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Telephone: (740) 373-4763
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# Model Dual Chamber 3326

Water Jacketed Incubator

## Manual No. 7003326

**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.

***Caution: All Internal Adjustments And Maintenance Must Be Performed By Qualified Service Personnel.***

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**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. 7003326**

| REV | ECN | DATE | DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | 4/82 | Original Manual |

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# FORMA MANUAL ADDENDUM

Re: Incubator CO2 Control

## CAUTION!

If the incubator substains a power failure long enough to effect temperature and in turn effect humidity, then the CO2 readout will be incorrect. The unit will return to NORMAL, indicating correct chamber conditions. NOTE: PLEASE ALLOW ADEQUATE TIME FOR THE UNIT TO STABILIZE. (Short OFF and ON power failures will not adversely effect the chamber operation).

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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 accesories is packed inside the incubator:

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

Also Packed With the Incubator
(Per Chamber)

| | | |
|---|---|---|
| 224200 | Square Stainless Shelves | 6 |
| 505072 | Stainless Shelf Brackets | 12 |
| 3113210 | Stainless Blower Channel | 1 |
| 3113220 | Stainless Duct Sheet, Left | 1 |
| 3113230 | Stainless Duct Sheet, Right | 1 |

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# SECTION 1: INTRODUCTION

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1.1 The Water Jacket: Key Features

1.2 Auxiliary Equipment

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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.

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- 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 CO2 alarm which is activated when the CO2 percent in the chamber deviates plus or minus 1% from CO2 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) SHELF CHANNELS

For mounting extra shelves and humidity pan. Two needed per shelf or pan. Minimum order of 1.

Catalog # 505072

### 3) 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

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4) MULTIPLEX STRIP RECORDER

This easy to install, self-contained strip recorder keeps a permanent record of both temperature and CO2.

Catalog # 197012

5) EXTRA RECORDER CHART PAPER

A one month supply of chart paper (1 roll) for the multiplex recorder.

Catalog # 180029

6) 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

7) EXTRA FYRITE FLUID

For replacing Fyrite tester fluid. Three bottles per carton.

Catalog # 220051

8) 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 # 853227

9) 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

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10) CO2 GAS GUARD

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

11) REPLACEMENT CO2 FILTER

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

Catalog # 770001

12) 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

13) LABORTORY DISINFECTANT

For use in and around the laboraotry. 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 avaliable 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

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14) 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

15) HYGROMETER

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

Catalog # 155010

16) GLASS THERMOMETER

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

Catalog # 285722

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## 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

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## 2.5 SHELVES

Capacity: 22 (6 Provided)
Dimensions: 17.8" W x 17.7" D
45.2 cm W x 45.2 cm D
Construction: 18 Ga. Perforated Stainless Steel
Type 304
Usable Shelf Area (per shelf): 2.2 Square Feet
Usable Shelf Area (maximum): 48.2 Square Feet
Flatness: +/- .032" Off Horizontal Plane
Clearance: Adjustable on 1" Centers

## 2.6 ALARM/MONITOR MODULE

Sensor: Thermistor
Controller Type: Proportional, Zero-Switching
Sensitivity: +/- .1 Degree C
Readout: LCD
Setpoint: Digital W/Screwdriver Adjust
Readability: 0.1 Degree C
Accuracy: +/- 0.2 Degrees C
Alarm Setability: 0.1 Degree C

## 2.7 CO2 MODULE

Sensor: Matched Thermistors
Controller: Thermal Conductivity
Sensitivity: +/- 0.1%
Readout: LCD
Setpoint: Digital with Screwdriver Adjust
Readability: 0.1%
Accuracy: 0.1%
Alarm Differential & Delay: +/- 1% (nominal) for longer than approx. 4 minutes

Supply Voltage: +/- 15V

## 2.8 TEMPERATURE CONTROL

Sensor: Thermistor
Controller Type: Proportional, Zero-Switching
~ Range: 0 to 60 Degrees C
Sensitivity: 0.05 Degrees C

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## 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: 5 Degrees C above ambient to 50 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 **

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~ 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

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3.1 Operation Overview

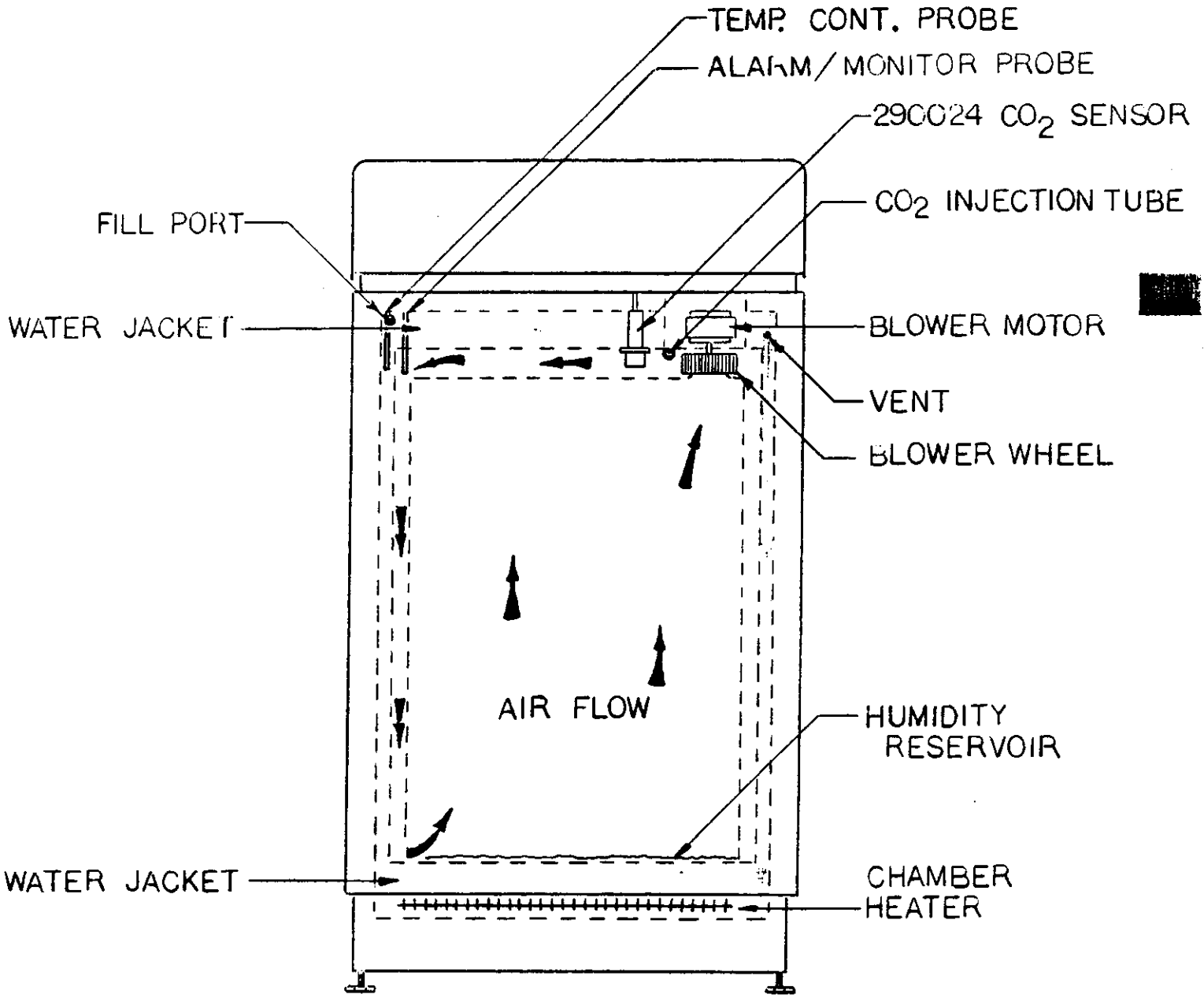
3.2 Humidification and CO2

3.3 Control Panel

3.4 CO2 Module

3.5 Alarm/Monitor Module

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OPERATION OF WATER-JACKETED INCUBATOR

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## 3.1 OPERATION OVERVIEW (See Figure I)

The water jacket is filled with approximately 10.5 gallons (39.7 liters) of water via 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 for improved temperature uniformity throughout the chamber. A separate and 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.

