Thermo
ELECTRON CORPORATION

# Models:
# 370/371 and 380/381

## Steri-Cycle $CO_2$ Incubator

## Direct Heat with Sterilization Cycle

**Operating and Maintenance Manual**
**Manual No: 7000370 Rev. 8**

**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.***

**Refer to the serial tag on the back of this manual.**

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

| Model | Sensor* | Voltage** |
|---|---|---|
| 370 | T/C | 115 |
| 371 | T/C | 230 |
| 380 | IR | 115 |
| 381 | IR | 230 |

*T/C is a thermal conductivity sensor. IR is an infrared sensor.

**All units are 50/60 Hz.

***If the incubator is not used in the manner specified in this operating manual, the protection provided by the equipment design may be impaired.***


**MANUAL NUMBER 7000370**

| | | | | |
|---|---|---|---|---|
| -- | 22434/IN-3211 | 8/25/04 | Updated water quality description for humidity pan | ccs |
| 8 | 21730/SI-9181 | 6/15/04 | Added alternate 250085 solenoid valve | ccs |
| 7 | 21980/IN-3156 | 11/07/03 | Added min/max load and analog output boards max external cable length | ccs |
| 6 | 21273/IN-3147 | 10/13/03 | Factory default for gas guard to ON from OFF | ccs |
| 5 | 21574/IN-3124 | 8/12/03 | Updated temp sensor from 290137 to 290184 (glass encapsulated) | ccs |
| 4 | 21237/IN-3068 | 2/24/03 | Upgraded inner door components (370-200-9) | ccs |
| -- | 20959/IN-3048 | 10/1/02 | Added spacers to power supply mounting | ccs |
| 3 | 20374/IN-2994 | 11/12/01 | Updated 200-6 drawing - Kaizen, board hardware | ccs |
| | 20460 | | Corrected 4-20mA board temp output to 12.5 - 162.5°C | |
| 2 | 20276/IN-2970 | 9/24/01 | Clarified Step 2 of Section 4.4 | ccs |
| 1 | 19948/IN-2947 | 9/10/01 | Updated $CO_2$ inlet labels, 200-9 exploded parts drawing | ccs |
| -- | -- | 6/28/01 | Updates per J. Leach | |
| | | | (art & list on page 5-4 and reference to 4-3, not 4-4 in Alarm section) | ccs |
| 0 | -- | 3/1/01 | Original manual | ccs |
| **REV** | **ECR/ECN** | **DATE** | **DESCRIPTION** | **By** |

***Important operating and/or maintenance instructions. Read the accompanying text carefully.***

***Potential electrical hazards. Only qualified persons should perform procedures associated with this symbol.***

***Hot surface(s) present which may cause burns to unprotected skin or to materials which may be damaged by elevated temperatures***

√ Always use the proper protective equipment (clothing, gloves, goggles, etc.)
√ Always dissipate extreme cold or heat and wear protective clothing.
√ Always follow good hygiene practices.
√ Each individual is responsible for his or her own safety.

## Do You Need Information or Assistance on Thermo Electron Corporation Products?

If you do, please contact us 8:00 a.m. to 6:00 p.m. (Eastern Time) at:

| | |
|---|---|
| 1-740-373-4763 | Direct |
| 1-888-213-1790 | Toll Free, U.S. and Canada |
| 1-740-373-4189 | FAX |
| http://www.thermo.com/forma | Internet Worldwide Web Home Page |
| services.controlenv@thermo.com | Service E-Mail Address |

Our **Sales Support** staff can provide information on pricing and give you quotations. We can take your order and provide delivery information on major equipment items or make arrangements to have your local sales representative contact you. Our products are listed on the Internet and we can be contacted through our Internet home page.

Our **Service Support** staff can supply technical information about proper setup, operation or troubleshooting of your equipment. We can fill your needs for spare or replacement parts or provide you with on-site service. We can also provide you with a quotation on our Extended Warranty for your Thermo products.

Whatever Thermo products you need or use, we will be happy to discuss your applications. If you are experiencing technical problems, working together, we will help you locate the problem and, chances are, correct it yourself...over the telephone without a service call.

When more extensive service is necessary, we will assist you with direct factory trained technicians or a qualified service organization for on-the-spot repair. If your service need is covered by the warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

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.

# Warranty Notes

## Information You Should Know Before Requesting Warranty Service

- **Locate the model and serial numbers.** A serial tag is located on the unit itself and on the operating manual shipped with the unit.
- For equipment service or maintenance, or with technical or special application inquiries, contact Technical Services at 1-888-231-1790 or 1-740-373-4763 (USA and Canada). Outside the USA, contact your local distributor.

## Repairs NOT Covered Under Warranty

- **Calibration of control parameters.** Nominal calibrations are performed at the factory; typically ±1°C for temperature, ±1% for gases, and ±5% for humidity. Our service personnel can provide precise calibrations as a billable service at your location. Calibration after a warranty repair is covered under the warranty.
- **Damage resulting from use of improper quality water, chemicals or cleaning agents detrimental to equipment materials.**
- **Service calls for improper installation or operating instructions.** Corrections to any of the following are billable services:
  1) electrical service connection
  2) tubing connections
  3) gas regulators
  4) gas tanks
  5) unit leveling
  6) room ventilation
  7) adverse ambient temperature fluctuations
  8) any repair external to the unit
- **Damage resulting from accident, alteration, misuse, abuse, fire, flood, acts of God, or improper installation.**
- **Repairs to parts or systems resulting from unauthorized unit modifications.**
- **Any labor costs other than that specified during the parts and labor warranty period, which may include additional warranty on $CO_2$ sensors, blower motors, water jackets, etc.**

