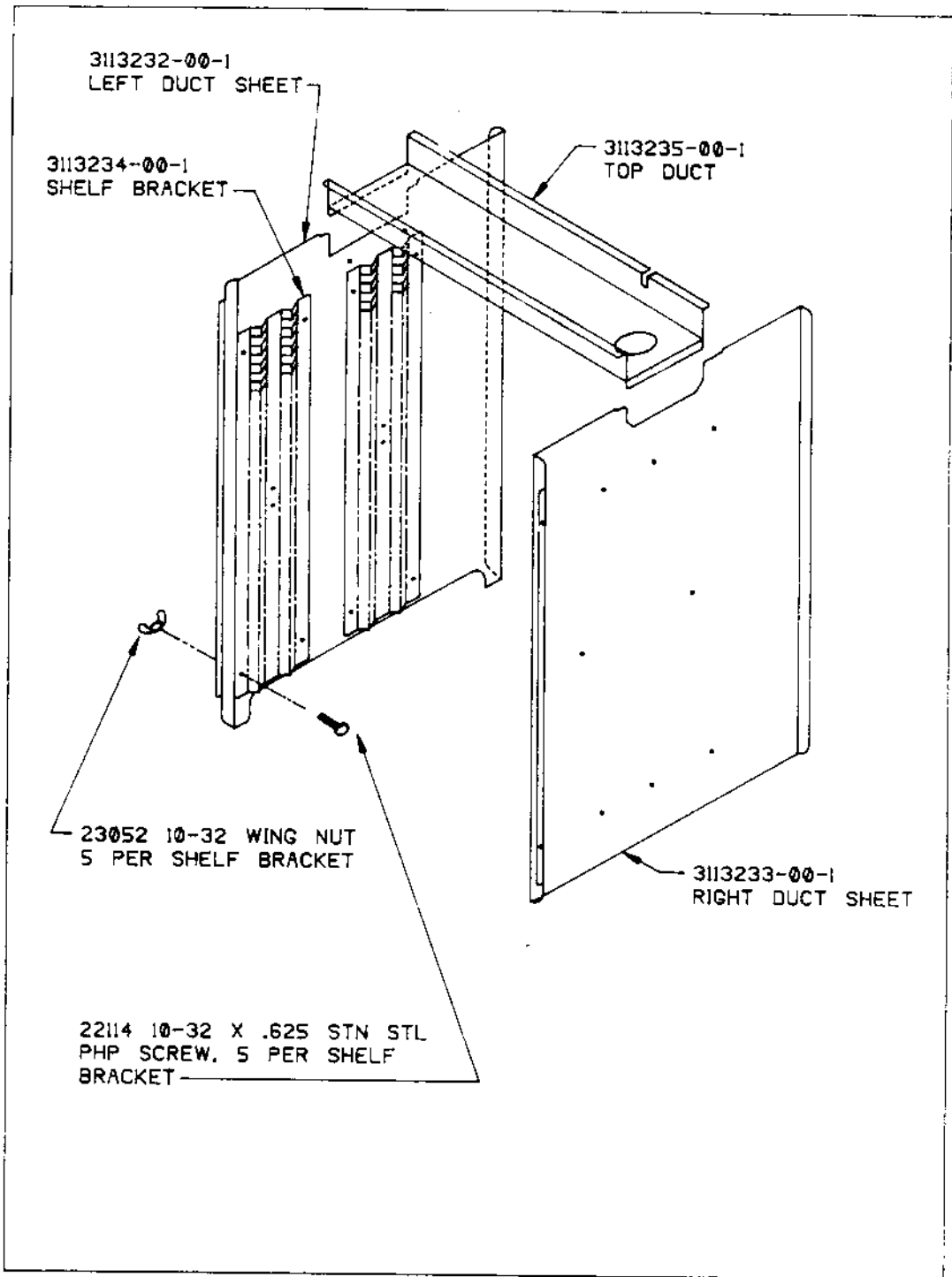
Turn leveling feet counterclockwise to extend them. Turn clockwise to shorten them. Check leveling by placing a bubble-type level on one of the shelves.

NOTE: Be sure to level the incubator before filling water jacket.

NOTE: Do not attempt to tilt the incubator unassisted.

NOTE: When tipping the incubator forward, be sure to secure the inner door and hold the outer door to prevent injury to personnel and damage to the unit.

SECTION 4 - INSTALLATION & START-UP



DUCT SHEET INSTALLATION DETAIL  
FIGURE 4-1

#### 4.7 CONNECTING TO POWER

With the incubator power switch OFF, connect the unit to an adequate power source. See Section 2.12 for specific power requirements.

NOTE: Forma recommends that the incubator be connected to a separate circuit.

#### 4.8 CONNECTING THE CO<sub>2</sub> SUPPLY

To provide for the most economical use of CO<sub>2</sub>, a main supply of liquid CO<sub>2</sub> is recommended. The liquid CO<sub>2</sub> should be supplied from tanks WITHOUT siphon tubes to ensure that only CO<sub>2</sub> gas enters the incubator injection system. It is also recommended that a two-stage pressure regulator with indicating gauges be installed at the supply cylinder outlet. The high pressure gauge should have an indicating range of 0 to 2000 PSIG to monitor tank pressure; and the low pressure gauge should have an indicating range of 0 to 30 PSIG to monitor actual input pressure to the incubator injection system. A suitable two-stage pressure regulator is available from Forma Scientific. See Section 2.2 for additional information.

The CO<sub>2</sub> source must be regulated at a pressure level of 5 to 10 PSIG. Higher pressure levels may damage the CO<sub>2</sub> system. Pressure levels lower than 5 PSI will not affect the operation of the incubator, but will increase the CO<sub>2</sub> recovery time.

##### TO CONNECT THE CO<sub>2</sub> SUPPLY:

The CO<sub>2</sub> fitting is located near the top rear of the incubator. Securely attach the vinyl CO<sub>2</sub> line to the serrated fitting, and check the connection for leaks. If a metal line is to be used, the serrated fitting can be unscrewed and the desired 1/8 MPT fitting can be added.

#### 4.9 PREPARING THE INCUBATOR FOR FILLING

CAUTION: INSTALL DUCT SHEETS (SHELF SUPPORTS) AND SHELVES BEFORE FILLING THE WATER JACKET. FILLING THE WATER JACKET DISTORTS THE CHAMBER WALLS SLIGHTLY, MAKING INSTALLATION OF DUCT SHEETS AND SHELVES MORE DIFFICULT.

NOTE: 450 mL of rust inhibitor was placed in the water jacket before the incubator was shipped. The rust inhibitor mixes with the distilled water during filling and provides a protective coating on the interior of the water jacket. DO NOT DRAIN THIS SOLUTION FROM THE WATER JACKET.

NOTE: The fill port is located on the front of the unit to facilitate filling and draining the water jacket without having to move the unit. The vent hole, adjacent to the fill port, allows the air displaced by water entering the jacket to escape. It also prevents distortion of the chamber by allowing air to escape as the unit expands and contracts during heating and cooling.

CAUTION: DO NOT PLUG VENT. A PLUGGED VENT CAN RESULT IN SERIOUS DAMAGE TO THE INCUBATOR.

The water-jacket fill-port is located behind the upper left-hand corner of the incubator outer door and is sealed with a threaded brass plug.

Remove the plug, check to see that the fill port and vent hole are clear, and install the threaded nylon fitting and vinyl tubing that were shipped with the unit. Proceed as follows:

- 1) Set the "TEMP SELECT" switch to the variable position and turn the temp control knob completely counterclockwise to keep the heater from coming on before the water jacket is filled.
- 2) Set main "POWER" switch to the "ON" position.
- 3) Push in and hold the set button on the monitor "Alarm Module", and adjust the overtemp alarm setpoint to a setting 2 or 3 degrees above the intended operating temperature (See Steps 4.12 & 4.13).
- 4) Set CO2 module power switch (toggle switch on CO2 module) to "Off" position.

CAUTION: CO2 MODULE POWER SWITCH MUST BE TURNED "OFF" WHEN MODULE IS REMOVE OR INSERTED TO PREVENT POSSIBLE DAMAGE TO CO2 AND TEMPERATURE MODULES.

- 5) Pull out "Nylatch" at bottom of CO2 module and slide CO2 module 2" to 3" out of panel.
- 6) Set alarm disable switch (at front left side of the control module PC board), temporarily to the "DISABLE" position to silence the CO2 alarm.

- 7) Push CO2 module back into position in panel and set CO2 module power switch to ON.

#### 4. 10 FILLING THE WATER JACKET

NOTE: Purity of the distilled water used in the water jacket and humidifier must be within the 50K ohm to 1 Meg Ohm, (1 Micromho to 20 Micromhos) range to protect, and prolong the life of the stainless steel water jacket. Use of tap water, or distilled water outside the specified range, will decrease the operating life of the unit and negate the warranty.

- 1) To prevent mineral buildup and minimize corrosion, use 50K Ohm to 1 Meg Ohm distilled water to fill the water jacket.
- 2) To restrict fungal and bacterial growth, add 2.65 mL of ROCCAL II to the water jacket water during filling.
- 3) Thread the port plug into the port until "finger tight" and below face of incubator. Use only the threaded plug provided with the unit to close the fill port. Use of any other plug could damage the port or door gasket.

NOTE: Forma recommends that 10%-Roccal II be added to the water in the water jacket at a dilution of 1:15,000 (2.65 mL/water jacket) to prevent the growth of fungi and bacteria.

CAUTION: MAKE SURE DUCT SHEETS (SHELF SUPPORTS) AND SHELVES ARE INSTALLED IN CHAMBER BEFORE FILLING THE WATER JACKET. AFTER WATER JACKET IS FILLED, DISTORTION OF CHAMBER WALLS MAKES PROPER INSTALLATION OF DUCT SHEETS AND SHELVES DIFFICULT.

#### FUNNEL METHOD

NOTE: All hardware (fittings, tubing, funnel, etc.) necessary for filling are contained in the accessories bag included with each incubator.

- 1) Fit funnel into one end of large vinyl tubing provided in kit packed with unit.
- 2) Remove plug from fill port and thread nylon fitting (either straight or right-angle) into port.
- 3) Attach free end of funnel tubing to fitting in fill port.
- 4) Hold funnel above level of fill port and pour water into funnel only until the "ADD WATER" alarm and light are silenced.



NOTE: The water jacket holds almost 40 Liters of water. It takes about 45 minutes to fill.

- 5) After "ADD-WATER" alarm and light are silenced, add one additional liter of distilled water to water jacket.

CAUTION: DO NOT ADD MORE THAN ONE LITER OF WATER AFTER "ADD WATER" ALARM STOPS. OVERFILLING WATER JACKET MAY CAUSE DISTORTION OF INCUBATOR CHAMBER WALLS, MAKING SHELF REMOVAL AND INSERTION DIFFICULT.

- 6) Remove fitting and tubing and install brass plug in fill port. Thread plug into port until end is flush with cabinet surface.

#### TAP FILL METHOD

NOTE: The fittings necessary for filling are contained in the accessories bag included with each incubator. The kit contains six feet of 1/4 inch vinyl tubing, if the distilled water outlet is more than six feet from the incubator, more tubing, and a connector will be required.

NOTE: Purity of the distilled water used in the water jacket and humidifier must be within the 50K ohm to 1 Meg Ohm, (1 Micromho to 20 Micromhos) range to protect, and prolong the life of the stainless steel water jacket. Use of tap water, or distilled water outside the specified range, will decrease the operating life of the unit and negate the warranty.

CAUTION: MAKE CERTAIN THAT THE WATER JACKET VENT HOLE ADJACENT TO THE FILL-PORT IS NOT PLUGGED. VENT MUST BE OPEN AT ALL TIMES TO PERMIT EXPANDING AIR TO ESCAPE, OR DAMAGE TO INCUBATOR WILL RESULT.

- 1) Remove brass plug from fill port and thread serrated nylon fitting (either straight or right-angle) from accessory bag into port.
- 2) Connect tubing between fitting and distilled water tap.
- 3) Open tap until water flows steadily into water jacket.

CAUTION: A HIGH RATE OF FLOW AND HIGH PRESSURE CAN CAUSE DISTORTION TO INCUBATOR CHAMBER WALLS.

- 4) Turn water off immediately when the "ADD WATER" alarm and light are deactivated.

CAUTION: DO NOT OVERFILL THE WATER-JACKET. OVERFILLING MAY RESULT IN DISTORTION OF THE INCUBATOR CHAMBER WALLS.

- 5) Replace the tap tubing with funnel and tubing, and add, by hand, one additional liter of water to the water jacket.
- 6) Remove hose and fitting and install brass plug into port until end is flush with cabinet.

#### 4.11 FILLING THE HUMIDITY RESERVOIR OR PAN

CAUTION: DO NOT USE PLASTIC PANS FOR HUMIDIFICATION AS THEY WILL HAVE AN UNPREDICATABLE EFFECT ON HUMIDITY AND CO<sub>2</sub> LEVELS IN THE INCUBATOR. USE ONLY THE FLOOR OF THE UNIT OR THE OPTIONAL STAINLESS STEEL HUMIDITY PAN.

NOTE: Either of the following may be added to the water to retard the growth of contaminants:

- A) Roccal II 10%, 10 ml
- B) 1% Sodium Dodecyl Sulfate (SDS)

CAUTION: THE ADDITION OF ROCCAL II OR SDS (SODIUM DODECYL SULFATE) TO THE WATER IN THE HUMIDITY RESERVOIR MAY NOT BE APPROPRIATE FOR CERTAIN APPLICATIONS (e.g., In-vitro fertilization). CONSULT A BIOLOGICAL SAFETY OFFICER OR EQUIVALENT AUTHORITY CONCERNING THE SUITABILITY OF ROCCAL II OR SDS TO YOUR APPLICATION.

WARNING: DO NOT USE SODIUM AZIDE AS AN ANTIMICROBIAL AGENT IN THE HUMIDITY RESERVOIR OR PAN AS IT FORMS A METALLIC AZIDE WHICH MAY EXPLODE WHEN EXPOSED TO PRESSURE.

CAUTION: DO NOT USE DEMINERALIZED OR DEIONIZED WATER IN THE HUMIDITY RESERVOIR OR PAN UNLESS IT HAS BEEN BOILED IMMEDIATELY PRIOR TO USE, AS IT MAY BE CONTAMINATED WITH BACTERIA.

There are two methods of providing elevated humidity in the chamber:

- 1) The reservoir in the bottom of the incubator can be filled with at least 3/4" of sterile, distilled (5K ohm to 1 Megohm) water
- 2) The optional humidity pan (Forma Stock #237001) can be filled to the fill line with sterile, distilled (5K ohm to 1 Megohm) water.