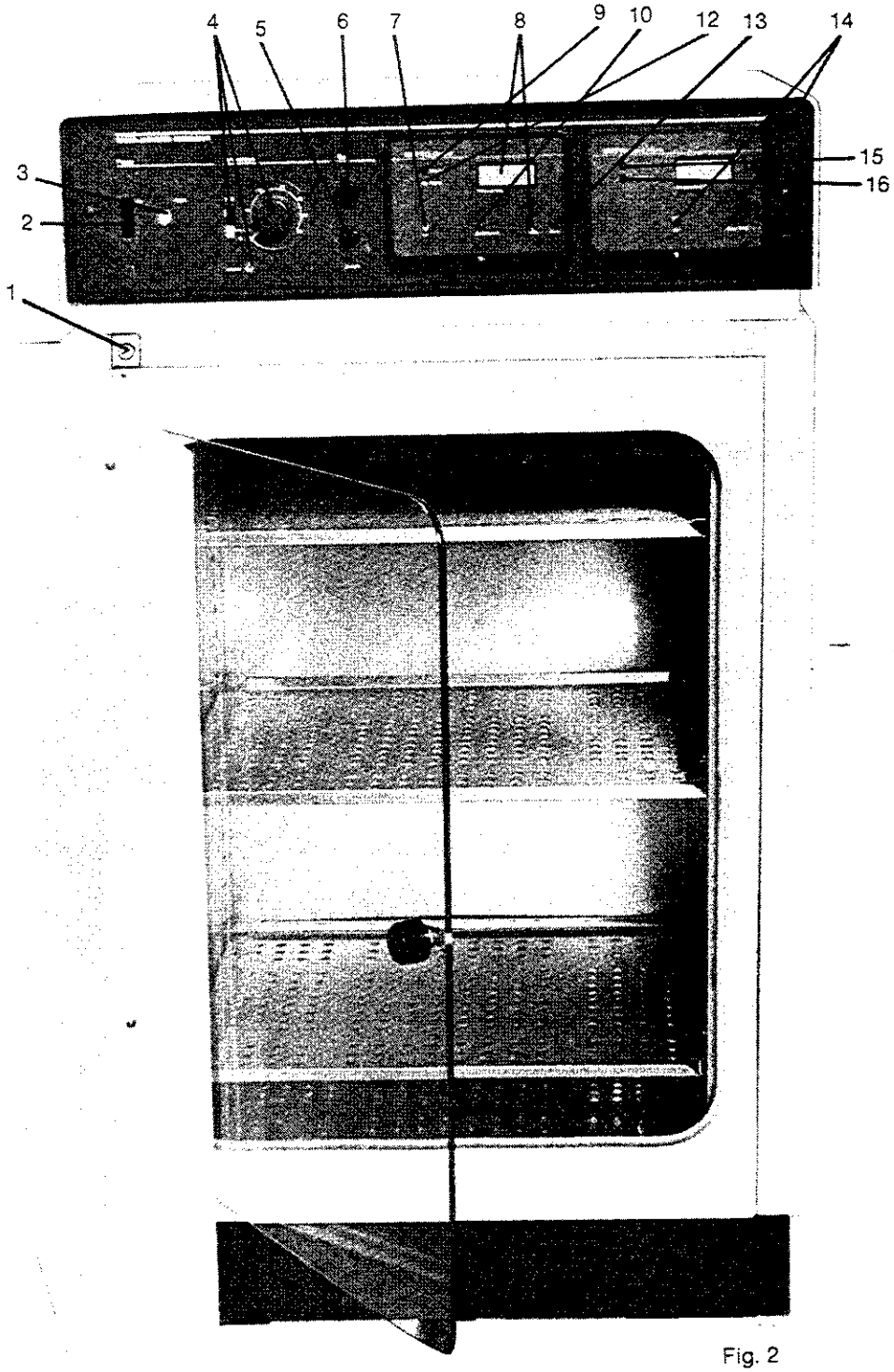
An internal blower functions to gently circulate the air in the chamber to prevent CO2 stratification while minimizing culture desiccation.

## 3.2 HUMIDIFICATION AND CO2 (IMPORTANT!)

Forma has selected the thermal conductivity method of measuring CO2, and when properly calibrated, our automatic CO2 system will provide stable CO2 control on a long term basis. The thermal conductivity of the incubator atmosphere is affected by not only the quantity of CO2 present, but also by the humidity level in the chamber. Since we want to control the CO2, it is important that the absolute humidity be held constant, so any change in thermal conductivity is caused by a change in the CO2 concentration only. Inadequate humidification can cause the incubator humidity to fluctuate with ambient atmospheric changes and can affect the CO2 calibration by as much as 1.5%. A special pan that is easy to remove for cleaning can be ordered from Forma (see Section 1.2). This pan, with the water level maintained between the add and full lines, will provide adequate humidification in the incubator.

It should be noted that temperature changes of themselves have little effect on CO2 calibration, but they do cause large changes in the absolute humidity, and these changes are reflected in changes in the CO2 calibration. If either the temperature or humidity setpoints are changed, the CO2 control should be zeroed for the new condition(s).

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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. $CO_2$ Power Switch
8. $CO_2$ Controller & Digital Display
9. $CO_2$ Alarm Light
10. Set/Silence Button
11. Alarm Disable Switch (Not Shown)
12. $CO_2$ Inject Light
13. $CO_2$ Zero Adjustment
14. Alarm/Monitor Module
15. Overtemp Light
16. Add Water Light

Fig. 2

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## 3.3 CONTROL PANEL (See Figure II)

### 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 ircubator 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.

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5) GAS SAMPLE PORT

A sample port for checking CO2 percentage by independent means (e. g. Fyrite or similar CO2 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 CO2 and overtemp setpoints. Pull out on the knob to release the screwdriver.

3.4 CO2 MODULE (See Figure II)

7) CO2 POWER SWITCH

The CO2 power switch controls the electrical power to the CO2 system, and it must be ON when the incubator is to be operated with CO2. The switch should be turned on as soon as power is applied to the unit to allow the CO2 system to warm up.

8) CO2 CONTROLLER AND DIGITAL DISPLAY

The LCD digital readout on the CO2 module continually displays the percent of CO2 in the chamber. The setpoint is displayed when the CO2 set/silence button is pushed.

CO2 setpoint is changed by pushing the CO2 set/silence button and rotating the CO2 setscrew to the desired percentage.

9) AUDIBLE CO2 ALARM AND PILOT LIGHT

The audible CO2 alarm and pilot light are activated when the percent CO2 deviates from setpoint by plus or minus 1% (nominal) for longer than approximately four minutes.

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10) SET/SILENCE PUSH BUTTON

When pushed, the set/silence button will silence the CO2 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 CO2 setpoint.

11) ALARM DISABLE SWITCH

NOTE: It is necessary to pull the CO2 module out slightly to gain access to the alarm disable switch.

When the switch is in the DISABLE position, the CO2 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) CO2 INJECT LIGHT

The CO2 inject light is activated whenever there is a demand for CO2 to meet setpoint requirements. Since the CO2 inject light is independent of the CO2 alarm, it will continue to signal a need for CO2 when the CO2 alarm is set to either the defeat or silence position.

13) CO2 ZERO ADJUSTMENT

The CO2 zero adjustment is used for zeroing the CO2 controller to specific control conditions. It is the ONLY user calibration adjustment on the CO2 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.

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

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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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4.12 Setting the Overtemp Safety Thermostat

4.13 Zeroing the CO2 Controller

4.14 Setting the CO2 Content


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## 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

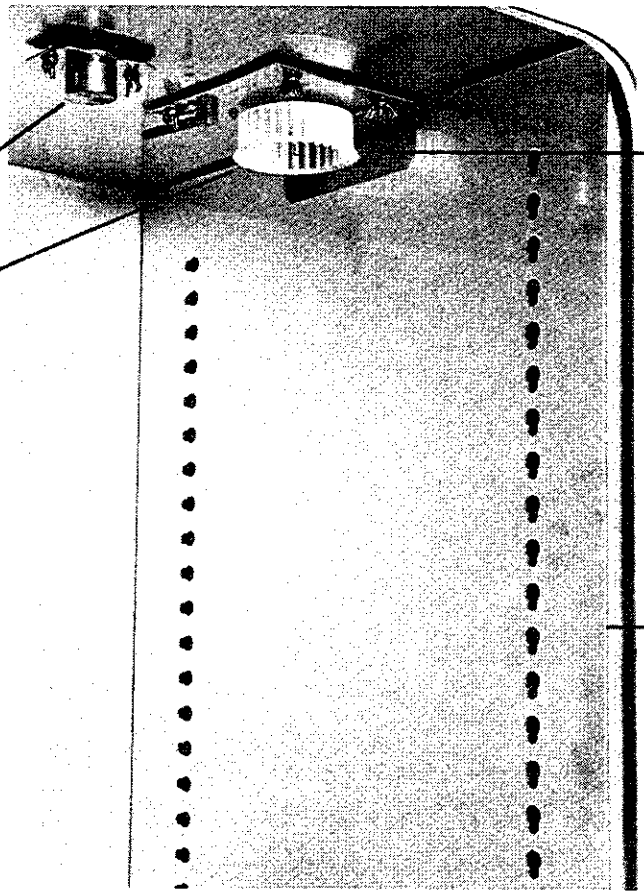
Immediately prior to installing the duct sheets and the shelves, disinfect all interior surfaces (including both door gaskets) by washing them down with Roccal II (5 ml/liter) or an equivalent laboratory disinfectant. Rinse the surfaces with distilled water. Also disinfect the $CO_2$ sensor and the blower 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.