## Table of Contents

# Section 1 - Installation and Start-up

## 1.1 Incubator Components

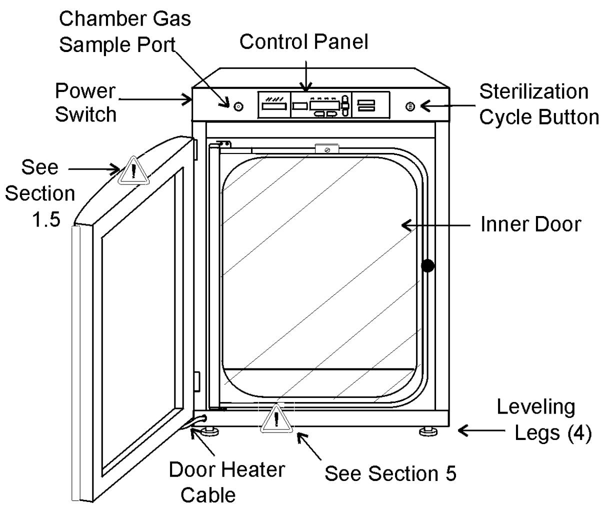



**Figure 1-1**
**Model 370 Series Incubator**

- Outer Door - Reversible to opposite swing, see Section 5.5
- Inner Door - Reversible to opposite swing, see Section 5.5
- Chamber Gas Sample Port - Used for sampling chamber $CO_2$ content using a FYRITE or similar instrument.
- Main Power Switch
- Control Panel - Keypad, Displays & indicators (Figure 1-2)
- Leveling Legs - Used to level the unit
- Power Switch - Mains disconnect
- Sterilization Cycle Button - Switch to initiate sterilization cycle

**Note:** The incubators are stackable. See Section 1.5.b.

## 1.2 Control Panel Keys, Displays and Indicators (See Figure 1-2)

1. **Silence** - Silences the audible alarm.
2. Alarm Indicator - Light pulses on/off during an alarm condition in the cabinet.
3. **Mode** Select Switch - Used to select Run, Setpoints, Calibration and System Configuration Modes.
4. Message Center - Displays system status.
5. **Mode** Select Indicators -

   **Run:** Run Menu

   **Set:** Set Points Menu

   **Cal:** Calibrate Menu

   **Config:** Configuration Menu
6. Up and Down Arrows - Increases or decreases the number values, toggles between choices.
7. **Enter** - Stores the value into computer memory.
8. **Heat** Indicator - Lights when power is applied to the heaters.
9. **Temp** Display - Program to display temperature continuously, RH continuously (with RH option), or toggle between temperature and humidity (with RH option). See Section 3.1, Configuration.
10. **Scroll for Parameters** Arrows - Moves the operator through the choices of the selected mode.
11. $CO_2$ **Inject** Indicator - Lights when $CO_2$ is being injected into the incubator.
12. **% CO2** Display - Displays $CO_2$ percentage continuously.

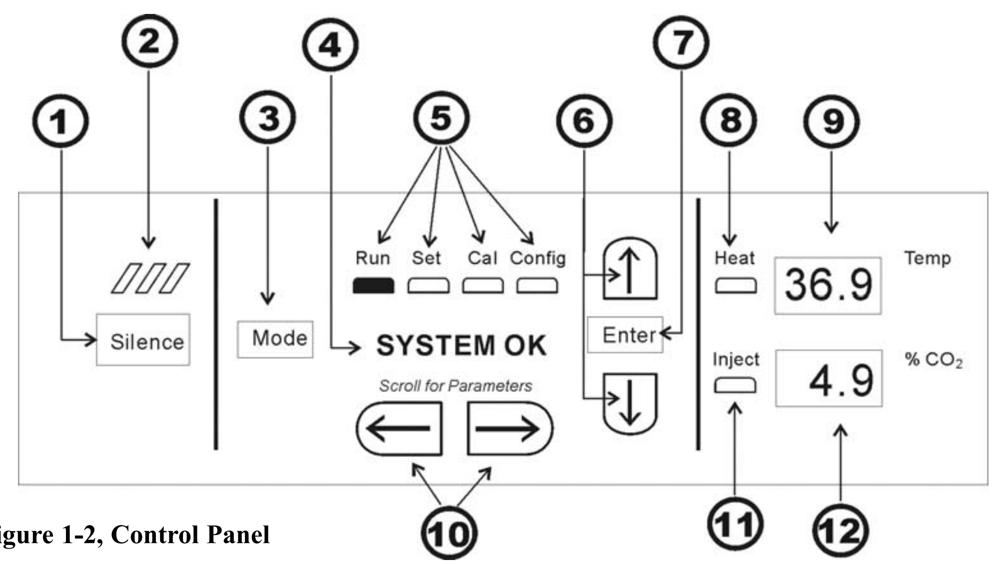



**Figure 1-2, Control Panel**

## 1.3 Operation of the Keypad

The Model 370 Series incubator has four basic modes which allow incubator setup: Run, Setpoints, Calibration and System Configuration.

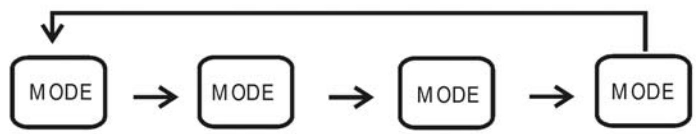
**Run** is the default mode which the incubator will normally be in during operation.