NOTE: The humidity pan may be placed either on the floor, or installed in the bottom set of shelf brackets. The best humidity and temperature response are obtained when the humidity pan is set directly on the incubator floor.

CAUTION: WHEN INSTALLING THE HUMIDITY PAN, USE CARE TO AVOID DAMAGING THE INNER DOOR GASKET.

The water level in the humidity reservoir or pan should be checked frequently. The water should be changed, and ROCCAL II added (7.5 ml), once a week to help prevent microbial contamination. It is very important that the water level in the reservoir or pan be kept relatively constant, as extreme fluctuations or "dry-outs" will effect the humidity level and CO2 control in the chamber.

#### 4.12 SETTING THE CHAMBER TEMPERATURE

Before the initial temperature setting is made, push in on the "PUSH TO SET" button on the alarm monitor module, and using the screwdriver on the control panel, turn the overtemp set screw until the display shows a temperature that is 2 degrees above the desired operating setpoint. The overtemp safety may be reset after the chamber temperature has stabilized at setpoint. (See Section 4.13)

If a chamber temperature of 37 degrees C is desired, set the Variable/37C switch to the 37C position.

If a value other than 37C is desired, set the switch to the Variable position, and set the temperature control knob to the desired setpoint. Any temperature, from 5 degrees C above ambient to 50 degrees C, may be selected.

#### 4.13 SETTING THE OVERTEMP SAFETY THERMOSTAT

Once the chamber temperature has stabilized (as indicated by the digital display), the overtemp safety should be set as follows:

- 1) Push in on the "PUSH TO SET" button on the alarm monitor module.
- 2) Using the screwdriver mounted on the control panel, turn the set screw until the desired overtemp alarm point is shown on the digital display. The overtemp setpoint can be set within 0.1 degree of operating setpoint, but it is recommended that it not be set within 0.5 of

NOTE: The overtemp safety should be checked quarterly to insure proper operation. To check the overtemp control, push in on the Push to Set button on the alarm monitor module, and turn the set screw counterclockwise until the overtemp safety light and audible alarm are activated. Reset the overtemp safety after the test.

#### 4.14 ZEROING THE CO2 CONTROLLER

IMPORTANT! This adjustment is made using the CO2 gas content of ambient air (0.03%), the most accurate standard available. NEVER USE A FYRITE OR OTHER ANALYZER FOR THIS ADJUSTMENT. The adjustment must be made on initial start-up, and it must also be made if a change in the humidification of the incubator is required.

##### TOOLS REQUIRED:

- 1) Calibration screwdriver (provided on the control panel).
- 2) Fyrite CO2 Analyzer (use only for checking) or other CO2 measuring device.

STEP 1: STABILIZE THE INCUBATOR AT THE OPERATING TEMPERATURE AND HUMIDITY WITH NO CO2 IN THE INTERIOR CHAMBER.

- 1.1 Turn off the CO2 at the supply.
- 1.2 Fill the humidity reservoir or pan.
- 1.3 Allow the incubator temperature and humidity to stabilize. This will take a minimum of 8 hours, but on initial start-up allow 3 days.

STEP 2: ADJUST THE ZERO SET POT

- 2.1 Using the small screwdriver mounted on the control panel, adjust the CO2 control zero pot to read 00.0 on the digital display. Wait 5 minutes. Repeat as necessary until the display is stable.
- 2.2 Turn on the CO2 at the supply.

2.3 Turn the CO2 setpoint to the desired %.

STEP 3 (Optional): CHECK CO2 AT THE DESIRED SETPOINT

- 3.1 Allow the incubator to reach setpoint and control (inject light will cycle) for a minimum of 30 minutes.
- 3.2 Check the CO2 level with a Fyrite until two consecutive readings agree. If the Fyrite and display are not within plus or minus 1.0%, consult the factory. See Section 3.9 for correct FYRITE sampling procedure.

NOTE: After proper zeroing, the CO2 display will be more accurate than the FYRITE, because the zero adjustment was accomplished using absolute atmospheric conditions.

4.15 SETTING THE CO2 CONTENT

The following conditions must be satisfied before the CO2 percentage can be set:

- 1) Allow the chamber temperature and humidity to stabilize. For initial settings of CO2, it is recommended that the temperature and humidity be allowed to stabilize for 72 hours.
- 2) Check the CO2 control zero (See Section 4.14 for detailed instructions).

NOTE: To set the CO2 percentage, press the CO2 Set/Silence button, and rotate the CO2 set screw until the desired percentage appears on the digital display.

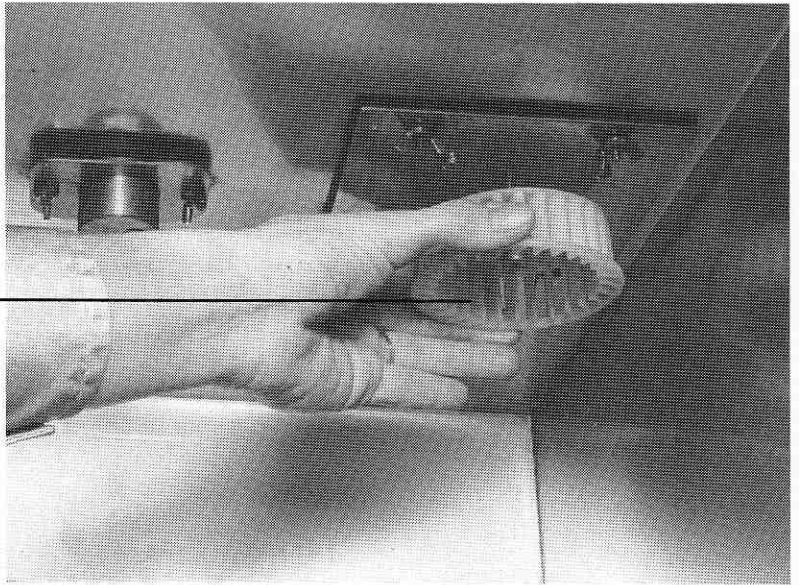
NOTE: If the unit is in overtemp and a CO2 injection occurs, a high CO2 reading will appear briefly on the digital display due to the shut down of the internal fan during overtemp. The high CO2 percentage occurs only at the sensor. Average CO2 in the chamber will remain normal.

**SECTION 5 - ROUTINE MAINTENANCE  
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- 5.1 Using the Blower Wheel Exchange Kit
- 5.2 Disinfecting the Incubator Interior
- 5.3 Cleaning the Cabinet Exterior
- 5.4 Draining the Water Jacket
- 5.5 Changing the CO<sub>2</sub> Filter
- 5.6 A Word About CO<sub>2</sub> Test Instruments
- 5.7 Overview of the Fyrite CO<sub>2</sub> Analyzer
- 5.8 Fyrite Operating Precautions
- 5.9 Operating the Fyrite
- 5.10 Checking the Fyrite Fluid Strength
- 5.11 Raising or Lowering the Fyrite Fluid Level

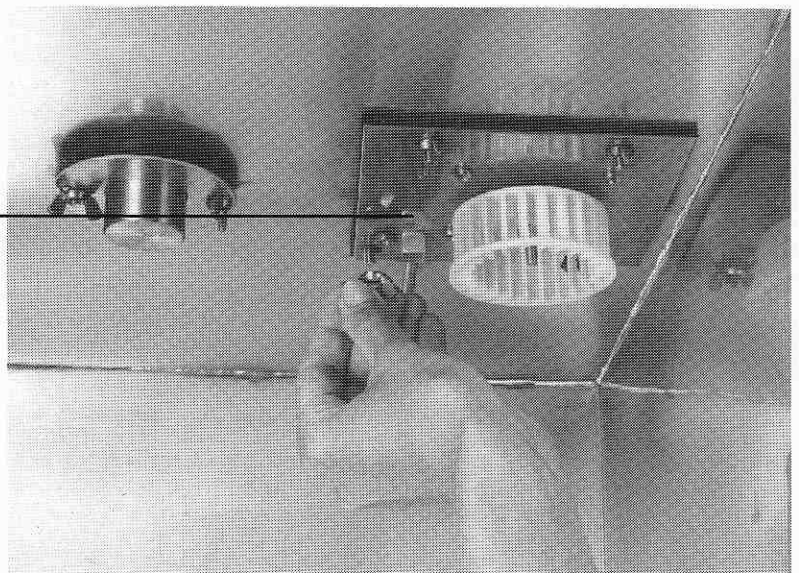
## 5.1 USING THE BLOWER WHEEL REPLACEMENT KIT

**BLOWER WHEEL**



- 1) Disconnect the incubator from the power supply.
- 2) Remove the shelves and duct sheets.
- 3) Remove and discard the blower wheel. To remove the blower wheel, grasp it as shown and pull down firmly.

**MOTOR MOUNTING PLATE**



- 4) Remove the four wing nuts holding the motor mounting plate in place. Hold the plate so the plate/motor assembly does not drop into the incubator.
- 5) Ease the plate/motor assembly into the incubator chamber.
- 6) Release the electrical connector by squeezing the connector's sides.
- 7) Disconnect the plastic tubings attached to the motor mounting plate.

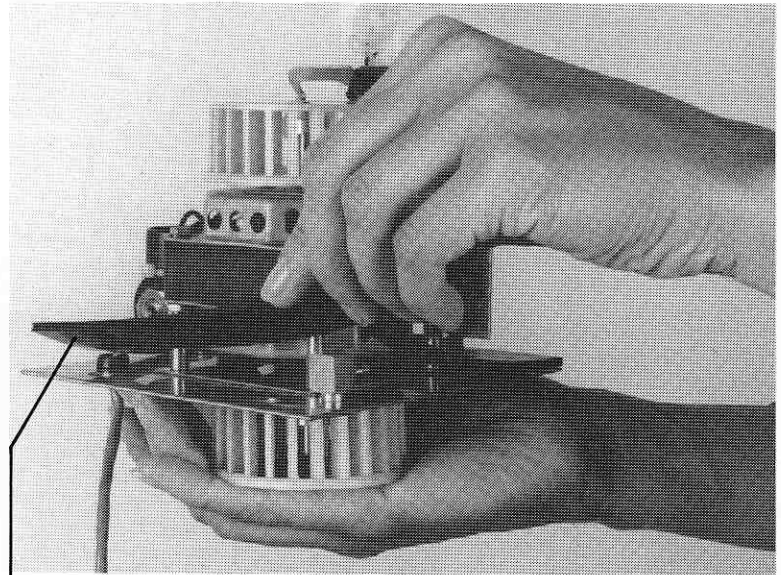
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- 8) Remove and discard the motor mounting plate gasket. Replace the gasket using the one provided in the kit.
- 9) To replace the plate/motor assembly, reverse steps 4-7 (connect tubing, connect electrical connector, ease motor into motor well, replace motor mounting plate).

**IMPORTANT: TUBING MUST FIT TIGHTLY ON CONNECTIONS UPON REINSTALLATION.**

THE MOTOR MOUNTING PLATE GASKET MUST LIE FLAT BETWEEN THE PLATE AND CHAMBER WALL. TIGHTEN THE WING NUTS FIRMLY TO ENSURE A SEAL BETWEEN THE PLATE AND CHAMBER.

THE MOTOR MOUNTING PLATE GASKET MUST BE INSTALLED FOR PROPER INCUBATOR OPERATION.



**MOTOR MOUNTING GASKET**

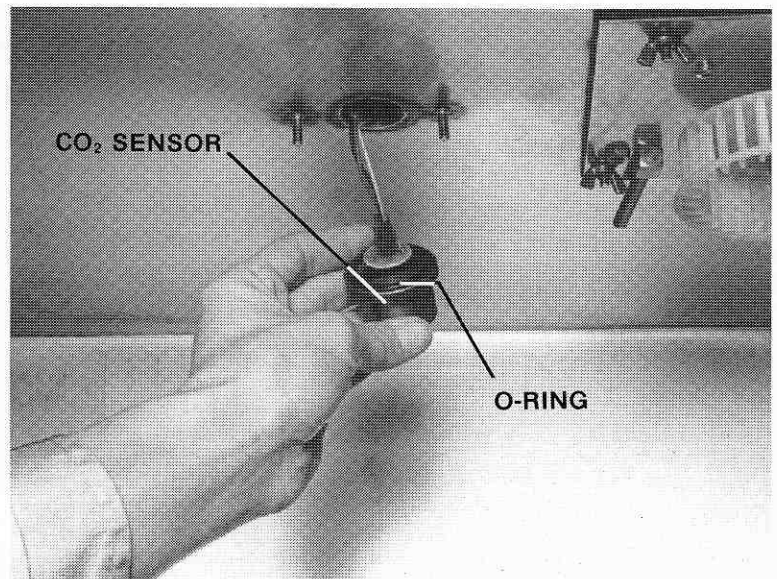
- 10) Replace the blower wheel using the one provided in the kit. Confirm that the wheel moves freely.

THE FOLLOWING STEPS APPLY TO AUTOMATIC CO<sub>2</sub> AND AUTOMATIC O<sub>2</sub>/CO<sub>2</sub> INCUBATORS. FOR CONSTANT FLOW INCUBATORS, SKIP TO STEP 15.

- 11) Remove the wing nuts securing the CO<sub>2</sub> sensor, and allow the sensor to drop down into the chamber. The sensor should not be pulled sharply, or damage to the wire may result. Disconnect the sensor.
- 12) Peel the o-ring off the sensor and replace it with the one provided in the kit. Discard the old o-ring.
- 13) Disinfect the sensor, taking care not to saturate it or leave a residue. Reconnect the sensor.

**NOTE:** Refer to Section 4.5 in the 3159/3327 Technical Manual for information concerning disinfection of the oxygen sensor.

- 14) Push the wires back into the opening, and reinstall the sensor. Be sure to tighten the wing nuts securely so the o-ring will seal properly.
- 15) Reinstall the incubator's shelves and duct sheets. Reconnect the incubator to the power supply.





## SECTION 5 - ROUTINE MAINTENANCE

### 5.2 DISINFECTING THE INCUBATOR INTERIOR

The incubator can be easily disinfected in about 30 minutes. Forma recommends the use of Roccal II 5 ml/l. Dilute with distilled water.

- 1) Remove the shelves and duct sheets, and clean all interior surfaces, taking care not to saturate the CO2 sensor.
- 2) Rinse the surfaces at least twice with distilled water.
- 3) Thoroughly clean the door gasket. It may be necessary to lift up the edge of the gasket.
- 4) Clean the inside of the glass door with the solution, and rinse with distilled water.
- 5) Wash or autoclave the shelves and duct sheets with the solution.
- 6) If desired, all surfaces can then be rubbed or sprayed with 70% alcohol.
- 7) Reinstall the duct sheets and shelves (See Sections 4.3 and 4.4).