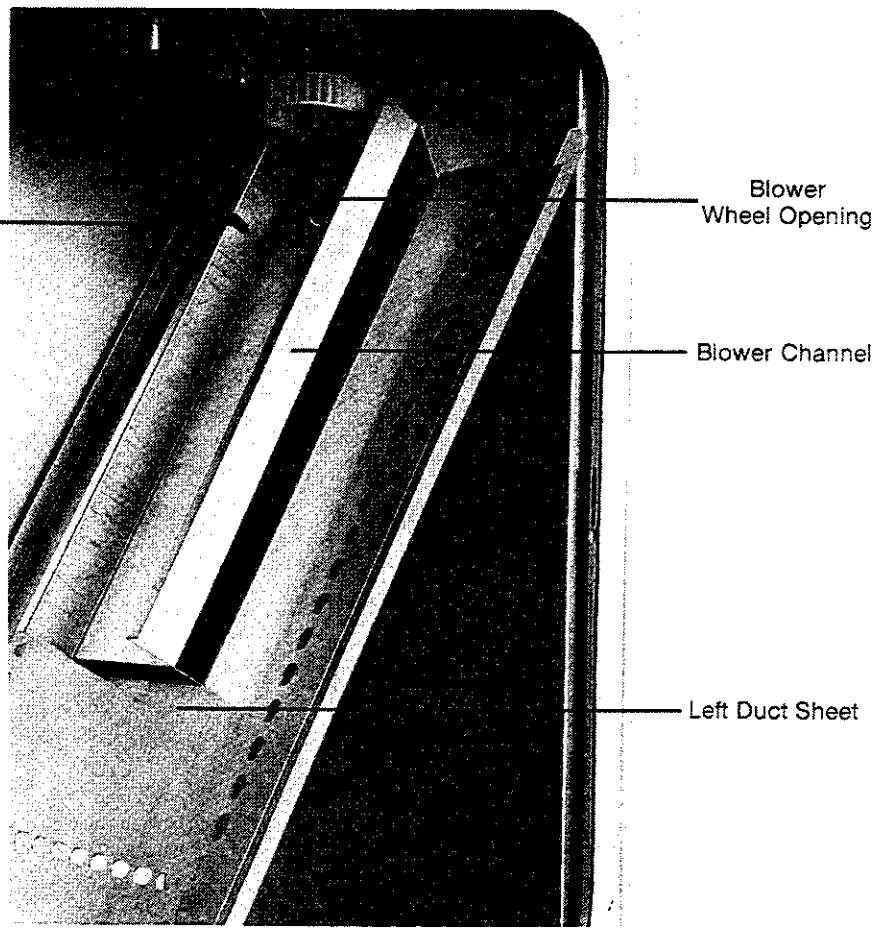
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## 4.3 INSTALLING THE DUCT SHEETS




**NOTE:**
The left duct sheet has a large notch in both the top and bottom edges. The right duct sheet has a notch in the top edge only.

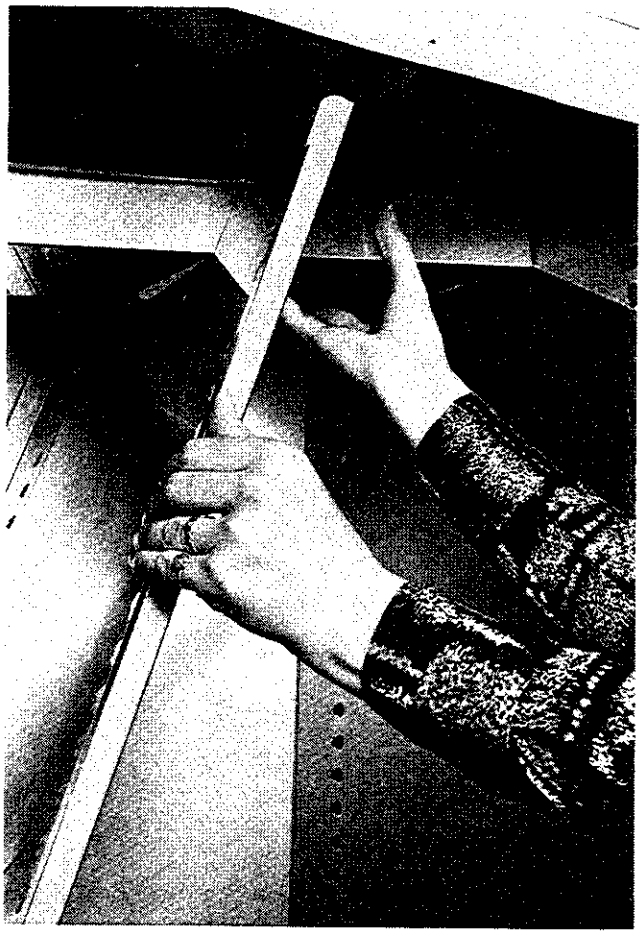
1) Carefully put the right duct sheet into the incubator chamber with the flanges toward the wall.



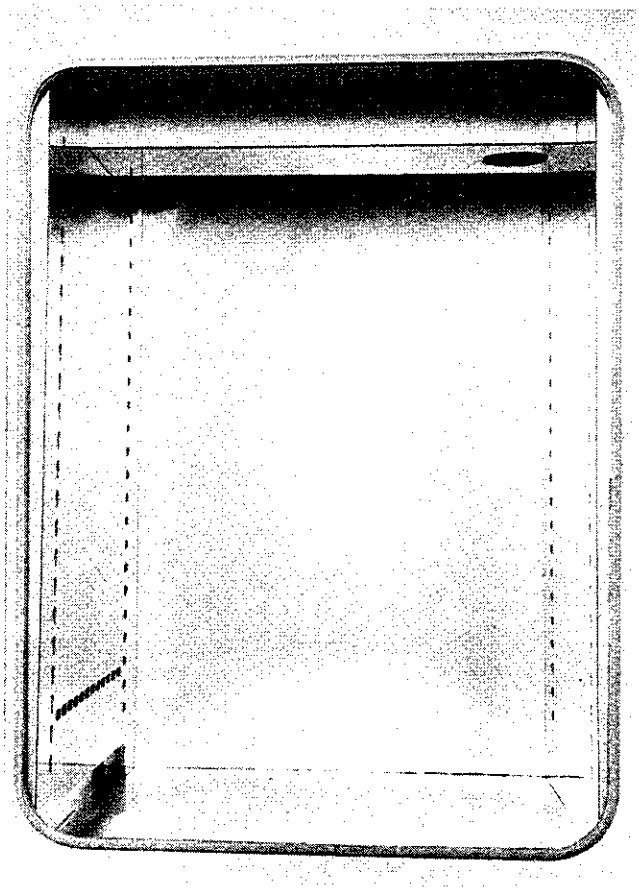

2) Put the left duct sheet into the chamber, with the square notch at the top and the flanges toward the wall.

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.