**Set** is used to enter system setpoints for incubator operation.

**Calibration** is used to calibrate various system parameters.

**Configuration** allows for custom setup of various options.

The chart below shows the selections under each of the modes.




| RUN | SETPOINT | CALIBRATION | CONFIGURATION |
|---|---|---|---|
| **Default Mode** | **Temperature** | **Temp Offset** | **Audible** |
| | **Overtemp** | **$CO_2$ Cal**[1] | **New HEPA Timer** |
| | **$CO_2$** | **IR Cal**[2] | **Replace HEPA Reminder** |
| | | *RH Cal* | **Access Code** |
| | | | **Temp Lo Alarm** |
| | | | **Temp Relay** |
| | | | **$CO_2$ Lo Alarm** |
| | | | **$CO_2$ Hi Alarm** |
| | | | **$CO_2$ Relay** |
| | | | **$CO_2$ Z & S #'s *** |
| | | | *RH Lo Alarm* |
| | | | *RH Relay* |
| | | | *Display Temp* |
| | | | *Display RH* |
| | | | *Tank Select* |
| | | | *Gas Guard* |
| | | | **RS485 Address** |

[1] T/C units only
[2] IR units only

Base Unit Displays
Option Displays
*T/C units only

**Scroll for Parameters Arrows:** Steps the operator through the parameters of SET, CAL and CONFIG Modes. The right arrow goes to the next parameter, the left arrow returns to the previous parameter.

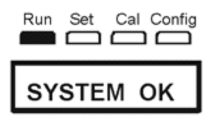
**Up Arrow:** Increases or toggles the parameter value that has been selected in the SET, CAL, and CONFIG Modes.

**Enter:** Must press Enter key to save to memory all changed values.

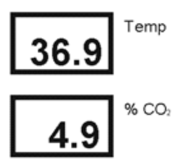
**Down Arrow:** Decreases or toggles the parameter values that have been selected in the SET, CAL and CONFIG Modes.

**Silence Key:** Press to silence the audible alarm. See Section 4 for alarm ringback times.

## 1.4 Displays




**Message Center:** Displays the system status (Mode) at all times. Displays CLASS 100 or SYSTEM OK during normal operation, or alarm messages if the system detects an alarm condition. See Section 4.1, Alarms. The display message CLASS 100 is a timing mechanism indicating that, under normal operating conditions with the HEPA filter installed, the air inside the chamber meets the Class 100 air cleanliness standard for particulates of 0.5 micron size or larger per cubic foot of air. (For further information on the Class 100 classification of air quality, see Appendix A.)




**Upper and Lower Displays:** These 7 segment displays vary depending upon the options present and the configuration chosen. The upper display can display temp or RH, or toggle between them. The bottom display shows $CO_2$ continuously.

## 1.5 Installing the Incubator

### a. Choosing the Location

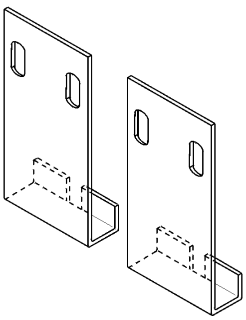
***Stacked units must be installed against a wall or similar structure.***

1. Maintain a minimum three-inch clearance behind the incubator for electrical and gas hook-ups. In addition, a three-inch ventilation space is needed on each side.
2. Locate the unit on a firm level surface capable of supporting the unit's weight of 260 lbs.
3. Locate the unit away from doors and windows and heating and air conditioning ducts.
4. Lift the unit only by the sides of the cabinet base. Do not attempt to lift it by the front and back. This places stress on the outer door hinges.

## b. Stacking the Incubators

***With incubators in a stacked configuration, do not leave both exterior doors open at the same time.***

***If the units have been in operation, turn them both off and disconnect the power before beginning any service work.***



Two stacking brackets (shown at left) are included in the parts bag shipped with each incubator.

**Figure 1-3**

1. Remove the cover plate securing the door cord from the incubator to be on top. See Figure 1-4. Disconnect the plug from the connector.

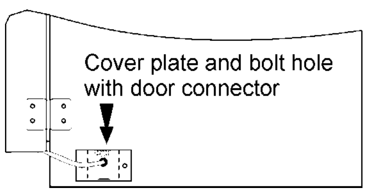



**Figure 1-4**

2. Remove the four screws securing the door hinges to the unit. Remove the door and set it aside.
3. Unscrew the two hole plugs from the top cover of the incubator to be the bottom of the stack (Figure 1-5).

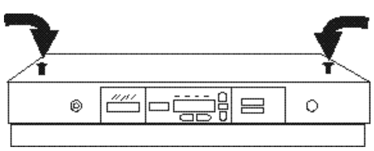


**Figure 1-5**

4. Unscrew and remove the 4 leveling feet from the unit to be stacked on top and lift it onto the bottom unit. Align all sides.

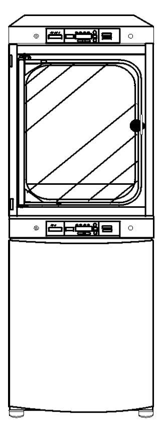


**Figure 1-6**

***This incubator weighs 260 lbs. Have sufficient personnel available when lifting. Lift the unit by the sides of the cabinet base to avoid placing stress on the outer door hinge.***

5. Insert the stacking brackets into the slots at the back of the stacked units as shown in Figure 1-7.
6. Align the slotted holes in the brackets with the mounting holes on the back of the top incubator. Secure the brackets with the screws and washers provided in the parts bag. See Figure 1-8.