WARNING: ALCOHOL, EVEN A 70% SOLUTION, IS VOLATILE AND FLAMMABLE. USE IT ONLY IN A WELL VENTILATED AREA THAT IS FREE FROM OPEN FLAME. IF ANY COMPONENT IS CLEANED WITH ALCOHOL, DO NOT EXPOSE THE COMPONENT TO OPEN FLAME OR OTHER POSSIBLE HAZARD.

WARNING: DO NOT USE STRONG ALKALINE OR CAUSTIC AGENTS. STAINLESS STEEL IS CORROSION RESISTANT, NOT CORROSION PROOF.

WARNING: DO NOT USE SOLUTIONS OF SODIUM HYPOCHLORITE (PUREX, CLOROX, ETC.), AS THEY MAY CAUSE PITTING AND RUST.

### 5.3 CLEANING THE CABINET EXTERIOR

The incubator exterior may be cleaned with soap and water and a general use laboratory disinfectant. Information about disinfectants recommended by Forma Scientific is included as a supplement to this manual.

### 5.4 DRAINING THE WATER JACKET

For best results, the water in the water jacket should be changed yearly.

- 1) Disconnect the unit from the power supply.
- 2) Remove the cap from the fill port, and attach the threaded fitting, vinyl tubing, and the funnel.
- 3) Prime the water line by holding the tubing straight up and pouring water slowly into the funnel until the tubing is completely filled.
- 4) Quickly drop the water line to a drain or large bucket. If the tube has been filled correctly, the water should siphon out of the jacket.
- 5) See Section 4.9 to fill the water jacket.

### 5.5 CHANGING THE CO<sub>2</sub> FILTER (FOR QUALIFIED SERVICE PERSONNEL ONLY!)

NOTE: Under conditions of normal useage, and dependent on the purity of gas being used, the CO<sub>2</sub> filter should be good for approximately five years.

If the CO<sub>2</sub> filter becomes clogged, it is easy to replace with Forma stock #770001.

- 1) Disconnect the unit from the power supply.
- 2) Turn the two 1/4 turn fasteners on the control panel, grasp the CO<sub>2</sub> sample port, and slide the control panel out.
- 3) Locate the CO<sub>2</sub> filter at the back of the control panel.
- 4) Remove and replace the filter.

## 5.6 A WORD ABOUT CO2 TEST INSTRUMENTS

During the course of our research into the use of Forma Automatic CO2 incubators, we discovered that the best standard available for zeroing or calibrating our CO2 controller is air, which typically contains 0.033% CO2 by volume. Variations from this figure are insignificant.

As previously noted, it is extremely important that any Forma automatic CO2 incubator be zeroed to air (See Section 4.13). CO2 TEST INSTRUMENTS SHOULD BE USED AS A SECONDARY CHECK OR TO CHECK CO2 AT OPERATING LEVELS ONLY!

Because sampling technique is so important to the effective use of CO2 test instruments, we have included information in this manual on the use of the most commonly used test instrument, the Fyrite. REMEMBER THAT THE FYRITE SHOULD BE USED FOR CHECKING PURPOSES ONLY; NOT FOR THE ACTUAL ZEROING OF FORMA EQUIPMENT!

## 5.7 OVERVIEW OF THE FYRITE CO2 ANALYZER

Many of our customers use Fyrite CO2 Analyzers as an independent means of checking the CO2 level in their incubators. We do not want to discourage this practice, but we feel that the safe and correct use of this test instrument is of vital importance to us. In an effort to inform our customers about the use of the Fyrite, we have compiled the following hints and instructions from the Fyrite instruction manual 11-9026, dated January, 1980.

**WARNING:** THE FLUID USED IN THE FYRITE CO2 ANALYZER CONTAINS POTASSIUM HYDROXIDE AND IS CORROSIVE. IT CONTAINS POISONOUS CHEMICALS AND SHOULD NOT BE TAKEN INTERNALLY. IN THE EVENT OF BODY CONTACT:

### ANTIDOTES

**EXTERNAL:** FLOOD WITH WATER, THEN WASH WITH VINEGAR.

**INTERNAL:** GIVE VINEGAR, OR JUICE OF LEMON, GRAPEFRUIT, OR ORANGE COPIOUSLY. FOLLOW WITH OLIVE OIL.

**EYES:** FLOOD WITH WATER, THEN WASH WITH A 5% BORIC ACID SOLUTION.

CALL PHYSICIAN

## 5.8 FYRITE OPERATING PRECAUTIONS

- 1) DO NOT invert the Fyrite when the plunger is depressed.
- 2) DO NOT hold the Fyrite near your face when the top plunger is depressed.
- 3) ALWAYS hold the FYRITE by the fins to prevent heat transfer from your hands.
- 4) ALWAYS moisten the filter in the sampling tube before taking a sample. Failure to do so will result in inaccurate readings.
- 5) For maximum accuracy, the FYRITE MUST be at ambient temperature. DO NOT store the FYRITE in a location subject to extreme temperatures (such as the trunk of a car or a window sill).
- 6) Check the strength of the FYRITE fluid whenever the instrument is used. See Section 5.10 for instructions on checking the fluid strength.

## 5.9 OPERATING THE FYRITE

- 1) Hold the FYRITE upright and away from your face. Press the plunger momentarily to vent the tester.
- 2) Invert the FYRITE to drain the fluid into the top.
- 3) Turn the FYRITE upright, and allow the fluid to drain to the bottom.
- 4) Hold the FYRITE at eye level. Loosen the locknut at the rear of the scale. Slide the scale until the top of the fluid column lines up with the zero on the scale. Tighten the locknut.

NOTE: Either the top or the bottom of the meniscus can be used for setting the zero as long as the same point is used when making measurements.

- 5) Attach the open end of the rubber gas sampler hose to the sample port on the incubator. DO NOT attach the tube to the FYRITE tester at this time. Pump the aspirator bulb a few times to clear the air from the sampler line.
- 6) Hold the FYRITE upright, and place the rubber connector tip from the sampler tube over the plunger valve, and pump the aspirator bulb at least 18 times. With the bulb still deflated, release the plunger valve during the final squeeze.

- 7) Invert the FYRITE, and allow all the liquid to drain to the top. Turn upright, and allow all the liquid to drain to the bottom. Repeat once.
- 8) Momentarily hold the FYRITE at a 45 degree angle to allow the fluid droplets to drain to the bottom.
- 9) Hold the FYRITE upright. Allow the fluid a few seconds to stabilize. Determine the percent CO<sub>2</sub> from the level of the fluid column. A delay of 5 to 10 seconds in taking the reading may result in a slight error; a longer delay may result in a substantial error.
- 10) Repeat steps 6 through 10 until two consecutive readings agree.
- 11) Remove the FYRITE hose from the sample port to allow the chamber to breathe.

NOTE: When used correctly, the FYRITE is only accurate to within  $\pm 1/2\%$  of actual CO<sub>2</sub> value. Incorrect sampling technique can cause an error of as much as 4%.

#### 5.10 CHECKING THE FYRITE FLUID STRENGTH

After taking a reading with the FYRITE, do not vent the sample. Invert the FYRITE again, and take another reading. If there is an increase of  $1/2\%$  or more on the second reading, fluid replacement is necessary.

Fluid strength can also be checked by testing a certified gas sample containing a known CO<sub>2</sub> concentration. Fresh FYRITE fluid should be good for approximately 350 samples.

NOTE: The dark red fluid floating on the top of the FYRITE solution is normal. It has been added to the solution to prevent excessive foaming at the meniscus and does not indicate defective fluid.

CAUTION: IF REPLACEMENT OF THE FLUID IS NECESSARY, CAREFULLY FOLLOW THE DIRECTIONS ON THE PACKAGE. REMEMBER THAT THE FLUID IS POISONOUS AND CAUSTIC.

## 5. 11 RAISING OR LOWERING THE FYRITE FLUID LEVEL

With the FYRITE vented and in the vertical position, it should be possible to adjust the zero scale to the top of the fluid column. If this is not possible, fluid should be added or removed.

TO ADD FLUID: Hold the FYRITE upright, and press the plunger. Add clean tap water a few drops at a time.

TO REMOVE FLUID: See your FYRITE manual.

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- 6.2C CO2 Module Troubleshooting
- 6.3 CO2 Control Calibration
- 6.4 37C Control Calibration
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- 6.16 Replacing the Blower Motor

CAUTION: SERVICING OF THE UNIT SHOULD BE PERFORMED BY  
QUALIFIED SERVICE PERSONNEL ONLY.

SECTION 6 - SERVICE

6.1 GENERAL TROUBLESHOOTING

PROBLEM 1: PILOT LIGHTS NOT ON. READOUTS ARE DARK  
CO2 POWER SWITCH IS ON

POSSIBLE CAUSES: a. Unit unplugged.  
b. Circuit breaker tripped.  
c. Outlet overload protection  
has tripped (blown).  
d. No voltage at outlet.  
e. Defective incubator wiring.  
f. Main power switch not on.

=====

PROBLEM 2: POWER PILOTT LIGHT ON BUT HEAT LIGHT AND  
ALARM MONITOR MODULE LIGHTS OUT

POSSIBLE CAUSE: a. 0.3 Amp fuse in control panel  
is blown.

=====

PROBLEM 3: CO2 SYSTEM INDICATOR AND READOUT ARE DARK.  
NO CONTROL OF CO2 IN CHAMBER.  
SWITCH IS ON.

POSSIBLE CAUSES: a. Circuit breaker tripped.  
b. Defective switch or wiring.  
c. Defective CO2 module.

=====

PROBLEM 4: CO2 SETPOINT AND DISPLAY AGREE.  
FYRITE READS LOWER.

POSSIBLE CAUSES: a. Fyrite not zeroed.  
b. Wool filter in Fyrite is dry.  
c. Fluid in Fyrite needs to be  
changed.  
d. Chamber absolute humidity has  
decreased.  
e. Control is incorrectly zeroed.  
f. Defective CO2 sensor or control.

=====



SECTION 6 - SERVICE

PROBLEM 5: ALARM SOUNDS PERIODICALLY, EVEN WITH THE  
ALARM DISABLED.  
CO2 ALARM LIGHT NOT ACTIVATED.

- POSSIBLE CAUSES:
- a. Overtemp control set too low.
  - b. Defective temperature control or sensor.
  - c. Shorted heater.

=====

PROBLEM 6: CO2 ALARM AND LIGHT ARE ACTIVATED.  
ALARM CAN BE RESET OR DISABLED.  
IF RESET, ALARM ACTIVATES AGAIN

- POSSIBLE CAUSES:
- a. CO2 level has deviated more than 1% from setpoint.
  - b. CO2 supply has been interrupted.
  - c. CO2 inject circuit is defective.
  - d. Defective CO2 solenoid.
  - e. Defective CO2 sensor fan.

=====

PROBLEM 7: DIGITAL CO2 DISPLAY AND FYRITE READ  
MORE THAN 1% DIFFERENT FROM SETPOINT.  
CO2 ALARM NOT ACTIVATED.

- POSSIBLE CAUSES:
- a. Alarm is disabled.
  - b. Defective alarm circuit.
  - c. Defective CO2 sampler or control.

=====

PROBLEM 8: CO2 DISPLAY AND FYRITE READ 0% CO2.  
SETPOINT IS OK.  
CO2 ALARM IS ACTIVATED.  
CO2 INJECT LIGHT IS ON.

- POSSIBLE CAUSES:
- a. Loss of CO2 supply.
  - b. Defective CO2 solenoid.
  - c. Clogged CO2 in-line filter.

=====

SECTION 6 - SERVICE

PROBLEM 9: CO2 DISPLAY SHOWS SOME RANDOM NUMBER OR DECIMAL POINT.

POSSIBLE CAUSES: a. Defective readout board.  
b. Defective output to readout board from CO2 control.  
c. Faulty interconnecting wiring.

=====

PROBLEM 10: CO2 DISPLAY WILL NOT GO TO ZERO NO MATTER HOW LONG THE DOOR IS LEFT OPEN.

POSSIBLE CAUSES: a. Improper procedure. Close door, allow temperature and rh to stabilize (8 hours).  
b. Defective CO2 sensor.  
c. Defective CO2 control.

=====

PROBLEM 11: DISPLAY FLICKERS BADLY OR COUNTS UP AND DOWN 3 OR 4 DIGITS.

POSSIBLE CAUSES: a. Defective readout board.  
b. Excessive electrical interference near the cabinet.  
c. Faulty grounding circuit.  
d. Sampler blower is improperly installed or defective.

=====

PROBLEM 12: CO2 SETPOINT CANNOT BE CHANGED.

POSSIBLE CAUSE: a. Defective CO2 control.

=====

PROBLEM 13: UNIT CANNOT BE ZEROED

POSSIBLE CAUSES: a. Defective CO2 pot.  
b. Defective zero control.  
c. Defective CO2 sensor.

=====

SECTION 6 - SERVICE

PROBLEM 14: CO2 OVERSHOOTS BADLY.

POSSIBLE CAUSES: a. Inoperative CO2 sampler  
blower.  
b. Defective CO2 control.  
c. CO2 inlet pressure too high.  
d. Unit in overtemp.

=====

PROBLEM 15: ACTUAL CO2 IS HIGHER THAN SETPOINT AND  
READOUT.  
RE-ZERDING HELPS FOR A TIME, THEN SYMPTOMS  
RETURN.

POSSIBLE CAUSES: a. Defective CO2 sensor.  
b. Incorrect calibration of  
CO2 control.

=====

PROBLEM 16: CO2 ALARM SOUNDS WHILE CO2 LEVEL IS  
CONTROLLING AT SETPOINT.

POSSIBLE CAUSES: a. Excessive RFI or EMI near unit.  
b. Faulty grounding circuit.  
c. Defective CO2 control.

=====

PROBLEM 17: CO2 SETPOINT CHANGES BY ITSELF.

POSSIBLE CAUSES: a. Faulty set pot.  
b. Defective CO2 control.