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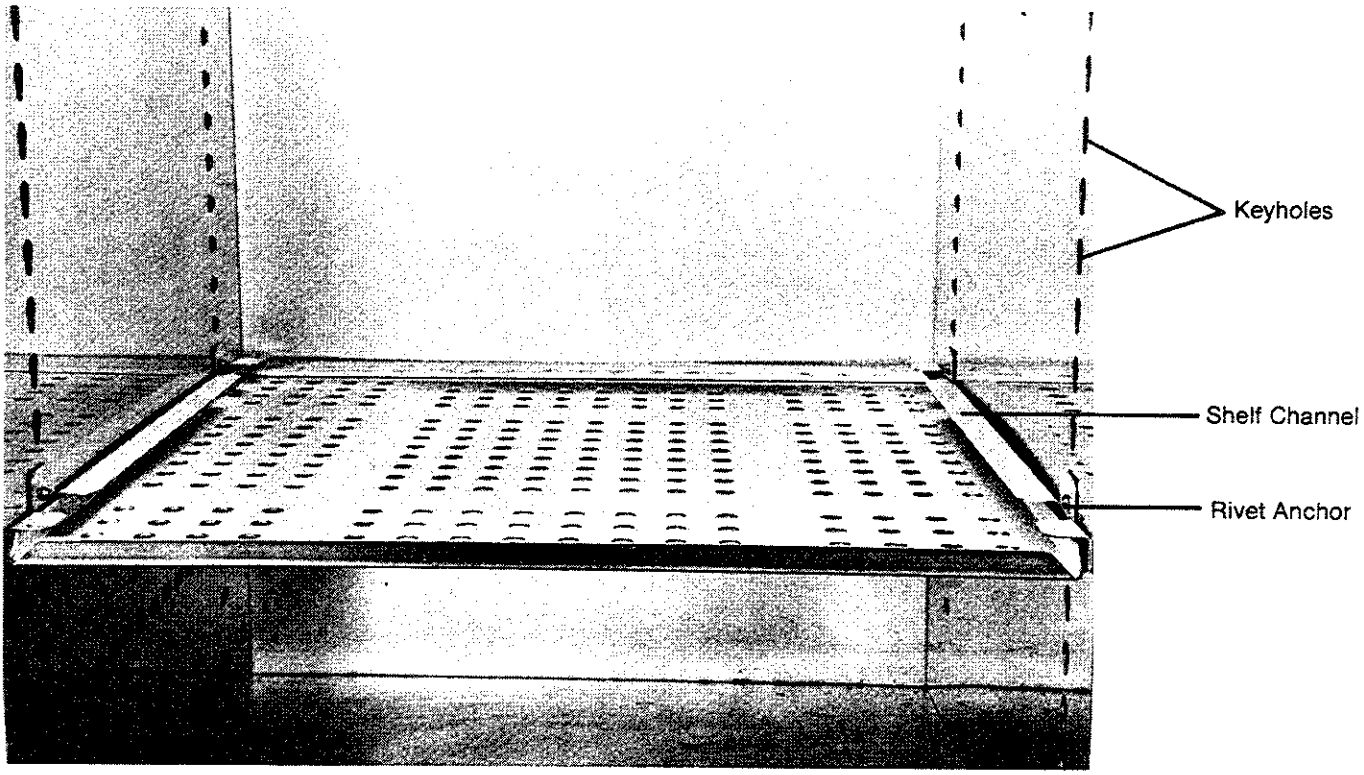


4) While supporting the blower channel, slide the left duct sheet up until it is vertical, making sure that the blower channel lines up into the slot on both duct sheets.

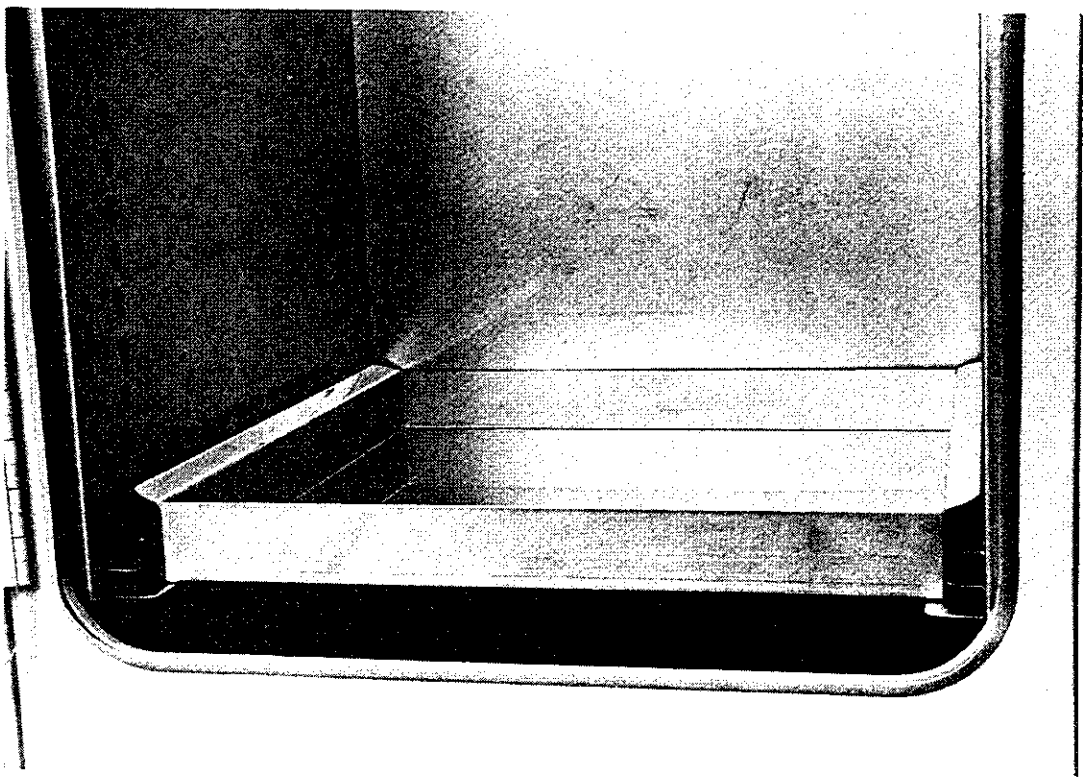


Completed installation of duct sheets and blower channel.

## 4.4 INSTALLING THE SHELVES




The shelves may be placed at any level in the chamber by installing the shelf channels at the desired levels. The channels are equipped with rivet anchors which fit into the keyholes of the vertical mounting brackets. The shelf is then simply slid into the shelf channels.



The optional humidity pan is mounted on the bottom shelf channels.

**Note: Do not** place the humidity pan on the floor of the incubator.

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## 4.5 LEVELING

Turning the leveling feet counterclockwise will lengthen them, and turning them clockwise will shorten them. Check leveling by placing a bubble-type level on one of the shelves.

### NOTES:

1) Be sure to level the incubator before filling it.
2) Do not attempt to tilt the incubator unassisted.
3) When tipping the incubator forward, be sure to secure the inner door and hold the outer door to prevent damage to the unit.

## 4.6 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.

## 4.7 CONNECTING THE CO2 SUPPLY

To provide for the most economical use of CO2, a main supply of liquid CO2 is recommended. The liquid CO2 should be supplied from tanks WITHOUT siphon tubes to ensure that only CO2 gas enters the incubator injection system. It 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.

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The CO2 source must be regulated at a pressure level of 5 to 10 PSIG. Higher pressure levels may damage the CO2 system. Pressure levels lower than 5 PSI will not affect the operation of the incubator, but will increase the CO2 recovery time.

TO CONNECT THE CO2 SUPPLY:

The CO2 fitting is located near the top rear of the incubator. Securely attach the vinyl CO2 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.

## 4.8 PREPARING THE INCUBATOR FOR FILLING

The access port for the water jacket is located behind the outer incubator door and is sealed with a screw cap.

Remove the cap, check to see that the opening is clear, and attach the threaded 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. This action will prevent the heater from coming on before the water jacket is filled.

2) Turn on the power to the incubator.

3) Push in on the set button on the monitor alarm module, and adjust the overtemp alarm setpoint to a setting above ambient.

4) Turn on the power to the CO2 module. Pull out on the module, and temporarily set the alarm switch to the Defeat position to silence the CO2 alarm. Push the module back in.

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## 4.9 FILLING THE WATER JACKET

### NOTES:

1) Forma recommends that you add Roccal II 10%, one part per 15,000 (2.65 ml/water jacket) to the water jacket to retard the growth of fungi and bacteria.

2) Use single distilled or demineralized water to fill the water jacket to prevent mineral build-up and minimize corrosion.

3) Use only the screw cap provided with the unit to seal the fill port. Use of another cap or cork could damage or plug the opening and impair its function.

FUNNEL METHOD

1) Fit the funnel into the vinyl tubing provided with the unit.

2) While extending the funnel above the fill port, pour water into the funnel until the Add Water alarm and light go off.

3) Add an additional liter of water, remove the hose, and cap the port finger tight.

SERRATED TAP METHOD

1) Fit the tubing to the serrated tap.

2) If the distilled water is supplied from a central system, turn the tap on so that water flows slowly to the incubator.

3) Turn the tap off when the Add Water alarm and light go off.

4) Add an additional liter of water, remove the hose, and cap the port finger tight.

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# CAUTION!

AS EXCESSIVE WATER PRESSURE OR OVERFILLING MAY DAMAGE THE INCUBATOR, DO NOT PLUG THE VENT DIRECTLY ABOVE THE DOOR! IF THE JACKET IS OVERFILLED, WATER CAN ESCAPE THROUGH THE VENT.

## 4.10 FILLING THE HUMIDITY RESERVOIR OR PAN

### NOTES:

1) Do not use glass or plastic pans for humidification, as they will have an unpredictable effect on humidity and CO2 levels in the incubator. Use only the floor of the unit or the optional Forma humidity pan.