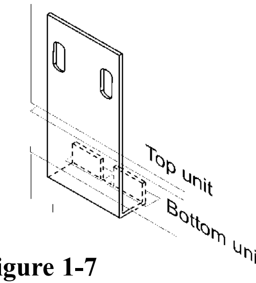



**Figure 1-7**

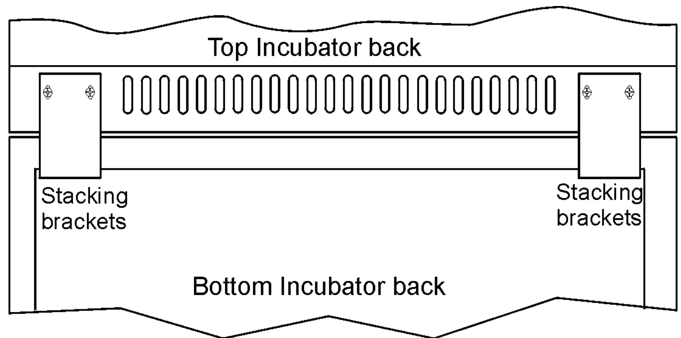



**Figure 1-8**

7. Thread one 1/4 x 20 bolt and washer included with the stacking brackets, into the hole behind the cover plate. Do not tighten. Refer to Figure 1-9.
8. Remove the cover plate from the same area on the other side of the top unit.
9. Thread the other 1/4 x 20 bolt and washer into this hole.
10. Tighten the bolts on both sides.

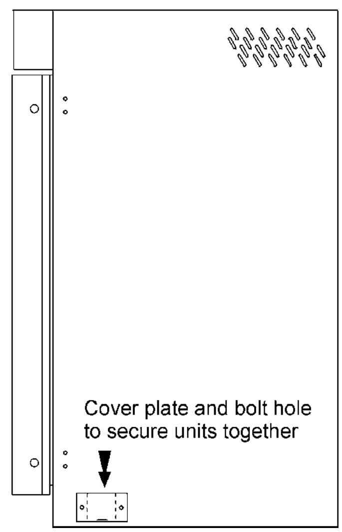



**Figure 1-9**

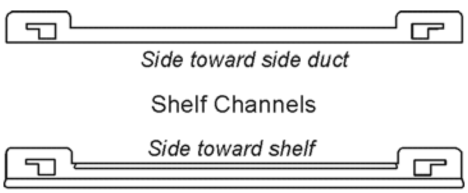
11. Assemble the door hinges to the unit. Secure with the screws.
12. Plug the door cord into the connector, as previously. Secure the cover plate.
13. Install the cover plate on the other side of the unit.
14. The stacked incubators are ready for service.

### c. Preliminary Cleaning

1. Using a suitable laboratory disinfectant, clean all interior surfaces.

### d. Installing the Shelves

1. Install the large sheet metal side ducts with the tabs facing into the center of the chamber with their slots up. There are no right side or left side ducts, simply turn one of them to fit the opposite side. Tilt the side ducts as they are placed into the chamber so the tops fit into the top air duct, then guide them into the vertical position. Figure 1-10 shows the side duct as it would be oriented for the right side of the chamber.



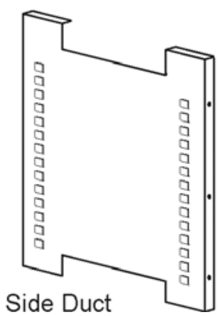




**Figure 1-10**

2. Note that there is no difference in the left and right side shelf channels.
3. Install the shelf channels by placing the channel's rear slot over the appropriate rear tab on the side duct. Pull the shelf channel forward and engage the channel's front slot into the side duct's appropriate forward tab. Refer to Figure 1-11.

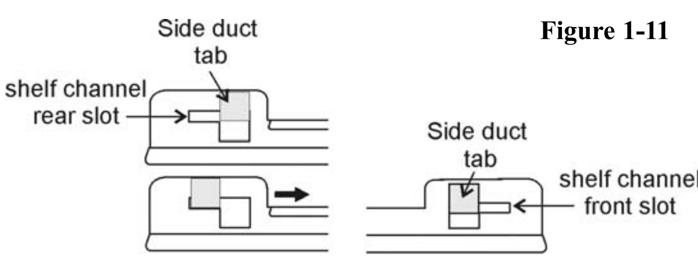



**Figure 1-11**

4. Figure 1-12 shows one of the channels installed on the right side duct.

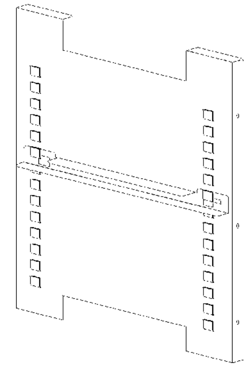
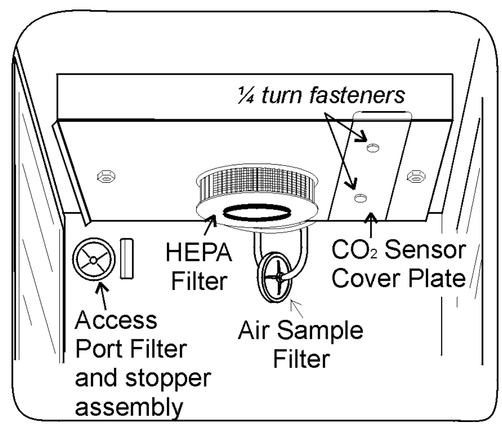


**Figure 1-12**

### e. Installing the Access Port Filter and $CO_2$ Sensor Cover Plate

1. Locate the opening in the top left corner on the inside of the chamber. Remove the tape covering the opening on the outside of the unit.
2. Locate the stopper with filter in the hardware bag. Lift the metal port cover and install the assembly in the opening inside the chamber. See Figure 1-13a.
3. Also in the hardware bag is the $CO_2$ sensor cover plate. Install, using the 1/4 turn fasteners. Refer to Figure 1-13a for the location.