## SECTION 6 - SERVICE

### 6.2 USE OF THE TROUBLESHOOTING FLOW CHARTS

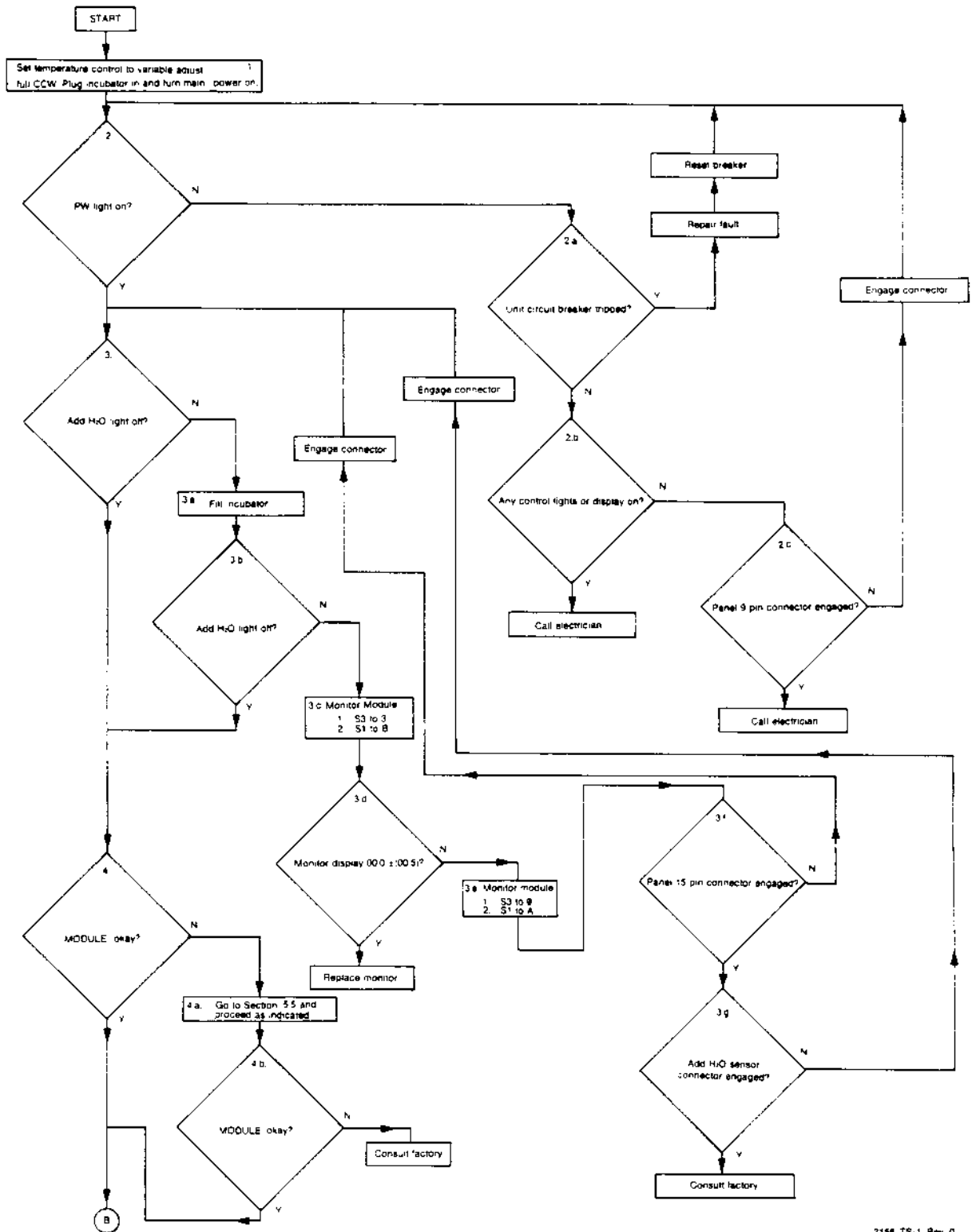
Follow the instructions on the flow charts to diagnose problems with the incubator electrical system and/or the CO<sub>2</sub> and alarm modules. For this diagnostic aid to be effective, all checks must be made in the sequence indicated by the flow chart, and all data must be carefully recorded.

The following two flow charts are for troubleshooting the incubator in general.

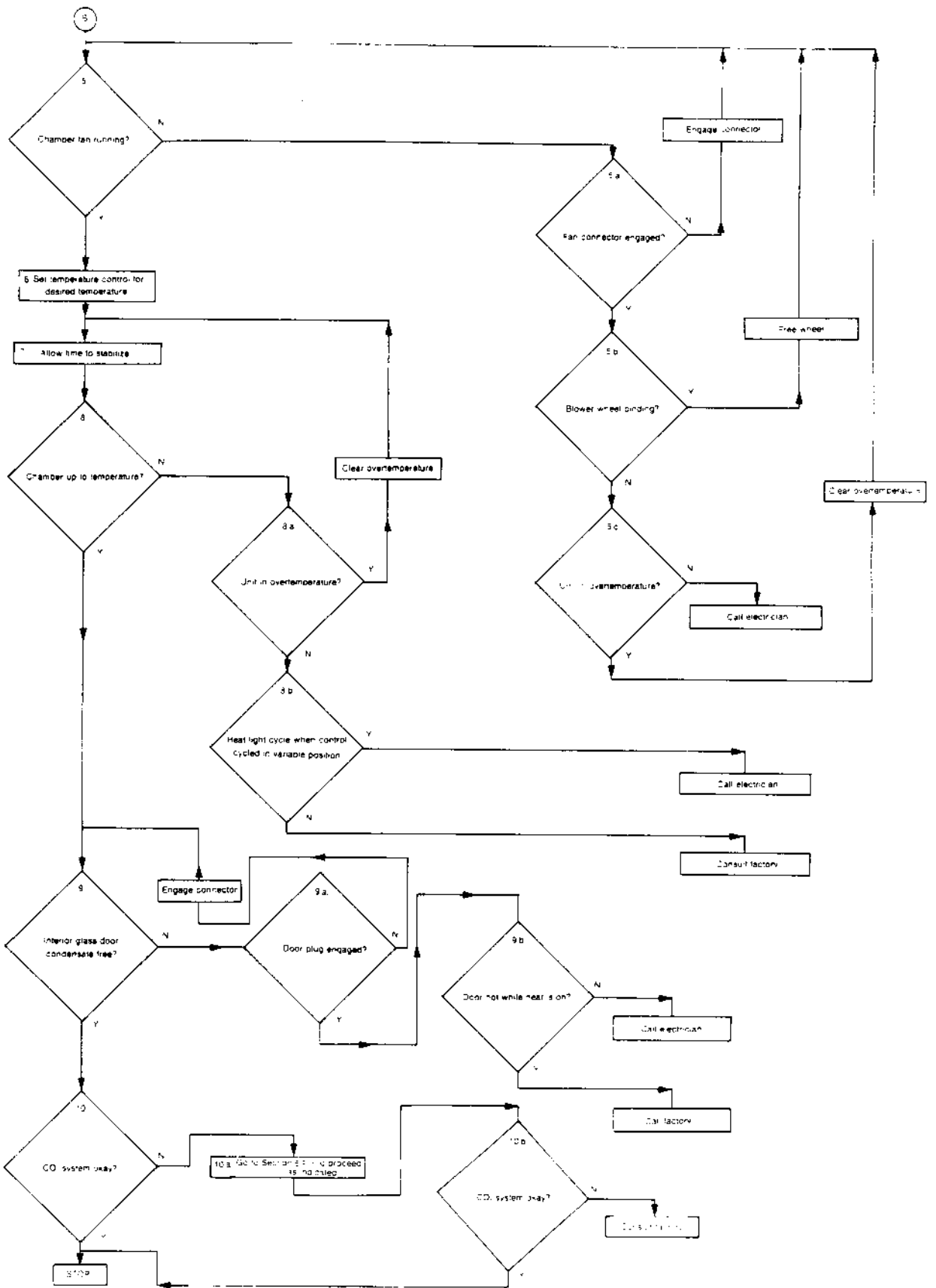
Y = Yes      N = No

# GENERAL TROUBLESHOOTING FLOWCHART

NOTE: Y = YES  
N = NO



3156-TS-1 Rev 0



## SECTION 6 - SERVICE

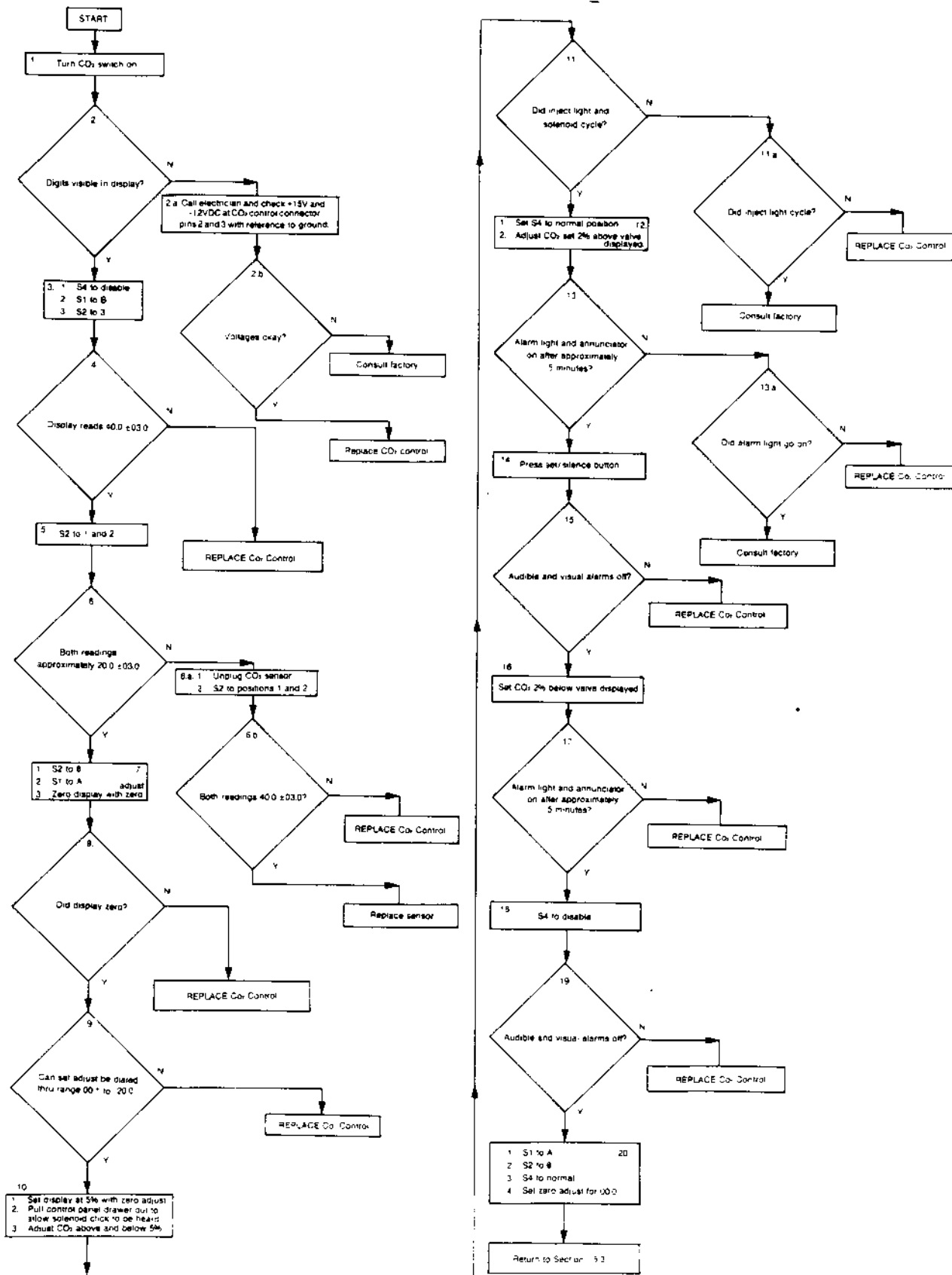
### 6.2B CO2 MODULE TROUBLESHOOTING - GENERAL NOTES

- NOTE 1: Before removing the CO2 control module from the unit, turn the power to that module off.
- NOTE 2: At various times during this procedure the CO2 alarm may sound. Unless otherwise noted in the procedure, the alarm may be silenced by pressing the alarm silence switch.
- NOTE 3: Unless otherwise noted in the procedure, the module referred to is the CO2 module, and the switches referred to are located on the CO2 module.
- NOTE 4: Switch locations for the CO2 module are labeled on the module picture.
- NOTE 5: The chamber temperature is stable when the monitor display indicates the interior heater is cycling.
- NOTE 6: Less than 4 hours is insufficient time for calibration, but is adequate for this test.
- NOTE 7: Recalibration of the control may be necessary if replacement is required.
- NOTE 8: When the chart calls for contacting an electrician, your in-house electrical technician should be called.
- NOTE 9: Y = Yes, N = No

# CO<sub>2</sub> MODULE TROUBLESHOOTING FLOWCHART

Note: Before using this flow diagram, it is important that the calibration of the CO<sub>2</sub> system has been checked first. This flow chart is to help diagnose problems that may occur other than calibration. It will be necessary to check the calibration of the CO<sub>2</sub> system after using this procedure. Turn CO<sub>2</sub> off at supply, and air out cabinet for 2 minutes. Allow approximately 30 minutes for R/H to recover for this procedure.