2) Add any of the following to the water to retard the growth of contaminants:

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

### WARNINGS!

1) 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.

2) DO NOT USE DEMINERALIZED OR DEIONIZED WATER IN THE HUMIDITY RESERVOIR OR PAN UNLESS IT IS BOILED IMMEDIATELY PRIOR TO USE, AS IT IS SOMETIMES CONTAMINATED WITH BACTERIA.

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There are two recommended 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 freshly distilled or tap water

OR

2) The optional humidity pan (Forma Stock #237001) can be filled to the fill line with freshly distilled or tap water. Mounted on the bottom shelf channels, this pan can be easily removed for filling or cleaning. DO NOT MOUNT THE HUMIDITY PAN ON THE FLOOR OF THE INCUBATOR, AS IT COULD CAUSE THE INNER DOOR GASKET TO TEAR.

The water level in the humidity reservoir or pan should be checked frequently, and the WATER SHOULD BE CHANGED AND ROCCAL II ADDED (7.5 ml) ON A WEEKLY BASIS 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 have an effect on the humidity level and CO2 control in the chamber.

## 4.11 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 your desired operating setpoint. The overtemp safety may be reset after the chamber temperature has stabilized at setpoint. (See Section 4.12)

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 between 5 degrees C above ambient to 50 degrees C may be selected.

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## 4.12 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 setpoint.

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.

## 4.13 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 panel)
2) Fyrite CO2 Analyzer (use only for checking) or other CO2 measuring device.

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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 if 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 5.9 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.

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## 4.14 SETTING THE CO2 CONTENT

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

1) Allow the temperature and humididty in the chamber to stabilize. For initial settings of CO2, it is recommended that the temperature and humidity be allowed to stabilize for three days.

2) Check the CO2 control zero (See Section 4.13 for detailed instructions).

TO SET THE CO2 PERCENTAGE, press the CO2 Set/Silence button, and rotate the CO2 set screw until the desired percentage is indicated on the digital display.

NOTE:

IF THE UNIT IS IN OVERTEMP AND A CO2 INJECTION OCCURS, YOU WILL SEE A BRIEF, HIGH CO2 PERCENTAGE ON THE DIGITAL DISPLAY DUE TO THE SHUT DOWN OF THE INTERNAL FAN DURING OVERTEMP. THE HIGH CO2 PERCENTAGE ONLY OCCURS AT THE SENSOR, AND AVERAGE CO2 THROUGHOUT THE CHAMBER WILL REMAIN NORMAL.

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# SECTION 5: ROUTINE MAINTENANCE

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5.4 Draining the Water Jacket

5.5 Changing the CO2 Filter

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5.7 Overview of the Fyrite CO2 Analyzer

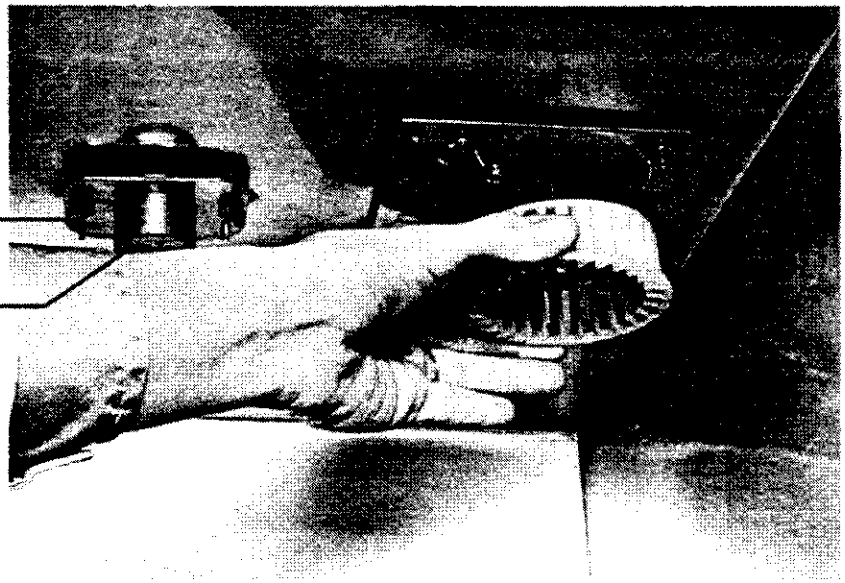
5.8 Fyrite Operating Precautions

5.9 Operating the Fyrite

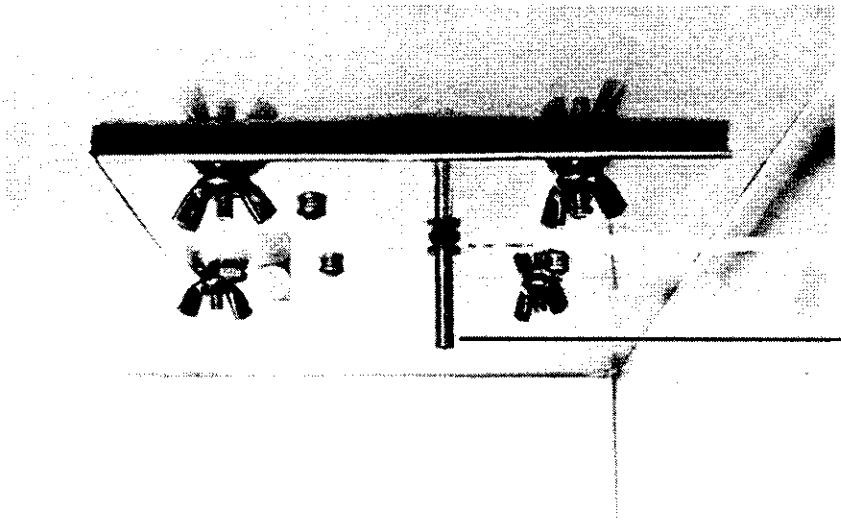
5.10 Checking the Fyrite Fluid Strength

5.11 Raising or Lowering the Fyrite Fluid Level

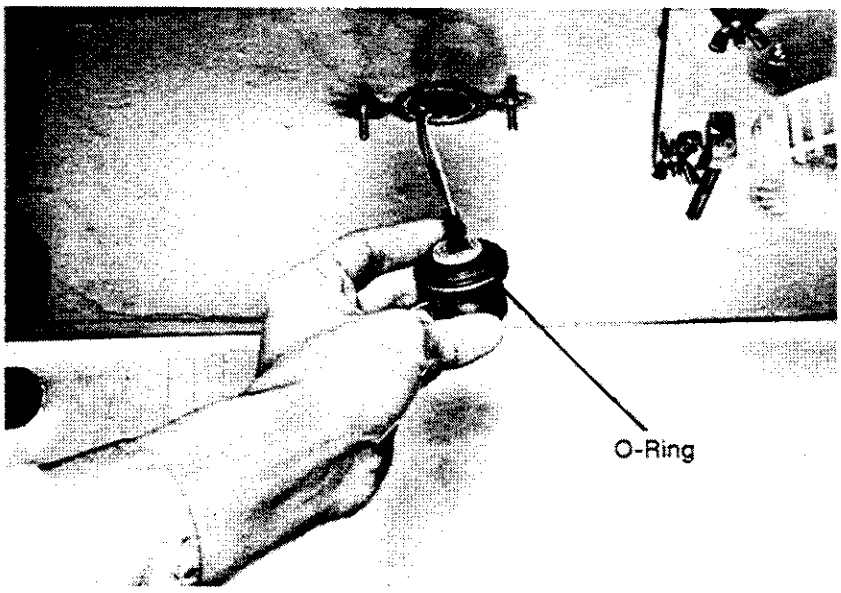

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1) Disconnect the unit from the power supply.
2) Remove the shelves and duct sheets from the unit.
3) Remove the blower wheel by firmly pulling it down.




5) Replace the blower wheel with the new one in the kit. Be sure that the blower moves freely and does not hit any of the mounting screws.




6) Remove the wing nuts securing the $CO_2$ sensor, and allow the sensor to drop down. The sensor should not be pulled sharply, or damage to the wires could result. Disconnect the sensor.
7) Peel the O-ring off of the sensor, and replace it with the O-ring provided in the kit.
8) Wipe the sensor clean, taking care not to saturate it. Reconnect the sensor.
9) Push the wires back into the opening, and re-install the sensor. Be sure to tighten the wing nuts securely so the O-ring will seal properly.

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## 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).

**WARNINGS**

1) ALCOHOL, EVEN A 70% SOLUTION, IS VOLITILE 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.

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

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

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## 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 CO2 FILTER (FOR QUALIFIED SERVICE PERSONNEL ONLY!)