**Figure 1-13a**




### f. Installing the Air Sample Filter

1. Remove the filter from the shipping bag.
2. Install the air sample filter assembly to the black hose barb behind the top duct.
3. Insert the other end of the filter assembly onto the metal tubing on the top duct. Refer to Figure 1-13b.

### g. Installing the HEPA Filter

***Use caution when handling the filter. The media can be damaged if it is mishandled.***
***To avoid damage to the incubator, do not operate the unit without the HEPA filter in place.***

1. Remove the filter from the shipping box.
2. Remove the plastic coating from the filter, using caution not to touch the filter media.
3. Install the filter as shown in Figure 1-13b. Refer to Section 5.6 for HEPA filter maintenance.

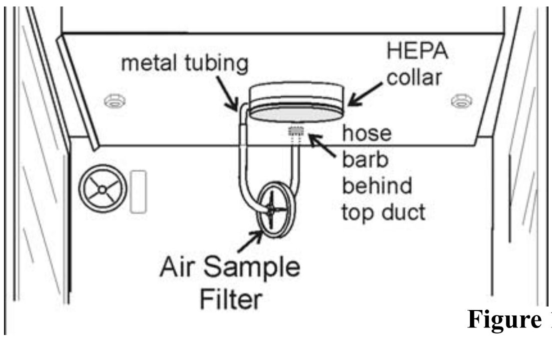



**Figure 1-13b**

### h. Leveling the Unit

Check for level by placing a bubble-style level on one of the shelves. Turn the hex nut on the leveler counterclockwise to lengthen the leg or clockwise to shorten it. Level the unit front-to-back and left-to-right.

### i. Connecting the Unit to Electrical Power

See the serial tag on the side of the unit for electrical specifications or refer to the electrical schematics at the end of this manual.

***Serial tag amp rating is based on amperage draw during sterilization cycle. Normal operating amperage is much less. Ensure that electrical circuit will handle amp draw of sterilization cycle.***
***Connect the incubator to a grounded, dedicated circuit. The power cord connector is the mains disconnect device for the incubator. Position the incubator so the unit can be easily disconnected.***

Plug the provided power cord into the power inlet connector on the back of the cabinet (Figure 1-14), then into grounded, dedicated, electrical circuit.

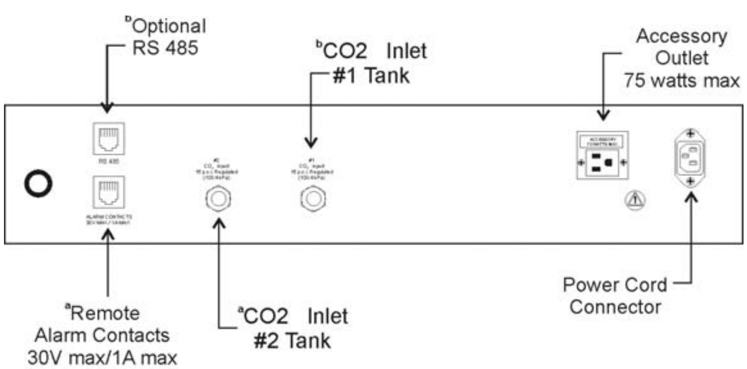



**Figure 1-14**

[a] *RJ-II telephone style connectors*
[b] *Used with the optional Gas Guard System*

### j. Filling the Humidity Pan

Fill the humidity pan with sterile distilled water to within 1/2” of the top. Place the pan directly in the center of the incubator floor.

For applications requiring high humidity, the pan should be placed against the left side wall of the incubator. The side ducts have been modified to allow the pan to be placed against the wall. Optimum humidity is achieved by capping the $CO_2$ sample port. This will, however, cause condensation in the chamber. To enhance RH recovery from door openings, place a second humidity pan in the right side duct.

For best operation of the incubator, sterilized distilled, demineralized or de-ionized water should be used in the humidity pan. Refer to ASTM Standard D5391-93 or D4195-88 for measuring water purity.

Distillation systems and reverse osmosis water purity systems produce water that is neutral in pH (approximately 7) and is the preferred water to use for humidification. High purity, ultra pure or milli-q water is considered an aggressive solvent and slightly acidic. While it may be used, it is not preferred. Chlorinated tap water, or additives containing chlorine, is not to be used as chlorine can deteriorate the stainless steel. Tap water may also have a high mineral content, which would produce a build-up of scale in the reservoir. Even high purity water can contain bacteria and organic contaminants. Water should always be sterilized or treated with a decontaminant, safe for use with stainless steel as well as safe for the product, prior to being introduced into the humidity pan.

Check the level and change the water frequently to avoid contamination. Do not allow the water level to fluctuate significantly. “Dry-outs” will have an adverse effect on the humidity level and $CO_2$ calibration of the T/C units.