NOTE: Y=YES  
N=NO



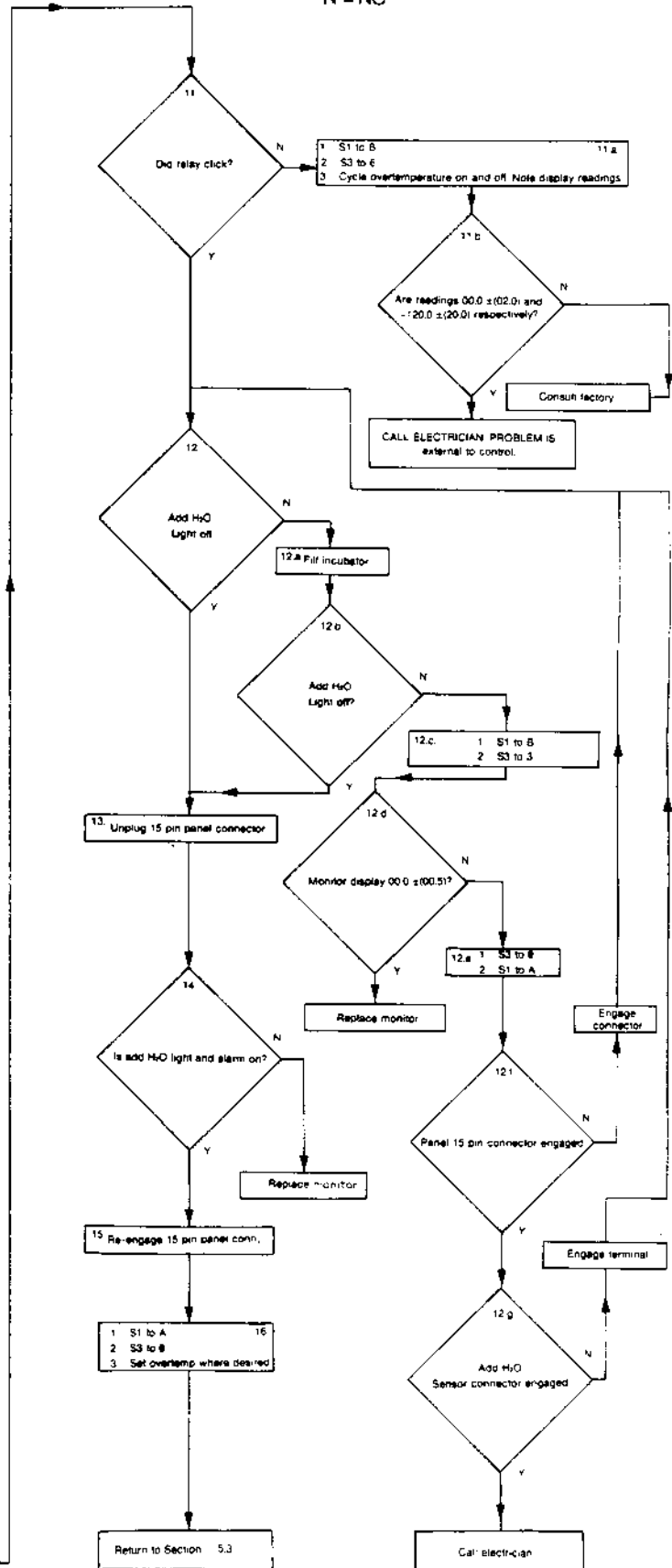
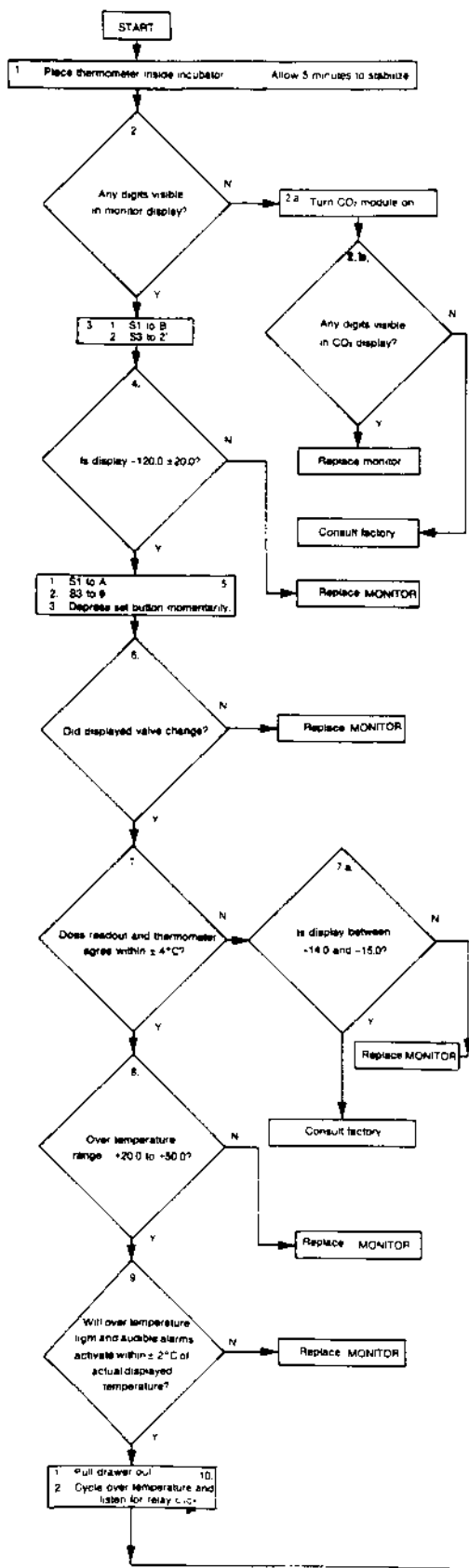


## 6.2C MONITOR MODULE TROUBLESHOOTING - GENERAL NOTES

- NOTE 1: Unless otherwise noted in the procedure, the module referred to is the Monitor Module, and the switches referred to are located on the Monitor Module.
- NOTE 2: Switch locations for the Monitor Module are labeled on the module picture.
- NOTE 3: When the chart calls for contacting an electrician, your in-house electrical technician should be called.
- NOTE 4: Y = Yes, N = No

# ALARM MODULE TROUBLESHOOTING FLOWCHART

NOTE: Y=YES  
N=NO



### 6.3 CO2 CONTROL CALIBRATION (See Fig. 4)

The adjustment will only be necessary under the following conditions. DO NOT recalibrate the incubator for any other reasons!

- 1) After the CO2 controller is replaced.
- 2) After the CO2 sensor is replaced.
- 3) If there is reason to believe that the controller has previously been calibrated incorrectly.

#### TOOLS NEEDED:

- 1) Calibration screwdriver (provided).
- 2) Fyrite CO2 Analyzer  
(See Sections 5.7 - 5.9 for proper usage)

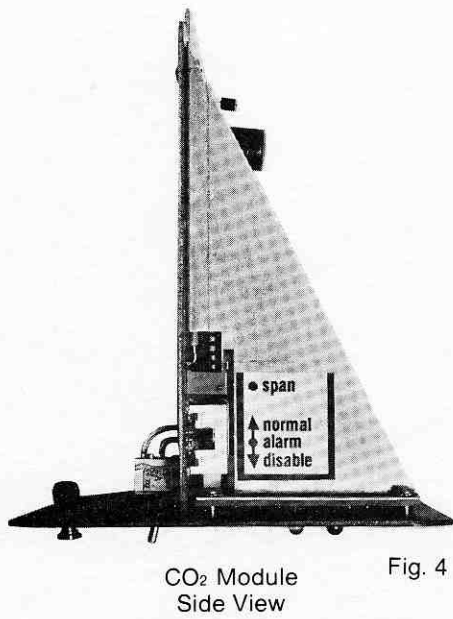
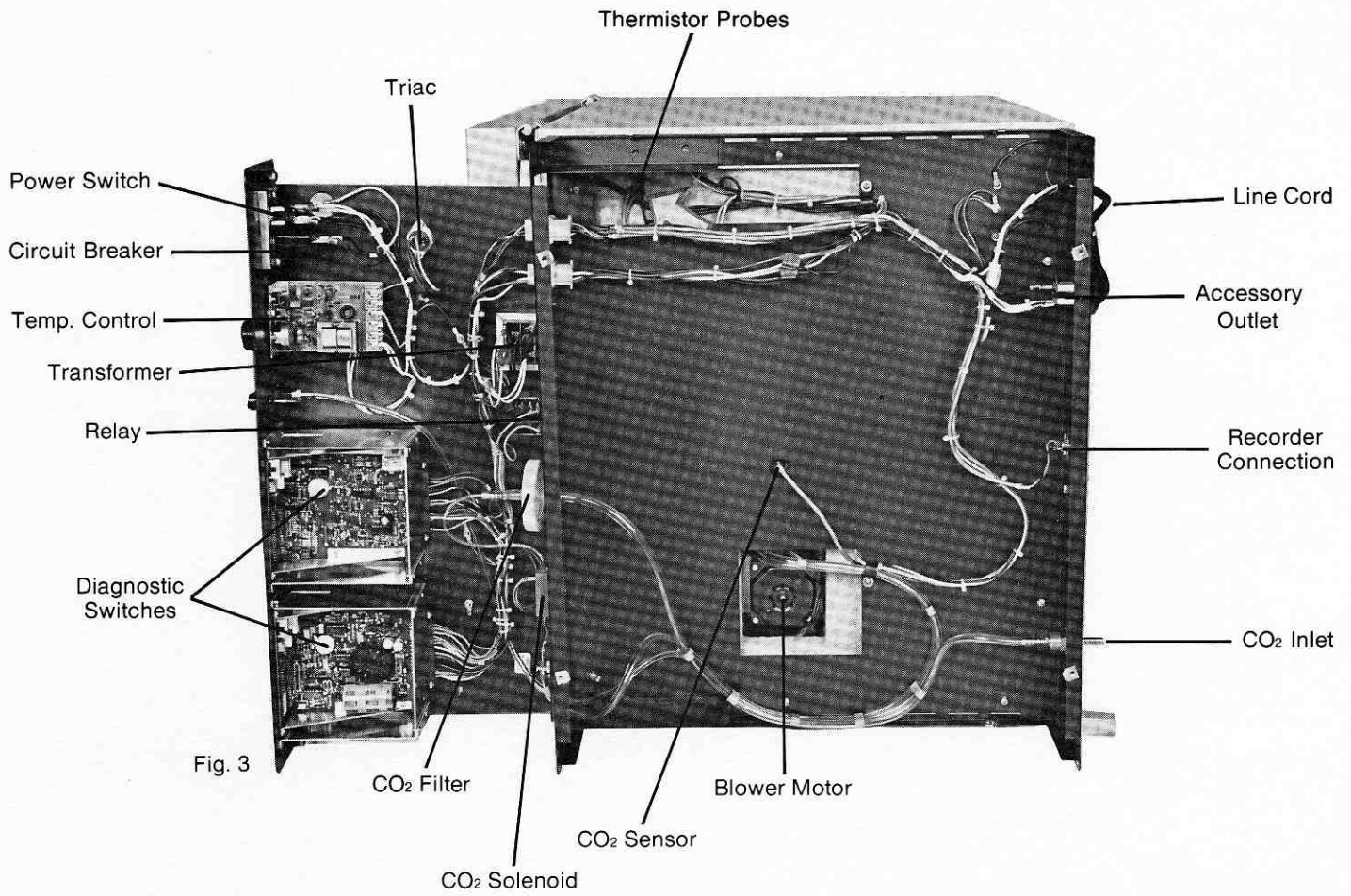
#### CALIBRATION PROCEDURE

STEP 1: STABILIZE THE INCUBATOR AT OPERATING TEMPERATURE AND HUMIDITY WITH NO CO2 IN THE CHAMBER.

- 1.1 Turn OFF the CO2 supply at the source.
- 1.2 Fill the humidity pan with freshly distilled water or tap water.
- 1.3 Allow the chamber temperature and humidity to stabilize. This will take a minimum of 8 hours if the temperature setpoint has been recently changed. Allow 3 days on initial start-up.
- 1.4 Turn the span pot counterclockwise 10 turns.

STEP 2: ADJUST THE ZERO POT

- 2.1 Using the calibration screwdriver, adjust the CO2 control zero pot to read 00.0 on the digital display.
- 2.2 Wait 5 minutes, and repeat as necessary until the display is stable.



STEP 3: ADJUST THE SPAN POT

- 3.1 Turn ON the CO2 at the supply.
- 3.2 Turn the CO2 setpoint to 10%. Allow the CO2 to stabilize at 10% on the readout and control (inject light will cycle) for a minimum of 15 minutes.
- 3.3 Using a FYRITE or other measuring device, check the CO2 level in the chamber until two consecutive readings agree.
- 3.4 Turn the CO2 setpoint to 0.0% to prevent CO2 from being injected into the chamber during the adjustment.
- 3.5 Adjust the span pot so the digital display agrees with the FYRITE reading.
- 3.6 Turn the setpoint back to 10%, and allow the CO2 to control and stabilize for a minimum of 15 minutes.
- 3.7 Check the CO2 in the chamber with a FYRITE or similar device until two consecutive readings agree. If the digital display is within plus or minus 1.0% of the Fyrite reading, proceed to Step 4. If the reading is not within plus or minus 1.0%, repeat steps 3.2 through 3.6.

STEP 4: RE-CHECK THE ZERO ADJUSTMENT

- 4.1 Turn OFF the CO2 at the supply.
- 4.2 Open both doors wide for 45 seconds. Close the doors, and allow a minimum of 15 minutes for the incubator to stabilize and assure a zero CO2 condition in the chamber.
- 4.3 If the readout is greater than 00.4, repeat the door opening for 15 seconds, and again allow the incubator to stabilize for a minimum of 15 minutes. If the display is not less than the previous reading, consult the factory. If the display now reads 00.4 or less, re-adjust the zero pot so the display reads 00.0.

## STEP 5: CHECK THE CO2 AT THE DESIRED SETPOINT

- 5.1 Turn ON the CO2 at the supply.
- 5.2 Turn the CO2 setpoint to the desired level.
- 5.3 Allow the incubator to reach setpoint and control for a minimum of 30 minutes.
- 5.4 Check the CO2 with a Fyrite or similar device until two consecutive readings agree. If the Fyrite and display are not within 1.0%, consult the factory.

NOTE: After proper calibration the CO2 display will be more accurate than the Fyrite, because the zero adjustment was made using atmospheric conditions.

## 6.4 37C CONTROL RECALIBRATION

If the digital display indicates a temperature other than 37C when the chamber temperature has stabilized (temp select switch set to 37C), it may be necessary to recalibrate the adjustment.

### TO RECALIBRATE:

- 1) Make a note of how much the display varies from
- 2) Locate the 37C recalibration adjustment on the control panel. (See Figure 1 at the start of Section 3)
- 3) Using the calibration screwdriver mounted on the control panel, turn the calibration screw one turn clockwise for every half degree that the display is below 37C. Turning the screw counterclockwise will lower the temperature.
- 4) Allow the temperature to stabilize, and check the display again. If it still varies significantly, repeat steps 1 through 3.

CAUTION: SERVICING SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. DISCONNECT THE INCUBATOR FROM THE POWER SOURCE BEFORE STARTING SERVICE PROCEDURES.

#### 6.5 REPLACING THE CO2 SENSOR (See Fig. 3)

- 1) Remove the shelves, duct sheets, and blower channel from the chamber.
- 2) Locate the CO2 sensor, and remove the wing nuts. The sensor will drop down. (See Figure 9-A)
- 3) There is a clip that connects the sensor wiring to the incubator wiring. To open the clip, pull out slightly on the clip tab to release the sensor.
- 4) Remove the O-ring, and place it on the new sensor.
- 5) Clip the new CO2 sensor onto the incubator wiring, and return the sensor to the original opening. Be sure to tighten the wing nuts securely so the O ring seals properly.
- 6) After the sensor has been replaced, recalibrate the the CO2 controller according to the instructions in Section 6.3.

#### 6.6 REPLACING THE CHAMBER HEATER (See Fig. 5)

- 1) Disconnect the unit from the power source, and drain the water from the jacket.
- 2) Locate the heater cover plate at the bottom of the front of the unit.
- 3) Use a phillips screwdriver to remove the screws that secure the ends of the panel.
- 4) Pull out the metal heater pan.
- 5) Open the pan by lifting up on the top piece of metal.
- 6) Disconnect the electrical connector that joins the heater wiring to the chamber wiring.
- 7) Grasp the wires that are connected to the heater. Pull up on the wires, and peel them out of the aluminum covering. The covering will remain attached to the heater plate.
- 8) Smooth the aluminum foil as much as possible.
- 9) Peel the paper backing from one half of the replacement heater. Apply the exposed half of the new heater to the foil remaining from the defective heater. BE SURE TO PLACE THE NEW HEATER IN THE SAME CONFIGURATION AS THE PREVIOUS HEATER.