NOTE: Under conditions of normal useage, and dependent on the purity of gas being used, the CO2 filter should be good for approximately five years.

If the CO2 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 CO2 sample port, and slide the control panel out.

3) Locate the CO2 filter at the back of the control panel.

4) Remove and replace the filter.

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## 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.

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## 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:

## ANTIDOTE

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 windowsill).

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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 CO2 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.

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## NOTE:

WHEN USED CORRECTLY, THE FYRITE IS ONLY ACCURATE TO WITHIN +1/2% OF ACTUAL CO2 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 CO2 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.

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## 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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6.12 Replacing the Circuit Breaker

6.13 Replacing the Power Switch

6.14 Replacing the Thermistors

6.15 Replacing the Blower Motor

6.16 Parts List, Supplements, Schematics
Warranty Information


CAUTION! SERVICING OF THE UNIT SHOULD BE ACCOMPLISHED BY QUALIFIED SERVICE PERSONNEL ONLY!

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## 6.1 GENERAL TROUBLESHOOTING

1) PROBLEM: Pilot lights not on.
Readouts are dark.
CO2 power switch 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.

---

2) PROBLEM: 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.

---

3) PROBLEM: 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.

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4) PROBLEM: 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.

---

5) PROBLEM: CO2 alarm and light are activated.
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.

---

6) PROBLEM: 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.

---

7) PROBLEM: 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.

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8) PROBLEM: 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.

---

9) PROBLEM: 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.

---

10) PROBLEM: 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.

---

11) PROBLEM: CO2 setpoint cannot be changed.

POSSIBLE CAUSE:
a. Defective CO2 control.

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12) PROBLEM: Unit cannot be zeroed.

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

---

13) PROBLEM: CO2 overshoots badly.

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

---

14) PROBLEM: Actual CO2 is higher than setpoint and readout.
Re-zeroing helps for a time, then symptom returns.

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

---

15) PROBLEM: 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.

---

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16) PROBLEM: CO2 setpoint changes by itself.

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

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## 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 CO2 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.

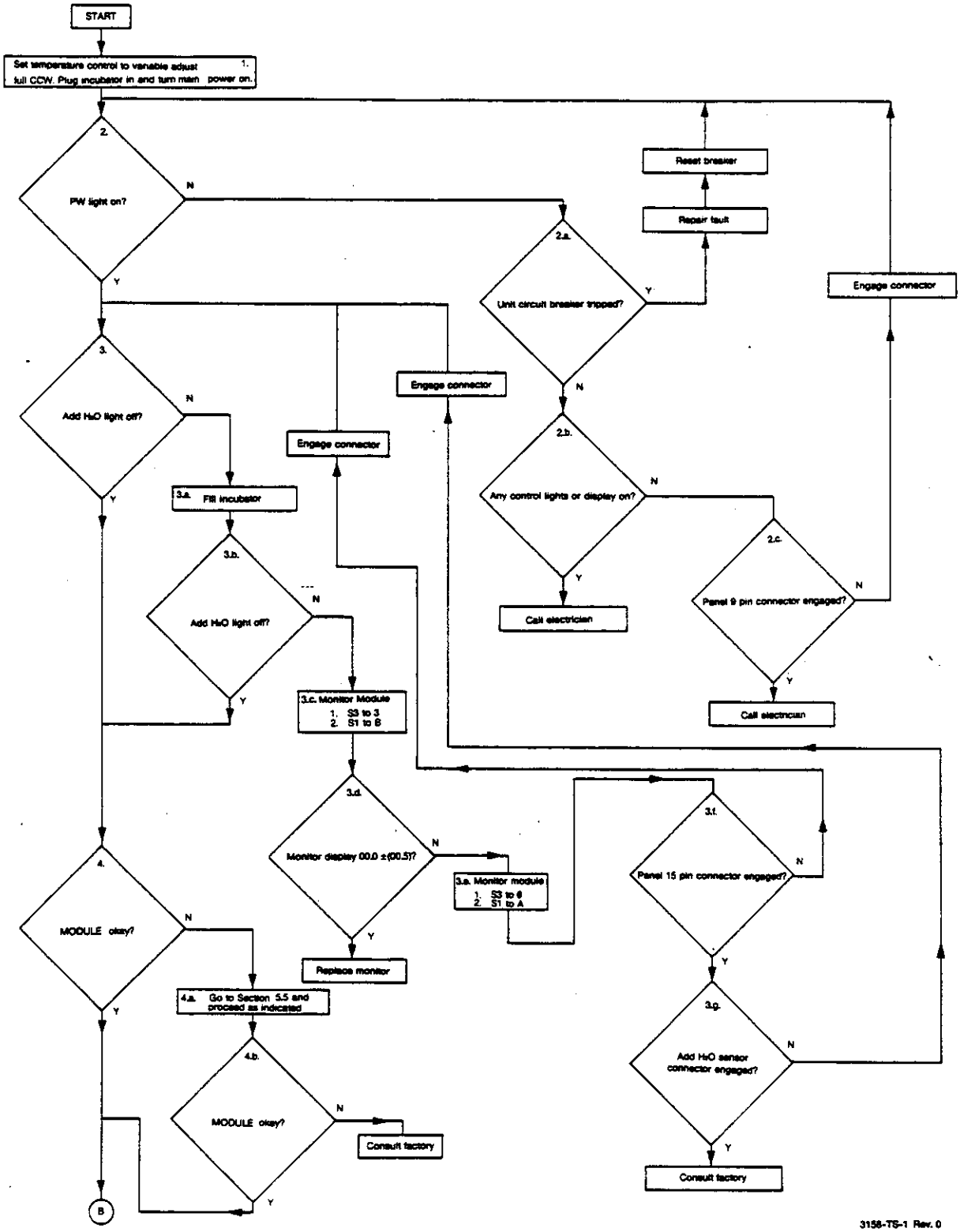
The following two flow charts are for troubleshooting the incubator in general.

Y = Yes N = No

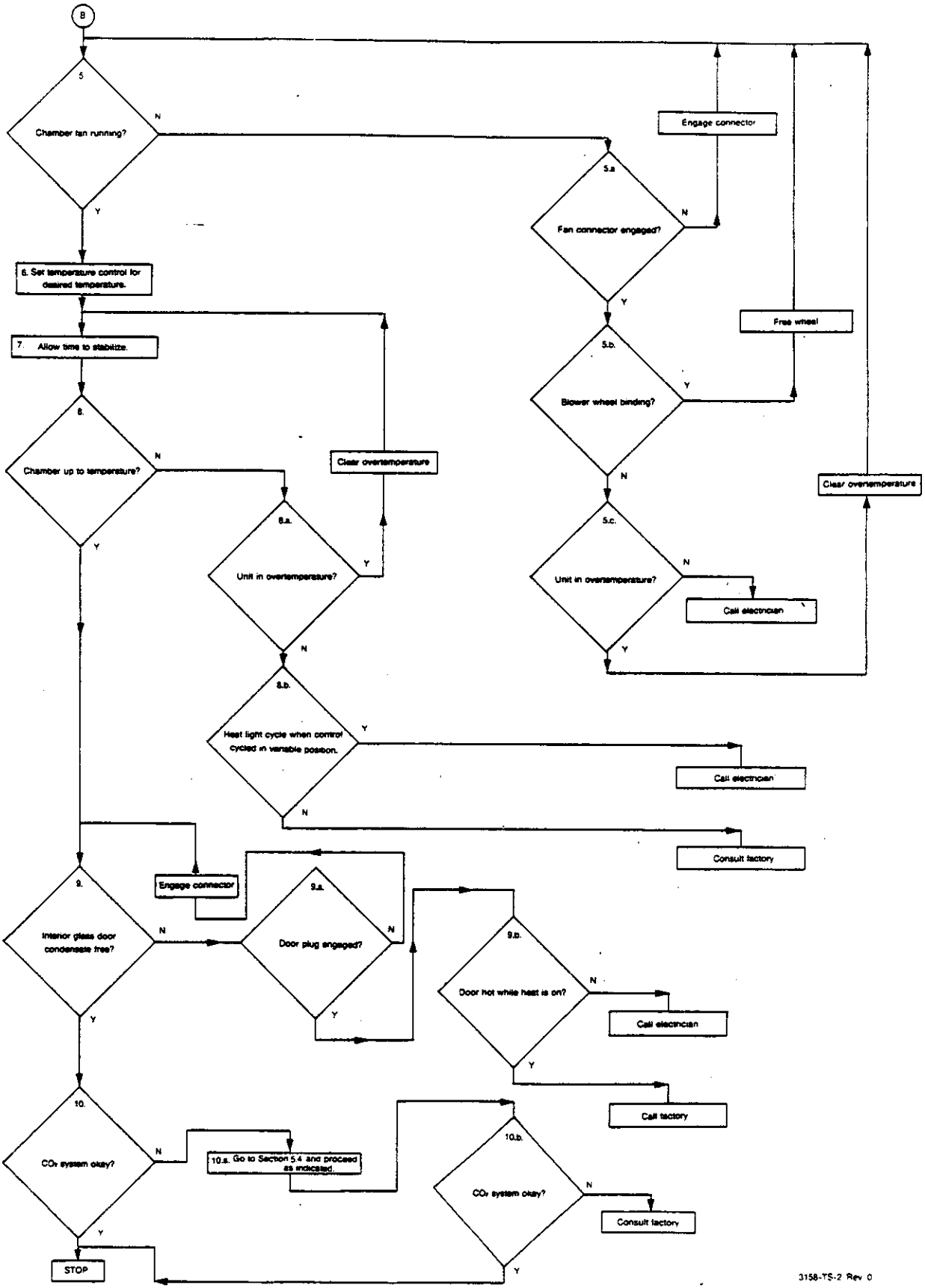
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# GENERAL TROUBLESHOOTING FLOWCHART

NOTE: Y= YES
N= NO




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## 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 calibraton, 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.