***Use of chlorinated water, or decontamination products containing chlorine, will deteriorate the stainless steel and cause rust, voiding the warranty.***

### k. Connecting the $CO_2$ Gas Supply

***High concentrations of $CO_2$ gas can cause asphyxiation! OSHA Standards specify that employee exposure to carbon dioxide in any eight-hour shift of a 40-hour work week shall not exceed the eight-hour time weighted average of 5000 PPM (0.5% $CO_2$). The short term exposure limit for 15 minutes or less is 30,000 ppm (3% $CO_2$). Carbon dioxide monitors are recommended for confined areas where concentrations of carbon dioxide gas can accumulate.***

***This incubator is designed to be operated with $CO_2$ gas only. Connecting a flammable or toxic gas can result in a hazardous condition.***
***Gases other than $CO_2$ should not be connected to this equipment. $CO_2$ gas cylinders have a UN1013 label on the cylinder and are equipped with a CGA 320 outlet valve. Check the gas cylinder for the proper identification labels. The $CO_2$ gas supply being connected to the incubator should be industrial grade, 99.5% pure. Do not use $CO_2$ gas cylinders equipped with siphon tubes. A siphon tube is used to extract liquid $CO_2$ from the cylinder which can damage the pressure regulator. Consult with your gas supplier to ensure that the $CO_2$ cylinder does not contain a siphon tube. Gas cylinders should also be secured to a wall or other stationary object to prevent them from tipping.***
***A two-stage $CO_2$ pressure regulator is required to be installed on the outlet valve of the gas cylinder. Input pressure to the incubator must be maintained at 15 psig (103.4 kPa) for proper performance of the $CO_2$ control system. A single stage $CO_2$ pressure regulator will not maintain 15 psig (103.4 kPa) to the incubator as the pressure in the CO2 cylinder decreases; therefore, a two stage regulator is recommended.***
***If higher purity $CO_2$ is desired inside the incubator (greater than 99.5% pure), the pressure regulator should be constructed with a stainless steel diaphragm, along with specifying the purity of the $CO_2$ from the gas supplier. Follow the manufacturer's instructions to ensure proper and safe installation of the pressure regulator on the gas cylinder.***
***Consult your facility safety officer to ensure that the equipment is installed in accordance with the codes and regulations that are applicable in your area.***

The $CO_2$ gas supply being connected should be industrial grade 99.5% pure and should not contain siphon tubes. Install a two-stage pressure regulator at the cylinder outlet. The high pressure gauge at the tank should have 0-2000 psig range. The low pressure gauge, at the incubator inlet, should have a 0-30 psig range. Input pressure to the incubator must be maintained at 15 psig (103.4 kPa).

The incubator has serrated fittings on the back of the cabinet to connect the gas supply. Refer to Figure 1-14. The fitting is labeled $CO_2$ Inlet #1 Tank. Make sure that the connections are secured with clamps. Check all fittings for leaks.

For units having the $CO_2$ Gas Guard option, refer to Section 6.2.

## 1.6 Incubator Start-Up

With the incubator properly installed and connected to power, the humidity pan filled, and the unit connected to gas supplies, system setpoints can be entered. The following setpoints can be entered in Set mode: Temperature, Overtemperature and $CO_2$. To enter Set mode, press the Mode key until the Set indicator lights. Press the right and/or left arrow keys until the proper parameter appears in the message center. See Chart 1-1 for more detail.

### a. Setting the Operating Temperature

All 370/380 Series incubators have an operating temperature range of 10°C to 50°C, depending on ambient temperature. The incubator is shipped from the factory with a temperature setpoint of 10°C. At this setting, all heaters are turned off. To change the operating temperature setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press the right arrow until "Temp XX.X" is displayed in the message center.
3. Press the up/down arrow key until the desired temperature setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run indicator lights for Run mode or press the right/left arrow keys to go to next/previous parameter.

### b. Setting the Overtemp Setpoint

***The independent overtemp system is designed as a safety to protect the incubator only. It is not intended to protect or limit the maximum temperature of the cell cultures or customer's equipment inside the incubator if an overtemp condition occurs.***

Model 370/380 Series incubators are equipped with a secondary temperature monitoring system to monitor the air temperature inside the cabinet. This system is designed as a safety device to turn off all heaters in the event of a temperature control failure. Temperature control in the incubator will be ±1° of the overtemp setpoint.

The overtemperature is set by the factory (default) at 40°C. However, the overtemp can be set up to 55°C in 0.5° increments.

If the incubator's operating temperature setpoint is set above the overtemp setpoint, the overtemp setpoint will automatically update to 1°C above the temperature setpoint. It is recommended that the overtemp setpoint be maintained at 1°C over the operating temperature setpoint.

To set the Overtemp setpoint:

1. Press the Mode key until the Set indicator lights
2. Press the right arrow until Otemp XX.X is displayed in the message center
3. Press the up or down arrow key until the desired Overtemp setpoint is displayed
4. Press Enter to save the setting
5. Press the Mode key until the Run indicator lights or press the right or left arrow to go to the next or previous parameter.

### c. Setting the $CO_2$ Setpoint

All T/C $CO_2$ cells are calibrated at the factory at 37°C, high humidity, and 10% $CO_2$. Therefore, if a temperature setpoint of 37° C has been entered, the humidity pan has been filled and the $CO_2$ control is to run between 0-10% with a T/C $CO_2$ sensor, the $CO_2$ setpoint may be entered immediately. Otherwise, it is important to allow the unit 12 hours to stabilize at the temperature setpoint before entering the $CO_2$ setpoint.