- 10) Peel the remaining paper backing from the heater, and apply it to the remaining area.
- 11) Connect the wiring from the new heater into the electrical connector on the wiring harness.
- 12) Reassemble the heater pan by reversing the above procedure.

#### 6.7 REPLACING THE DOOR HEATER

- 1) Disconnect the unit from the power supply, and unplug the door heater.
- 2) Pull back the gasket on the inside of the door to expose the screws securing the interior of the door.
- 3) Use a phillips screwdriver to remove the screws. DO NOT remove the screw from the lower right corner of the door, as it acts as an electrical ground for the heater. (This screw has a star lock washer on it.)
- 4) Carefully lift off the door interior.
- 5) Note the configuration of the wiring. Disconnect the wires that lead from the heater to the main unit.
- 6) Grasp the heater wires, and peel them away from the the aluminum backing. The backing will remain attached to the door interior.
- 7) Smooth out the aluminum foil as much as possible.
- 8) Remove half of the paper backing from the new heater.
- 9) Apply the exposed half of the heater to the remaining foil in the same configuration as the old heater.
- 10) Peel off the remaining paper backing, and apply the remainder of the new heater.
- 11) Connect the wiring in the same manner as before.
- 12) Re-assemble door by reversing above procedure. BE SURE THE GROUND WIRE IS PROPERLY INSTALLED.



## 6.8 REPLACING THE TRIAC (See Fig. 3)

- 1) Disconnect the unit from the power supply.
- 2) Loosen the two 1/4 turn fasteners on the front of control panel, and pull the control panel out.
- 3) Open the incubator outer door in order to gain access to the triac mounting screws from underneath the control panel.
- 4) Remove the two mounting screws securing the triac.
- 5) Carefully disconnect wires to the triac. Note their positions to insure proper connection to the new triac.
- 6) Remove the triac from the unit. Note the thermal compound between the base of the triac and the floor of the control panel housing. If necessary, reapply more thermal compound before installing the new triac.
- 8) Install the new triac by reversing the above procedure. Be sure to install the wiring in the same configuration as the old triac. See Drawing #140018-74-0-D.

## 6.9 REPLACING THE CO2 SOLENOID (See Fig. 3)

(See Drawing #140018-74-0-D)

- 1) Loosen the two 1/4 turn fasteners on the front of the control panel, and pull the control panel out.
- 2) Locate the CO2 solenoid, and disconnect the tygon tubing attached to it. Note how the tubing is installed so that it can be attached to the new solenoid in the same way.
- 3) Remove the screws that hold the solenoid in place.
- 4) Disconnect the wiring to the solenoid, making note of its configuration.
- 5) Remove the solenoid, and replace it with the new solenoid by reversing the above procedure. Be sure to connect the wiring and the tubing as noted during the removal of the old solenoid. Note the flow direction marked on the solenoid.

#### 6. 10 REPLACING THE TEMPERATURE CONTROL (See Fig. 3)

- 1) Loosen the two 1/4 turn fasteners on the front of the control panel, and pull the control panel out.
- 2) Remove the temp control knob by loosening the two allen head screws recessed in the knob.
- 3) Remove the nut on the shaft, then remove the nut on the back of the panel behind the control knob.
- 4) Remove the wiring to the temp control, and make note of its configuration. (See Drawing #140018-74-O-D.)
- 5) Remove the control, and replace it with the new control by reversing the above procedure.

#### 6. 11 REPLACING PILOT LIGHTS

- 1) Loosen the two 1/4 turn fasteners on the front of the control panel, and pull the control panel out.
- 2) Disconnect the wiring behind the defective light, and break the retaining clip loose. Remove the pilot light.
- 3) Insert the new pilot light from the front, and install the new retaining clip.
- 4) Rewire the pilot light in the same configuration as the old light.

#### 6. 12 REPLACING THE CIRCUIT BREAKER (See Fig. 3)

- 1) Loosen the two 1/4 turn fasteners on the front of the control panel, and pull the control panel out.
- 2) Remove the two nuts securing the circuit breaker mounting plate to the control panel.
- 3) Remove the nut securing the circuit breaker to its mounting plate.
- 4) Remove the wiring, and note its configuration.
- 5) Install the new circuit breaker by reversing the above procedure.

#### 6.13 REPLACING THE POWER SWITCH (See Fig. 3)

- 1) Loosen the two 1/4 turn fasteners on the front of the control panel, and pull the control panel out.
- 2) Remove the two nuts securing the power switch mounting bracket.
- 3) Remove the two screws and nuts retaining the power switch on the bracket.
- 4) Remove the wiring, and note its configuration.
- 5) Install the new power switch by reversing the above procedure.

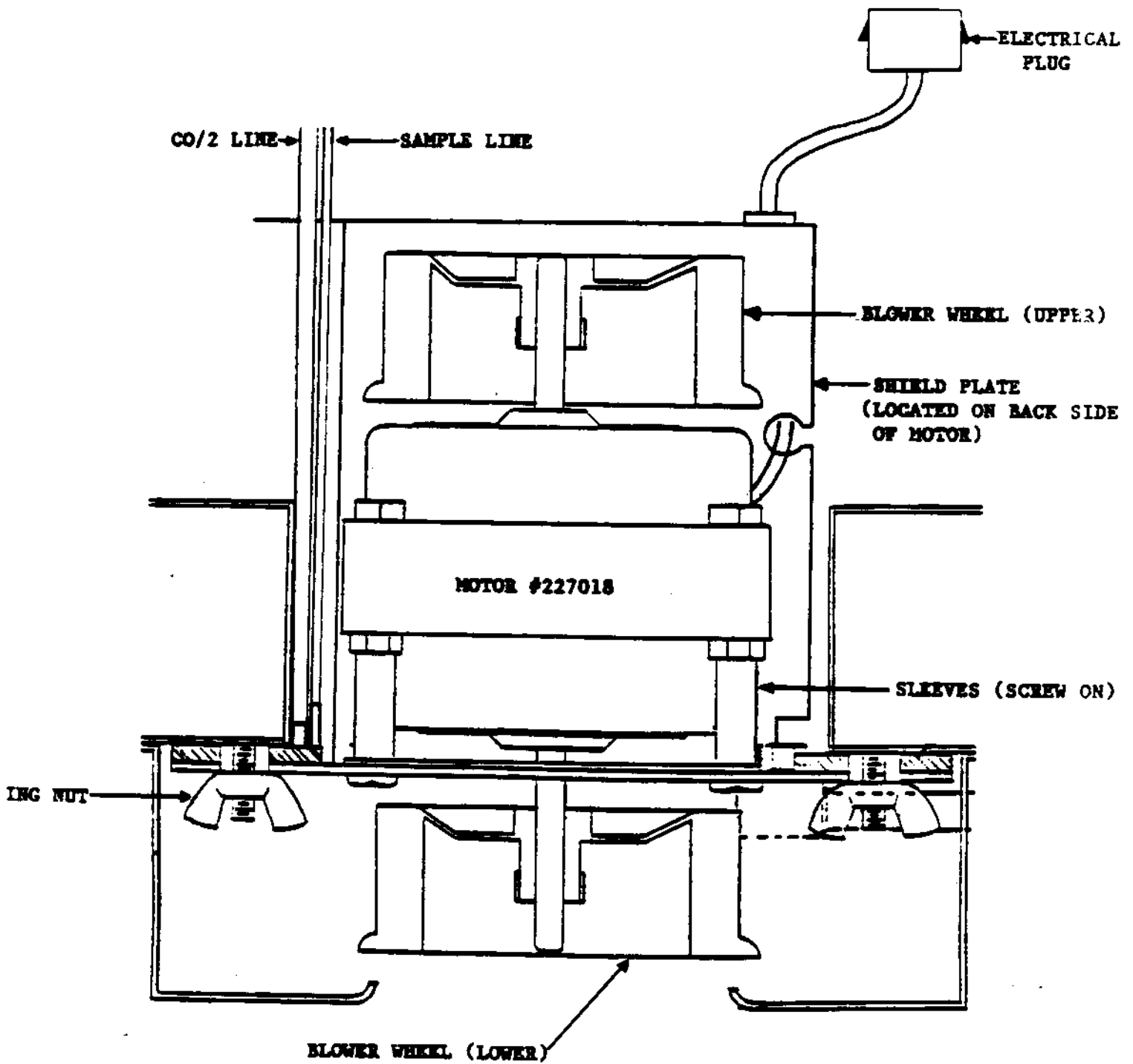
#### 6.14 REPLACING THE THERMISTORS (See Fig. 3)

- 1) Loosen the two 1/4 turn fasteners on the front of the control panel, and pull the control panel out.
- 2) Locate the thermistors, and remove the silastic around the thermistor cable.
- 3) Pull the defective thermistor out of the probe sheath.
- 4) Cut the wires to the defective thermistor, making note of their configuration.
- 5) Attach the new thermistor by the use of electrical in-line connectors.
- 6) Install the new thermistor by reversing the above procedure. Taking care not to damage the probe tip, make sure that the probe is fully extended in the sheath. Also RESEAL the port with silastic or similar material.

#### 6.15 REPLACING THE 0.3 AMP FUSE

The 3/10 amp fuse is located in the center of the control panel tray, about an inch behind the left-hand rear corner of the CO<sub>2</sub> monitor module housing. To replace fuse:

- 1) Disconnect all power to the incubator.
- 2) Disengage the 1/4 turn fasteners on the front of the control panel and pull panel out until fuse holder in center of tray is accessible.



- 3) Use a fuse puller, a small screw driver, or a wooden or plastic pry to lift one end of fuse from clip. Grasp fuse and remove from holder. Discard fuse.

NOTE: Use fuse puller carefully. Use of a puller on small fuses can result in breakage of the glass fuse barrel.

- 4) Insert a new 0.3 Amp fuse into holder and press ends into clips.

NOTE: 3/10 Amp fuses have very fine elements. Continuity test fuse before installation to be sure element is intact.

- 5) Push in and secure control panel.
- 6) Connect power to incubator. Turn "POWER" switch to "ON" and check operation of controls.

#### 6.16 REPLACING THE BLOWER MOTOR

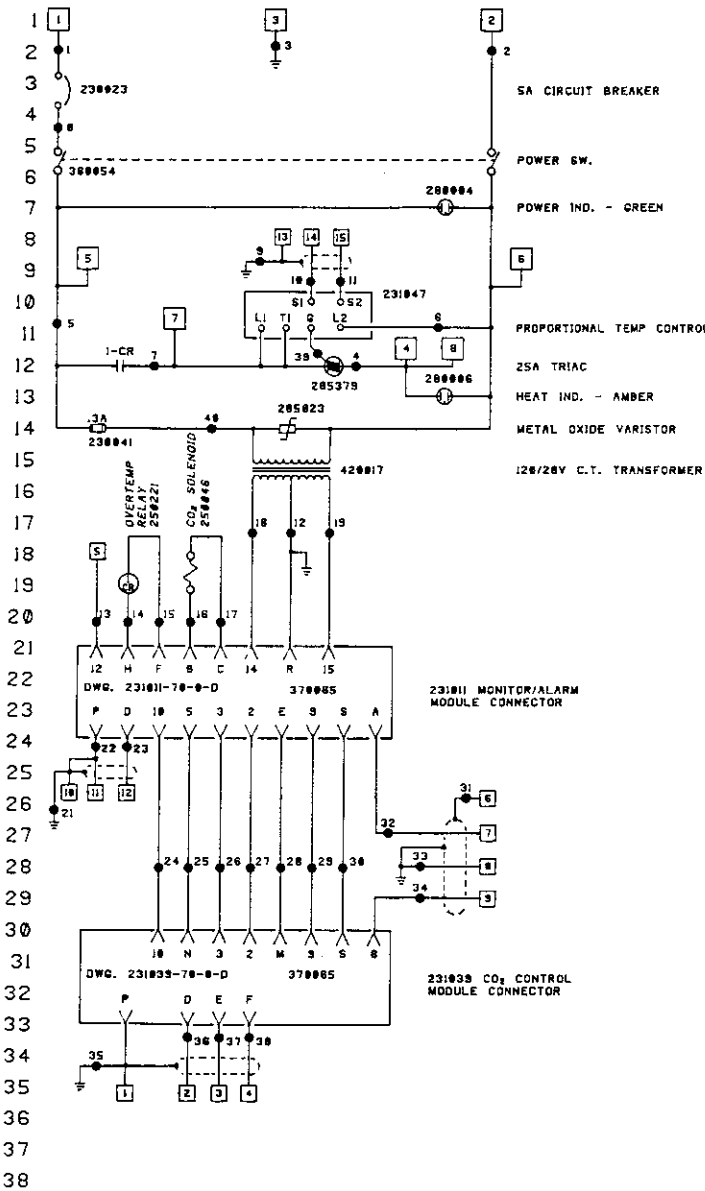
- 1) DISCONNECT UNIT FROM POWER SOURCE!
- 2) Remove the shelves, duct sheets and blower channel from the incubator interior.
- 3) Remove the blower wheel by firmly pulling it down.
- 4) Remove the (4) wing nuts that secure the blower mounting plate to the incubator ceiling.
- 5) Remove the (8) screws securing the top of the incubator.
- 6) Loosen clamp securing tygon tubing.
- 7) Pull blower motor assembly down into chamber area.
- 8) Electrically disconnect blower motor.
- 9) Disconnect tygon tubing from mounting plate.  
NOTE: OBSERVE THE DIFFERENT SIZES OF TYGON TUBING AND THEIR PROPER CONNECTION.
- 10) Remove blower motor and save the screw on the sleeves.
- 11) Install new shield plate. NOTE: POSITION SHIELD PLATE ON BACK SIDE OF MOTOR. (REFER TO DRAWING LOCATED ON THE FOLLOWING PAGE).

- 12) Install new blower motor. NOTE: SCREW ON SLEEVES MUST BE USED.
- 13) Electrically connect blower motor.
- 14) When reinstalling the motor assembly, make sure that the tygon tubing is not kinked.