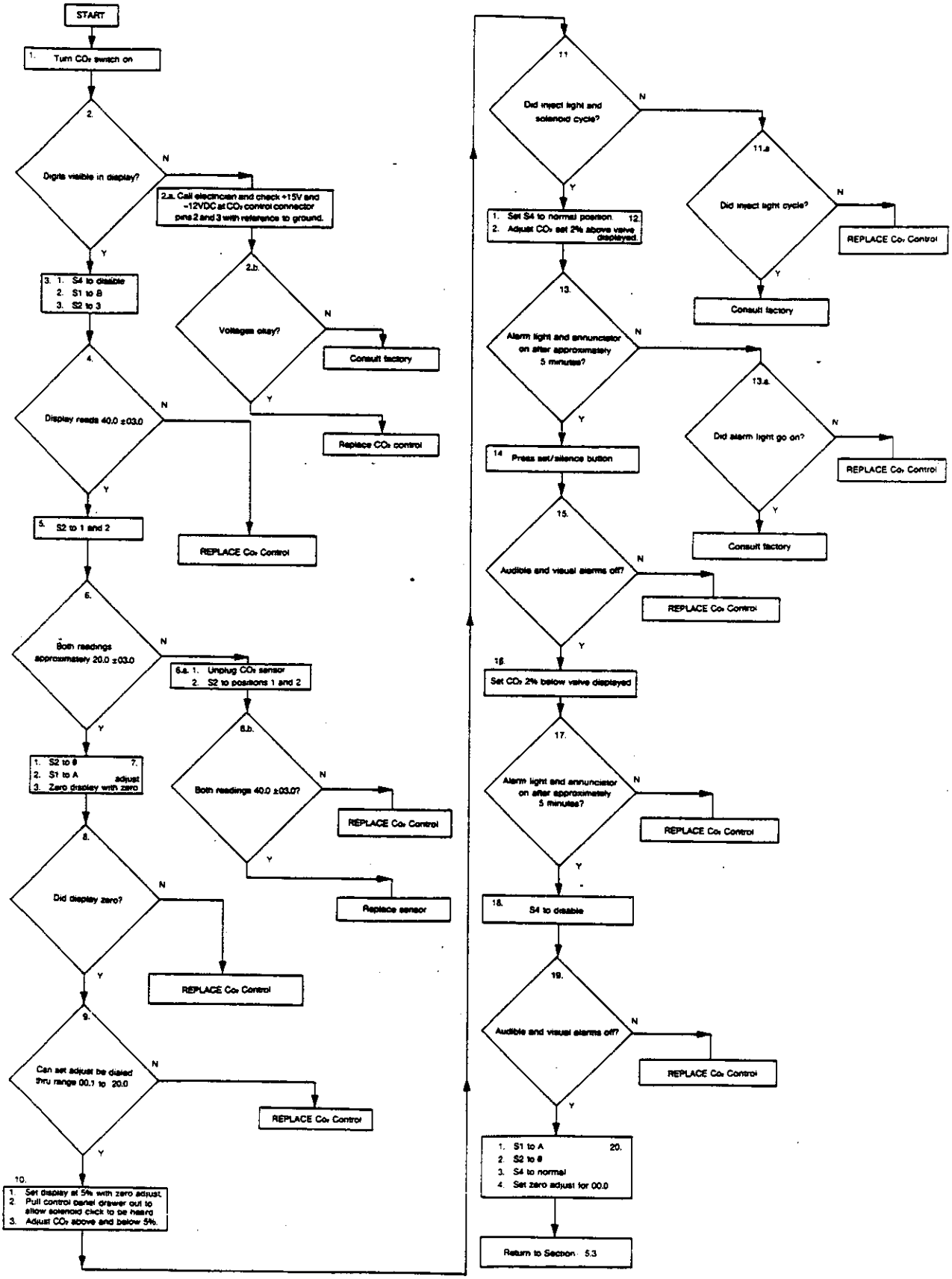
NOTE 9: Y = Yes, N = No

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# $CO_2$ MODULE TROUBLESHOOTING FLOWCHART

Note: Before using this flow diagram, it is important that the calibration of the $CO_2$ 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 $CO_2$ system after using this procedure. Turn $CO_2$ 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




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## 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.

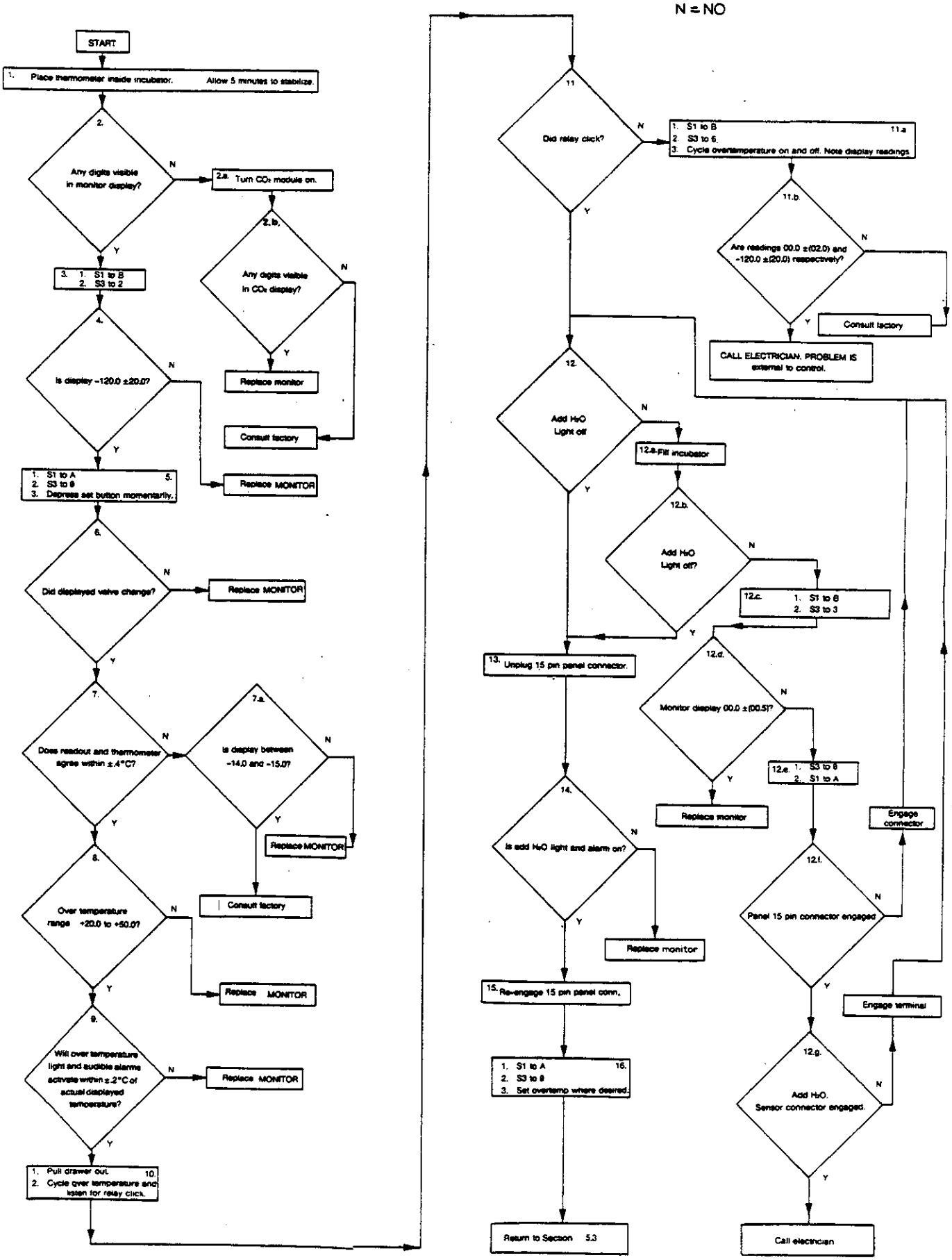
NOTE 3: When the chart calls for contacting an electrician, your in-house electrical technician should be called.