All models of the incubator have a $CO_2$ setpoint range of 0.0% to 20.0%. The incubator is shipped from the factory with a $CO_2$ setpoint of 0.0%. At this setting, all $CO_2$ control and alarms are turned off. To change the $CO_2$ setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press the right arrow until "CO2 XX.X" is displayed in the message center.
3. Press the up/down arrows until the desired $CO_2$ setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run indicator lights to go to Run mode or press the right/left arrow keys to go to next/previous parameter.

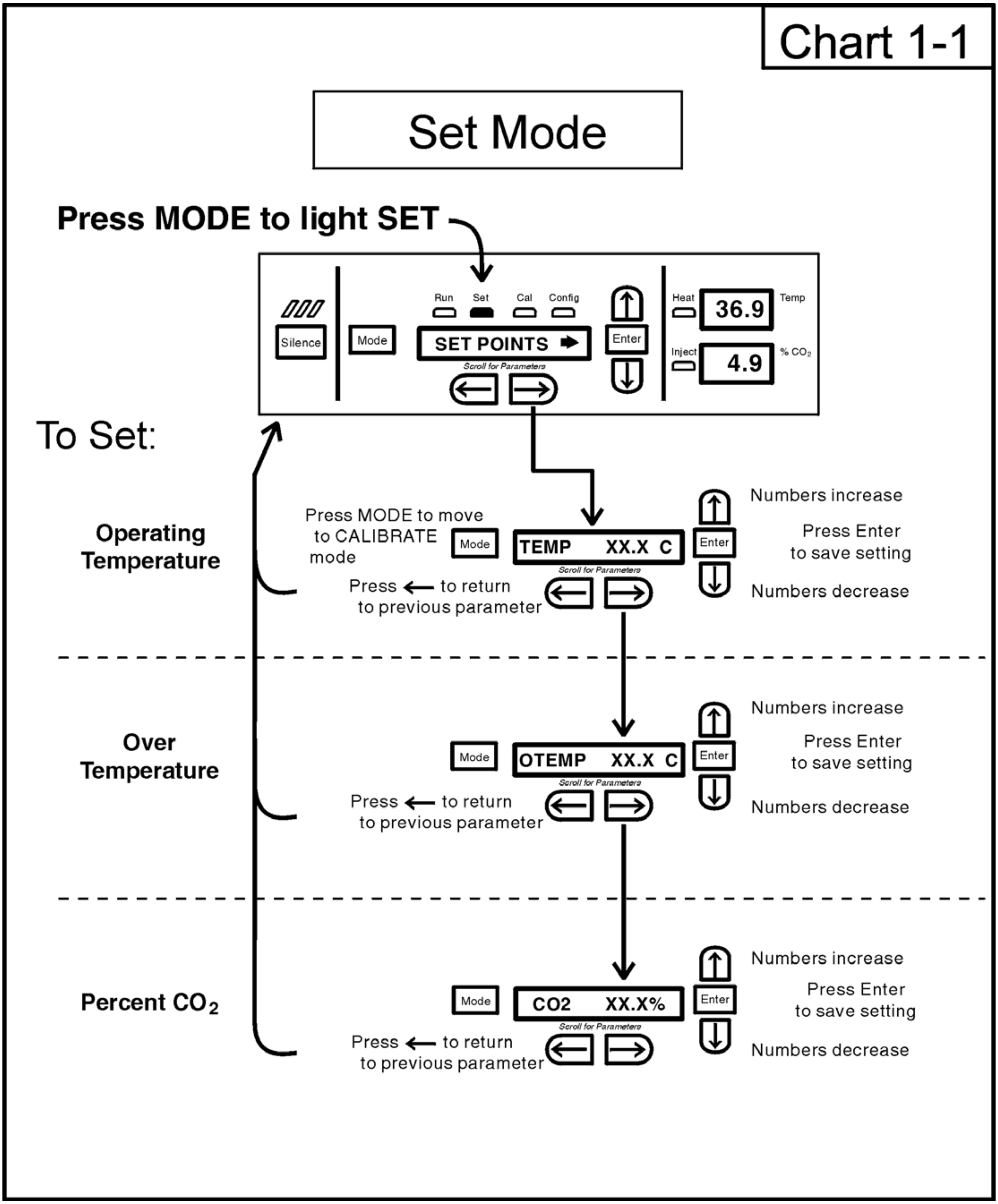


Chart 1-1
Set Mode
Press MODE to light SET
Silence
Mode
Run
Set
Cal
Config
SET POINTS
Scroll for Parameters
Enter
Heat
36.9
Temp
Inject
4.9
% $CO_2$
To Set:
Operating Temperature
Press MODE to move to CALIBRATE mode
Mode
TEMP XX.X C
Scroll for Parameters
Enter
Numbers increase
Press Enter to save setting
Numbers decrease
Press ← to return to previous parameter
Over Temperature
Mode
OTEMP XX.X C
Scroll for Parameters
Enter
Numbers increase
Press Enter to save setting
Numbers decrease
Press ← to return to previous parameter
Percent $CO_2$
Mode
CO2 XX.X%
Scroll for Parameters
Enter
Numbers increase
Press Enter to save setting
Numbers decrease
Press ← to return to previous parameter

# Section 2 - Calibration

## 2.1 Calibration Mode

After the unit has stabilized, several different systems can be calibrated. In the calibration mode, the air temperature, CO2 and RH levels can be calibrated to reference instruments. To access the calibration mode, press the Mode key until the Cal indicator lights. Press the right and/or left arrow until the appropriate parameter appears in the message center. See Chart 2-1 at the end of this section for more detail.