SECTION 7 - PARTS LIST

MODEL 3326 - PARTS LIST

QTY	STOCK #	DESCRIPTION
1	116011	HINGE, Interior Door
1	231011	CONTROL MODULE, Alarm/Monitor
1	231039	MODULE, CO2 Control
1	290024	ASSEMBLY, CO2 Sensor
1	505522	LATCH TAB, for Incub. Door
1	890155	DOOR, Glass, Inner
1	260001	KNDB, Blk, 1/4" Bush, 1/4" Dia.
1	505523	STUD, Latch, for Incub. Door
6	224200	SHELF, Square, Stainless Steel
14	505072	CHANNEL, Shelf
1	460024	OUTLET, Electrical, Snap-In
1	950020	CORD SET, 6/3 SJT, 8 Ft.
1	132004	HEATER, Door, 5 Watt, 120V, Foil
1	431142	GASKET, Magnetic, Molded, 4 Side
1	950016	CORD, 4 Wire, 15", w/Special Plug
2	116012	HINGE, Exterior Door
7.2	400296	GASKET, Silicone Feather
1	100008	WHEEL, Blower
1	227018	MOTOR, Blower Assembly
1	370067	RECEPTACLE, 3 Circuit Mate-N-Lock
1	132007	CABLE, Heater, 120V, 6 Watt, Foil
1	132008	HEATER, Chamber, 260 Watt, Foil
1	231044	CONTROLLER, Temperature
2	235013	SCREWDRIVER, Adjustment, Panel
1	230023	BREAKER, Circuit, SP, 5 Amp
1	285379	TRIAC, 25 Amp
1	880007	PLUG, 1/2" MPT, Nylon (Fill Port)
1	250221	RELAY, DPDT, 12V DC, Coil
1	250000	SOLENOID, Reed
2	290027	CABLE, Thermistor, 1K, 7 Ft.
1	280004	LIGHT, Pilot, Green
1	280005	LIGHT, Pilot, Red
1	280006	LIGHT, Pilot, Amber
2	111008	CLIP, Mounting, Pilot Light
1	360054	SWITCH, Rocker, DPST, On/Off
1	770001	FILTER, Line, CO2



- EXTERNAL CONNECTIONS**
- 39 1 120VAC (HOT)
  - 40 2 120VAC (NEUTRAL)
  - 41 3 GROUND
  - 42 4 HEATERS, CYCLED
  - 43 5 OUTLET
  - 44 6 NEUTRAL
  - 45 7 FAN
  - 46 8 9 6W CHAMBER HEATER
  - 47 1 CO<sub>2</sub> SENSOR, SHIELD
  - 48 2 CO<sub>2</sub> SENSOR, REFERENCE CELL
  - 49 3 CO<sub>2</sub> SENSOR, COMMON
  - 50 4 CO<sub>2</sub> SENSOR, CO<sub>2</sub> CELL
  - 51 5 ADD WATER SENSOR
  - 52 6 RECORDER, SHIELD
  - 53 7 RECORDER, TEMP OUTPUT
  - 54 8 RECORDER, OUTPUT COMMON
  - 55 9 RECORDER, CO<sub>2</sub> OUTPUT
  - 56 10 OVERTEMP SENSOR, SHIELD
  - 57 11 OVERTEMP SENSOR
  - 58 12 OVERTEMP SENSOR
  - 59 13 CONTROL SENSOR, SHIELD
  - 60 14 CONTROL SENSOR
  - 61 15 CONTROL SENSOR
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**WIRE REFERENCE CHART**

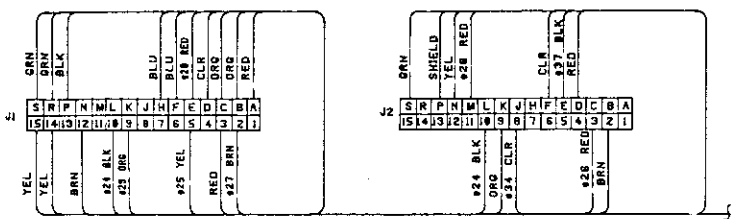
WIRE#	GA.	COLOR	
1	18	BLK	
2	18	WHT	
3	18	GRN	
4	14, 20	BLK, RED	
5	14, 20	BLK	
6	20	WHT	
7	20	BLK	
8	20	BLK	
9	24	SHLD	CABLE
10	24	BLK	
11	24	WHT	
12	20	BRN	
13	20	BRN	
14	20	BLU	
15	20	BLU	
16	20	ORG	
17	20	ORG	
18	20	YEL	
19	20	YEL	
20	24	SHLD	CABLE
21	24	BLK	
22	24	CLR	
23	24	BLK	
24	20	BLK	
25	20	YEL	
26	20	RED	
27	20	BRN	
28	20	RED	
29	20	ORG	
30	20	GRN	
31	22	SHLD	CABLE
32	22	RED	
33	22	BLK	
34	22	WHT	
35	22	SHLD	CABLE
36	22	RED	
37	22	BLK	
38	22	WHT	
39	20	YEL	
40	20	BLK	

NOTES:		CUSTOMER APPROVAL/REFERENCE	
① Denotes Terminal Strip Connection	Pin No. Reference Number	APPROVED BY	5 51-495(2-10-84)BOW/LDW
1-CR Lot Label Number	○ Assembly	DATE OF APPROVAL	4 1N-481(4-10-83)DW/LDW
N/A Lot Label Number	○ Panel		3 51-330(3-10-83)DW/LDW
4-0 Lot Pvc Number	○ Refrigerator		2 1N-431(1-3-83)DW/LDW
	○ Weigh		1 51-295(1-22-82)DW/LDW
			REVISION NO. DATE BY APPR DESCRIPTION OF REVISION
<input type="checkbox"/> DENOTES 15 PIN MATE-N-LOK CONNECTOR (PIN #)			DATES-11-81/DWN DAG APPR SCALE NONE
<input type="checkbox"/> DENOTES 9 PIN MATE-N-LOK CONNECTOR (PIN #)			CUSTOMER STK # 140018
			JOB TITLE AUTOMATIC CO <sub>2</sub> CONTROL PANEL
			DWG TITLE ELECTRICAL SCHEMATIC
			DRAWING NUMBER
			JOB NUMBER
			140018-70-0-D

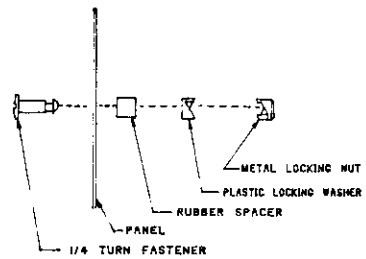


### HARDWARE CHART

SYM.	STOCK NO.	DESCRIPTION
A	23021	#8 FLAT WASHER
B	235013	SCREWDRIVER
C	710002	STUD RECEIVER
D	040020	1/4" HOSE FITTING
E	950013	1/4" ID TUBING 3" LONG
F	300206	ADAPTER 3/16" HOSE X 1/8" MPT
G		
H	23002	#8-32 KEPS NUT
I	30001	TIE WRAP ANCHOR
J	22002	#4-48 X 1/2" PHP SCREW
K	23005	#4-48 KEPS NUT
L	22043	#6-32 X 3/8" PHP SCREW
M	23001	#8-32 KEPS NUT
N	23056	#6 EXTERNAL STAR LOCKWASHER
O	040011	BRS. REDUCER 3/16" HS X 1/16" HS
P	040013	BRS. REDUCER 1/4" HS X 1/16" HS
Q	22130	#4-48 X 1/4" PHP SCREW
R	124001	CARD GUIDE
S	67000	COUNTERSUNK POP RIVET
T	22115	#6-32 X 1/4" PHP SCREW
U	230033	FUSE CLIP
X	040023	1/4" X 1/8" HOSE FITTING
Y	22050	#6-32 X 1/2" SS PHP SCREW
Z	24032	#8-32 X 3/8" SS PHP SCREW

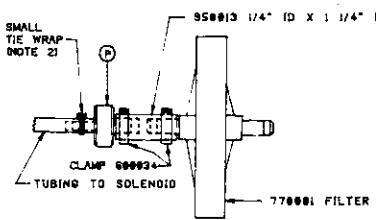


DETAIL 1  
CONNECTION SHOWN AS VIEWED FROM BACK

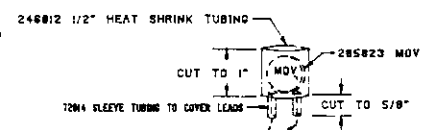
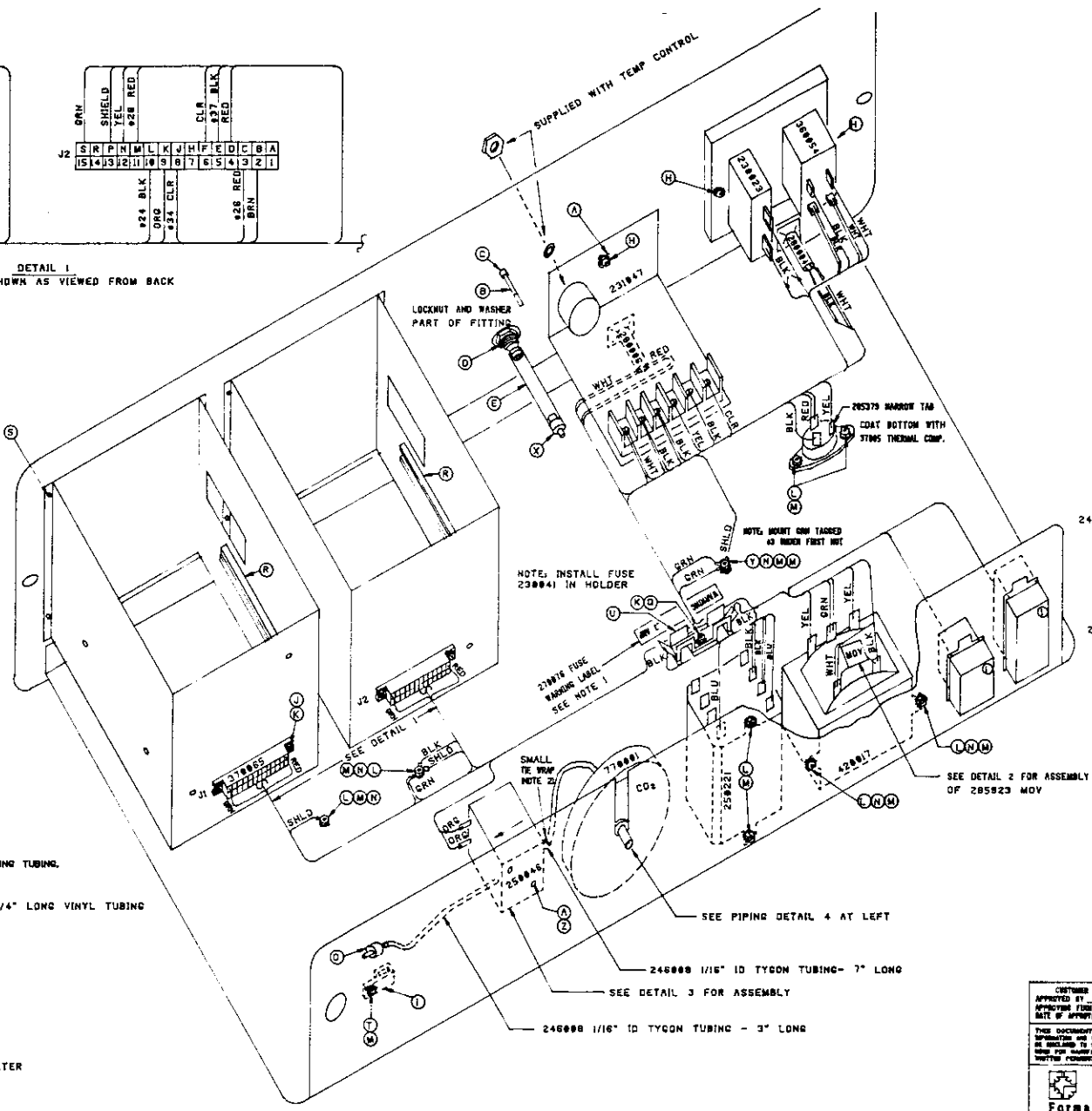


620002 FASTENER INSTALLATION

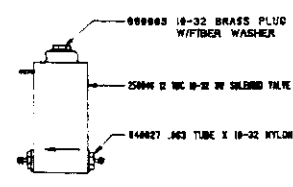
- NOTES:
1. USE "WARNING FIRE HAZARD" AND "FUSE JUMP" PORTION OF LABEL ONLY.
  2. SET STA-STRAP TOOL TO MEDIUM WHEN SECURING TUBING.