NOTE 4: Y = Yes, N = No

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# ALARM MODULE TROUBLESHOOTING FLOWCHART

NOTE: Y = YES
N = NO




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## 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.

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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.

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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 37C.

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.

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CAUTION! For Sections 6.5 - 6.15, SERVICING SHOULD BE ACCOMPLISHED BY QUALIFIED SERVICE PERSONNEL ONLY! ALWAYS DISCONNECT THE INCUBATOR FROM THE POWER SOURCE BEFORE INITIATING 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.

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8) Smooth the aluminum foil as much as possible.

9) Peel half of the paper backing off 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.

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11) Connect the wiring in the same manner as before.

12) Reassemble the door by reversing the 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 that secure the triac.

5) Carefully disconnect the wires to the triac, and make note of their configuration 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

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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 #140018-74-0-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.

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## 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 BLOWER MOTOR (See Fig. 3)

1) Remove the shelves, duct sheets, and blower channel from the incubator interior.

2) Remove the four wing nuts securing the blower mounting plate to the incubator ceiling.

3) Remove the blower wheel and the V-seal by pulling them down gently but firmly.

4) Remove the tygon tubing from the mounting plate,

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and disconnect the electrical connector from the motor wiring.

5) Remove the four mounting screws and lock washers that secure the motor to the mounting plate, and remove the motor. Remove and retain the two V-seals on the motor shaft for use on the new motor.

6) Remove the four metal stand-offs from the motor mounting screws, and retain them for use on the new motor.

7) Install the metal stand-offs on the mounting screws of the new motor. Place the V-seal on the motor shaft approximately 1/2" down.

8) Install the new motor by reversing the above procedure, taking care that the wires and tubing are connected in the same configuration as they were before.

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# MODEL 3326 - PARTS

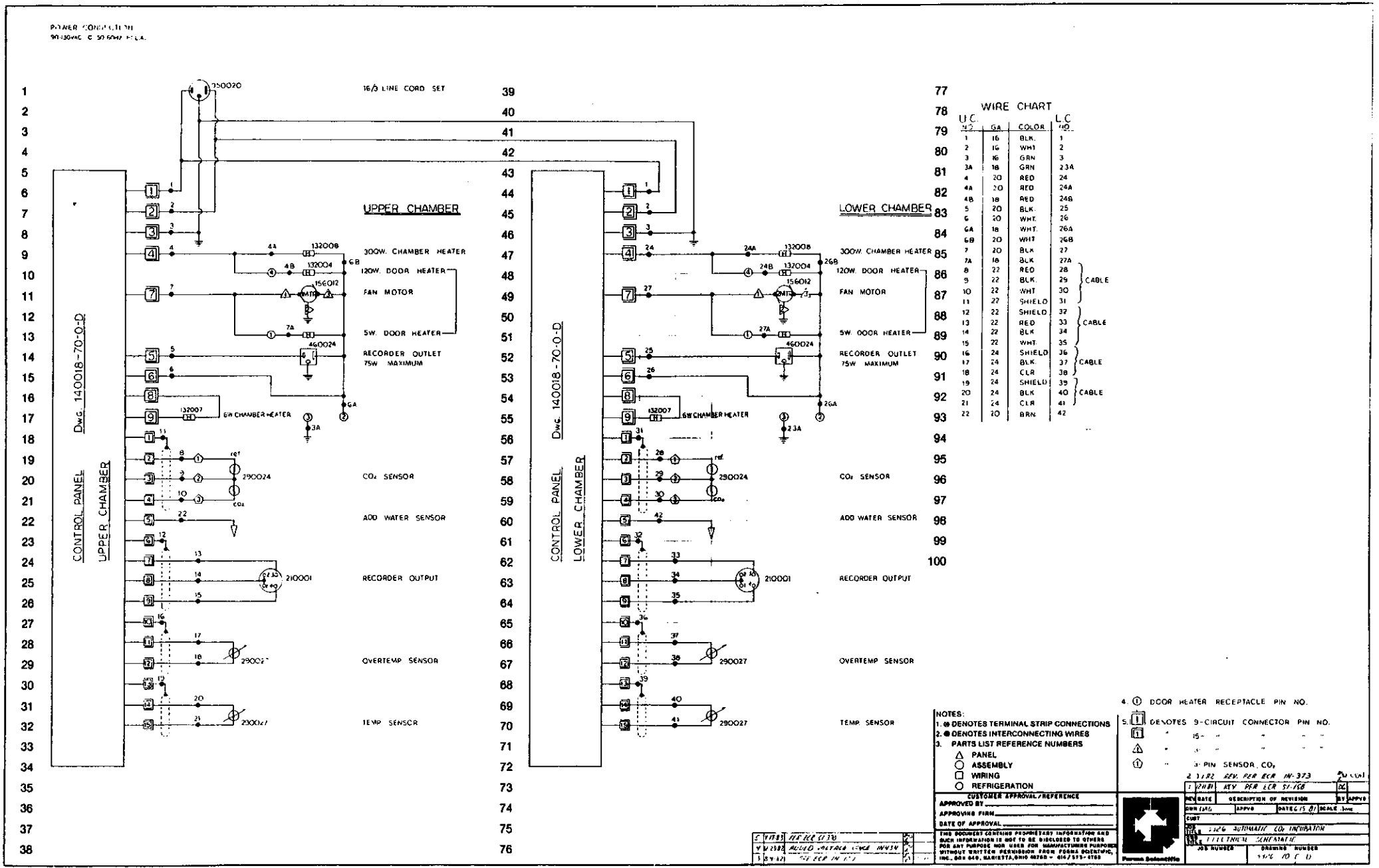
| QUANTITY | STOCK # | DESCRIPTION |
|---|---|---|
| 2 | 116011 | Interior Door Hinge |
| 2 | 231011 | Monitor/Alarm Module |
| 2 | 231039 | CO2 Control Module |
| 1 | 290024 | CO2 Sensor Assembly |
| 2 | 505522 | Latch Tab for Incub. Door |
| 2 | 890155 | Glass Door |
| 2 | 260001 | Knob, Blk, 1/4" Bush, 1/4" Dia. |
| 2 | 505523 | Latch Stud for Incub. Door |
| 12 | 224200 | Shelf, Square, Stainless Steel |
| 24 | 505072 | Shelf Channel |
| 2 | 460024 | Snap-In Outlet, Mini |
| 1 | 950020 | 16/3 SJT Cord Set, 8 Ft. |
| 2 | 132004 | Door Heater, 5 Watt, 120V, Foil |
| 2 | 431142 | 4 Side Molded Magnetic Gasket |
| 2 | 950016 | 15" 4 Wire Cord w/Special Plug |
| 4 | 116012 | LH Exterior Door Hinge |
| 14.4 | 400296 | Silicone Feather Gasket |
| 2 | 100008 | Blower Wheel |
| 2 | 156012 | Motor, 2 Pole, 115VAC, 50/60 Hz |
| 2 | 370067 | 3 Circuit Mate-N-Lock Receptacle |
| 2 | 132007 | Heater Cable 120V, 6 Watt, Foil |
| 2 | 132008 | Chamber Heater, 260 Watt, Foil |

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| QUANTITY | STOCK # | DESCRIPTION |
|---|---|---|
| 2 | 231004 | Temperature Controller |
| 4 | 235013 | Adjustment Screwdriver |
| 2 | 230023 | 5 Amp SP Thermal Circuit Breaker |
| 2 | 285379 | 25 Amp Triac |
| 2 | 880007 | 1/2" MPT Nylon Plug (Fill Port) |
| 2 | 250221 | 12V DC DPDT Coil Relay |
| 2 | 250002 | 1/8 Hose Ryton Valve (CO2) |
| 2 | 290027 | 1K, 7 Ft. Thermistor Cable |
| 2 | 280004 | Green Pilot Light |
| 2 | 280006 | Red Pilot Light |
| 4 | 111008 | Pilot Light Mounting Clip |
| 2 | 360054 | Rocker Switch DPST On/Off |
| 2 | 770001 | CO2 Filter |

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