CO<sub>2</sub> SUPPLY PIPING DETAIL 4



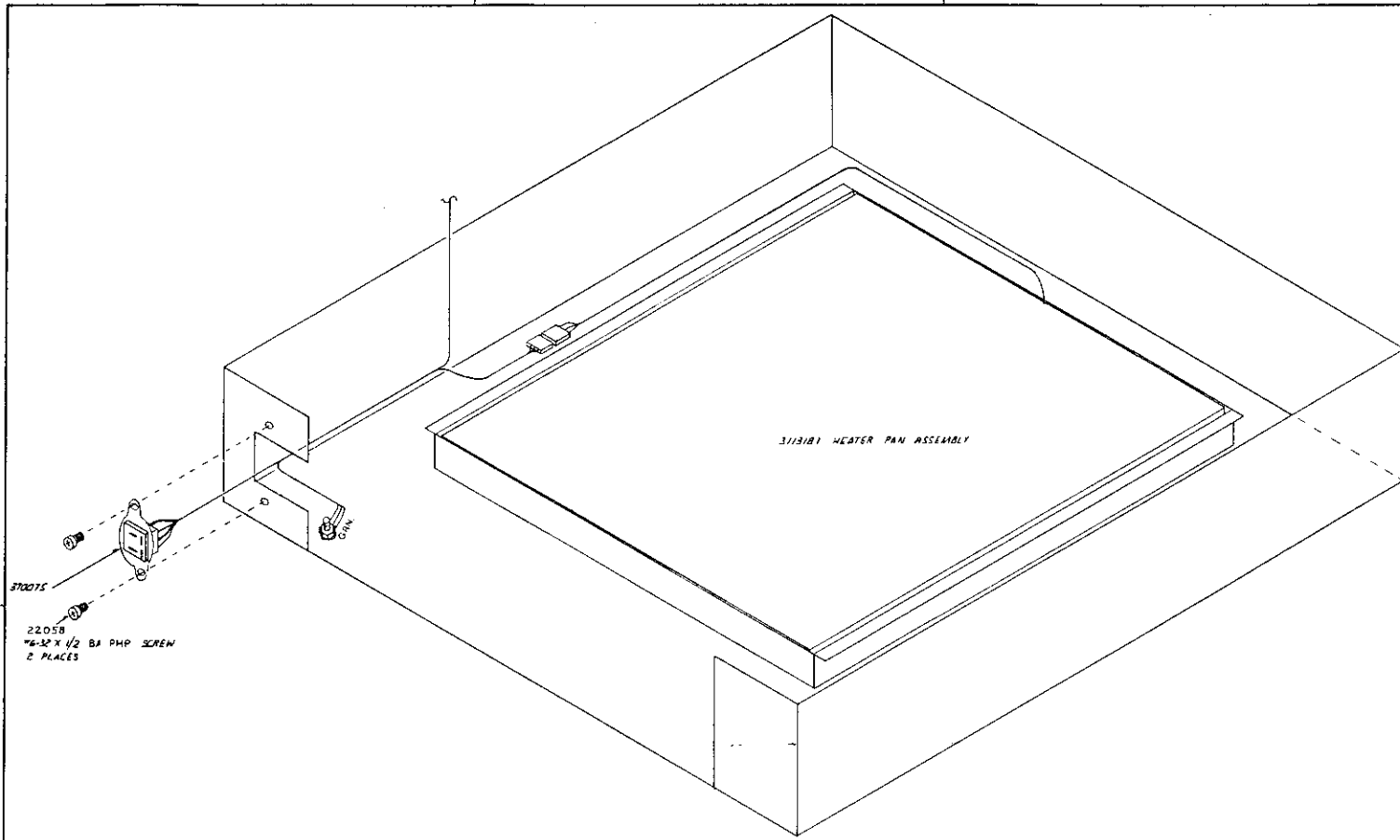
DETAIL 2




DETAIL 3

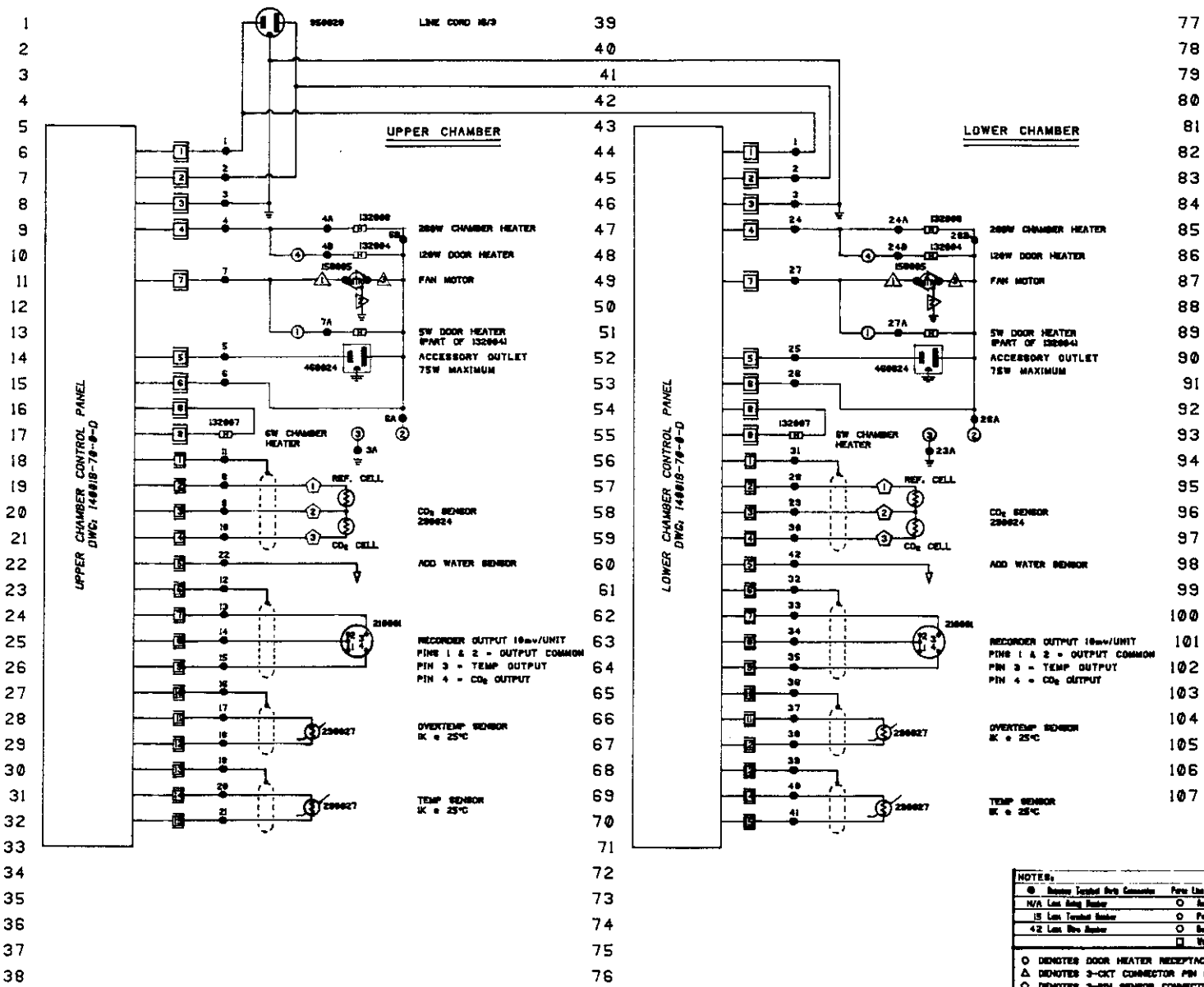
<p>12 IN-723-2-0-01 (REV) REV. TUBING CLAMPS</p> <p>11 IN-671 3-0-05 (REV) (REV) REMOVED PILOT LIGHT CLIP STUB</p> <p>10 IN-5082-5-05 (REV) (REV) REMOVED LEAK-LOK NOTE ON DETAIL 2</p> <p>9 IN-49512-13-04 (REV) (REV) ADJ. AIR CO<sub>2</sub> ADJ. SOLENOID</p> <p>8 IN-44513-22-03 (REV) (REV) REDESIGN OF MODULE BOXES</p> <p>7 IN-4614-13-03 (REV) (REV) NEW TEMP CONTROL</p> <p>6 IN-45613-22-03 (REV) (REV) NEW SAMPLE PORT FITTINGS</p> <p>5 IN-45613-22-03 (REV) (REV) NEW SAMPLE PORT FITTINGS</p> <p>4 IN-45613-22-03 (REV) (REV) NEW SAMPLE PORT FITTINGS</p> <p>3 IN-45613-22-03 (REV) (REV) NEW SAMPLE PORT FITTINGS</p> <p>2 IN-45613-22-03 (REV) (REV) NEW SAMPLE PORT FITTINGS</p> <p>1 IN-45613-22-03 (REV) (REV) NEW SAMPLE PORT FITTINGS</p>	<p>DATE: 12-11-01</p> <p>BY: DWN</p> <p>APPD</p> <p>SCALE: NONE</p>
<p>CUSTOMER APPROVAL/REFERENCE</p> <p>APPROVED BY</p> <p>APPROVING FIRM</p> <p>DATE OF APPROVAL</p>	<p>CUSTOMER</p> <p>JOB TITLE AUTOMATIC CO<sub>2</sub> CONTROL PANEL</p> <p>JOB TITLE WIRING DIAGRAM LAYOUT</p> <p>DRAWING NUMBER</p> <p>JOB NUMBER</p>

140018-74-0-D



CUSTOMER APPROVAL REFERENCE					
APPROVED BY					
APPROVED FIRM					
DATE OF APPROVAL					
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REV /	REV NO.	DATE	BY	APPROV.	DESCRIPTION OF REVISION
1	1	11/18/81	DK	REV PER ECR	SI-158
DATE	BY	DRAWN	DATE	APPROV.	SCALE
					N.T.S.
 <b>Fornia Scientific</b> 800 866 4667 FAX 415 744 4444 151 PINE LAKE AVENUE SUITE 200 SAN RAFAEL, CA 94903					
<b>CUSTOMER</b> JOB TITLE WATER-JACKETED INCUBATOR DRAWN TITLE BOTTOM BASE WIRING DIAGRAM DRAWING NUMBER 3158-72-0-D JOB NUMBER					

POWER CONNECTION  
80-120V, 1-PL2W, SA/9N/2, 8PLA



WIRE REFERENCE CHART

WIRE #	GA	COLOR	L.C.
1	18	BLK	1
2	18	WHT	2
3	18	BRN	3
3A	18	GRN	23A
4	20	RED	24
4A	20	RED	24A
4B	18	RED	24B
5	20	BLK	25
6	20	WHT	26
6A	18	WHT	26A
6B	20	WHT	26B
7	20	BLK	27
7A	20	BLK	27A
8	22	RED	28
9	22	BLK	29
10	22	WHT	30
11	22	SHLD	31
12	22	SHLD	32
13	22	RED	33
14	22	BLK	34
15	22	WHT	35
16	24	SHLD	36
17	24	BLK	37
18	24	WHT	38
19	24	SHLD	38
20	24	BLK	40
21	24	WHT	41
22	24	BRN	42

NOTES:  
 (Symbol) Denotes Insulated Wire Connector Part Use Insulated Solder  
 N/A Low Amp Solder O Assembly  
 15 Low Temp Solder O Lead  
 42 Low Amp Solder O Substrate  
 [ ] Wire  
 O DENOTES DOOR HEATER RECEPTACLE PIN NO.  
 Δ DENOTES 3-CKT CONNECTOR PIN NO.  
 ○ DENOTES 3-PIN SENSOR CONNECTOR  
 □ DENOTES 15-PIN CKT CONNECTOR  
 ▢ DENOTES 9-PIN CKT CONNECTOR

FORMA Scientific  
 1000 W. 10th St., Suite 100, Lincoln, NE 68502  
 (402) 441-1111  
 FAX (402) 441-1112

REV	DATE	BY	DESCRIPTION OF REVISION
6	01-25-02	04-04	REV D
5	02-28-02	04-02	REV LON
4	01-24-01	04-02	REV LON
3	08-10-00	04-02	REV LON
2	05-27-00	04-02	REV LON
1	02-28-00	04-02	REV LON

REVISIONS: 1-ADDED 15-PIN AND 9-PIN CONNECTORS TO THE DOOR HEATER RECEPTACLE  
 2-ADDED 15-PIN AND 9-PIN CONNECTORS TO THE DOOR HEATER RECEPTACLE  
 3-ADDED 15-PIN AND 9-PIN CONNECTORS TO THE DOOR HEATER RECEPTACLE  
 4-ADDED 15-PIN AND 9-PIN CONNECTORS TO THE DOOR HEATER RECEPTACLE  
 5-ADDED 15-PIN AND 9-PIN CONNECTORS TO THE DOOR HEATER RECEPTACLE  
 6-ADDED 15-PIN AND 9-PIN CONNECTORS TO THE DOOR HEATER RECEPTACLE

DATE 01-25-02 BY 04-04 DESCRIPTION OF REVISION REV D

DATE 02-28-02 BY 04-02 DESCRIPTION OF REVISION REV LON

DATE 01-24-01 BY 04-02 DESCRIPTION OF REVISION REV LON

DATE 08-10-00 BY 04-02 DESCRIPTION OF REVISION REV LON

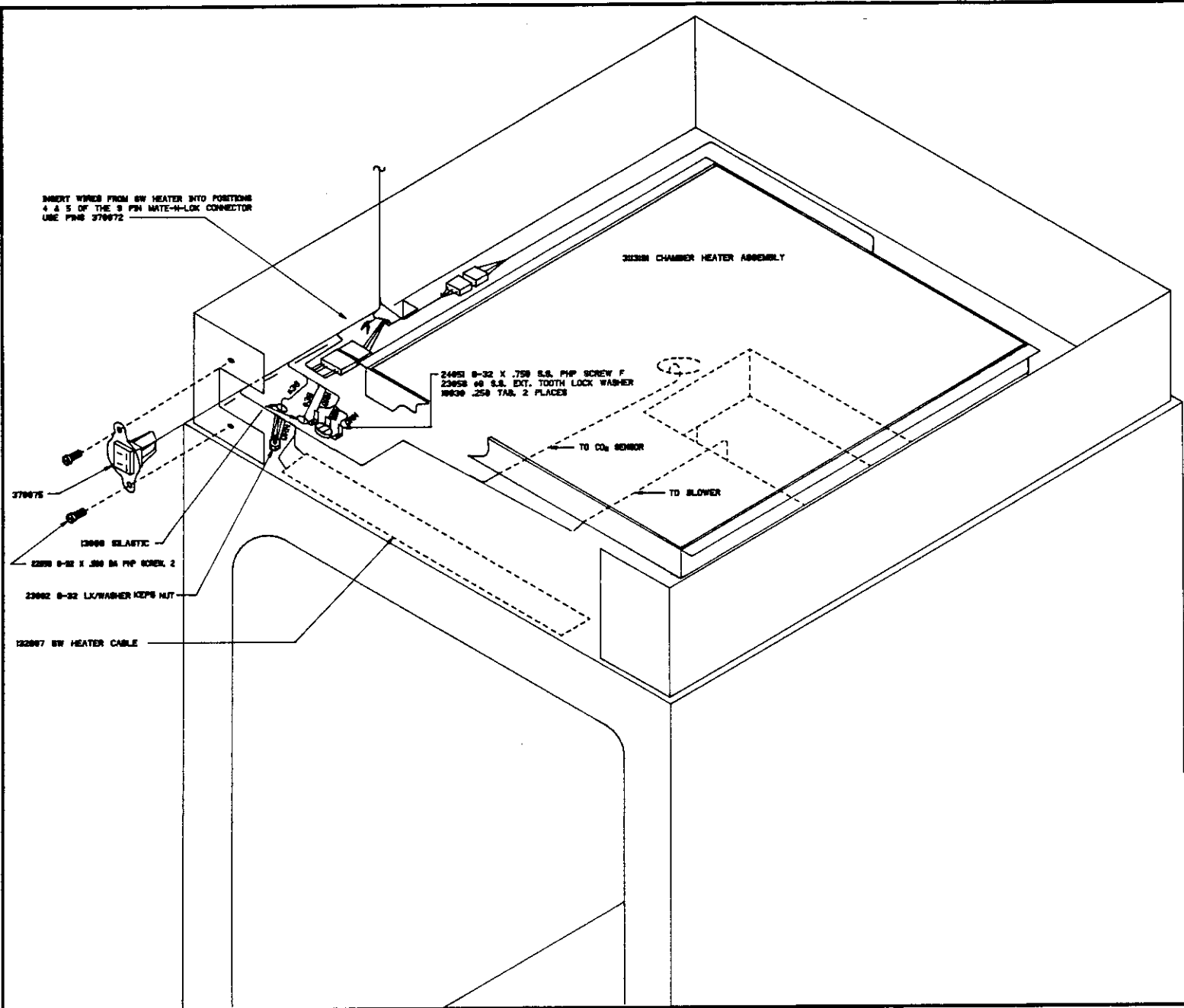
DATE 05-27-00 BY 04-02 DESCRIPTION OF REVISION REV LON

DATE 02-28-00 BY 04-02 DESCRIPTION OF REVISION REV LON

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Forma Scientific 600 W. 30TH ST. 4TH FL. NEW YORK, N.Y. 10001 TEL. (212) 633-6300 FAX (212) 633-6301		CONTINUED JOB TITLE 30328/30330 AUTOMATIC CO <sub>2</sub> INCUBATOR DRAWING NUMBER 3926-72-0-0 JOB NUMBER _____