Calibration frequency is dependent on use, ambient conditions and accuracy required. A good laboratory practice would require at least an annual calibration check. On new installations, all parameters should be checked after the stabilization period.

Prior to calibration, the user should be aware of the following system functions. While the unit is in the calibration mode, all system control functions are stopped so the unit remains stable. Readout of the system being calibrated will appear on the message center. If no keys are pressed for approximately five minutes while in calibration mode, the system will reset to Run mode so control functions are reactivated.

***Before making any calibration or adjustments to the unit, it is imperative that all reference instruments be properly calibrated.***

### a. Calibrating the Temperature

Before calibration, allow the cabinet temperature to stabilize. Place the calibrated instrument in the center of the chamber. The instrument should be in the air flow, not against the shelf.

#### Temperature Stabilization Periods

**Startup** - Allow 12 hours for the temperature in the cabinet to stabilize before proceeding.

**Already Operating** - Allow at least 2 hours after the display reaches setpoint for temperature to stabilize before proceeding.

1. Press the Mode key until Cal indicator lights.
2. Press the right arrow until “TEMPCAL XX.X” appears in the message center.
3. Press up/down arrow to match display to calibrated instrument.
4. Press Enter to store calibration.
5. Press the Mode key to return to Run or the right/left arrow to go to next/previous parameter.

### b. Calibrating Thermal Conductivity $CO_2$ System

Models 370 and 371 have a thermal conductivity (T/C) $CO_2$ sensor. Thermal conductivity of the incubator atmosphere is not only effected by the quantity of $CO_2$ present but also by the air temperature and water vapor present in the incubator atmosphere. In monitoring the effects of $CO_2$, air temperature and absolute humidity must be held constant so any change in thermal conductivity is caused by a change in $CO_2$ concentration.

Changing temperature or changing from elevated humidity to room ambient humidity levels will necessitate a re-calibration of the $CO_2$ control.

#### T/C $CO_2$ Sensor Stabilization Periods

Some T/C $CO_2$ sensors go through an aging period, especially on new installations. Calibration should be checked on a weekly basis and adjusted as necessary. When stabilization occurs, checks may become less frequent.

**Start -Up** - The $CO_2$ sensor has been calibrated at the factory for 37°C and elevated humidity. Allow the temperature, humidity, and $CO_2$ levels in the chamber to stabilize at least 12 hours before checking the $CO_2$ concentration with an independent instrument.

**Presently Operating** - Make sure the chamber doors are closed. Allow at least 2 hours after the temperature and $CO_2$ displays reach their setpoints for chamber atmosphere stabilization.

1. Make sure the stabilization periods outlined above are followed.
2. Sample the chamber atmosphere through the sample port with an independent instrument. Sample the atmosphere at least 3 times to ensure accuracy of the instrument.
3. Press the Mode key until the Cal indicator lights.
4. Press the right arrow until “CO2 CAL XX.X” is displayed in the message center.
5. Press the up /down arrows to change the display to match the independent instrument.
6. Press Enter to store the calibration.
7. Press the Mode key to return to Run or the right or left arrows to go to the next/ previous parameter.

### c. Calibrating the Infrared $CO_2$ System

Models 380 and 381 have an infrared (IR) $CO_2$ sensor. Infrared $CO_2$ sensors are not effected by chamber atmosphere temperature or humidity. However, the light detector in the sensor is effected by wide temperature changes. Therefore, changing temperature setpoints could necessitate a recalibration of the $CO_2$. Chamber temperature should be allowed to stabilize before checking $CO_2$ concentrations with an independent instrument, especially on start-up.

#### IR $CO_2$ Sensor Stabilization Times

**Start-Up**- Allow the temperature and the $CO_2$ of the cabinet to stabilize at least 12 hours before proceeding.

**Presently Operating** - Allow $CO_2$ to stabilize at least 2 hours at setpoint before proceeding.

1. Measure the $CO_2$ concentration in the chamber through the gas sample port with a Fyrite or other independent instrument. Several readings should be taken to ensure accuracy.
2. Press the Mode key until the Cal indicator lights.
3. Press the right arrow until “IR CAL XX.X” appears in the message center.
4. Press the up/down arrow to adjust the display to match the independent instrument reading.
5. Press Enter to store the calibration.
6. Press the Mode key to return to Run mode.

### d. Calibrating Relative Humidity

All 370/380 Series incubators can be equipped with an optional direct-readout relative humidity sensor. This is a readout only of the chamber relative humidity level. It does not provide any control of the relative humidity in the cabinet.

#### Relative Humidity Stabilization Times

**Start-Up** - Allow 12 hours for the relative humidity and temperature in the chamber to stabilize before proceeding.

**Already Operating** - Allow at least 2 hours after temperature display reaches setpoint for relative humidity to stabilize before proceeding.

1. Place an accurate independent instrument in the center of the chamber. Allow at least 30 minutes for RH to stabilize.
2. Press the Mode key until the Cal indicator lights.
3. Press the right arrow key until “RH CAL XX” appears in the message center.
4. Press the up/down arrow to match the display to the independent instrument.
5. Press Enter to store the calibration.
6. Press the Mode key to return to Run mode.

If a reliable RH measuring device is not available, you may calibrate the display to a typical level;

1. Follow the RH stabilization periods outlined above.
2. With a full humidity pan and stable temperature, the relative humidity in the chamber will be 95%.
3. Using Step 3-5 of the relative humidity sensor adjustment, adjust the display to 95%.

This calibration method should be accurate to within 5%.

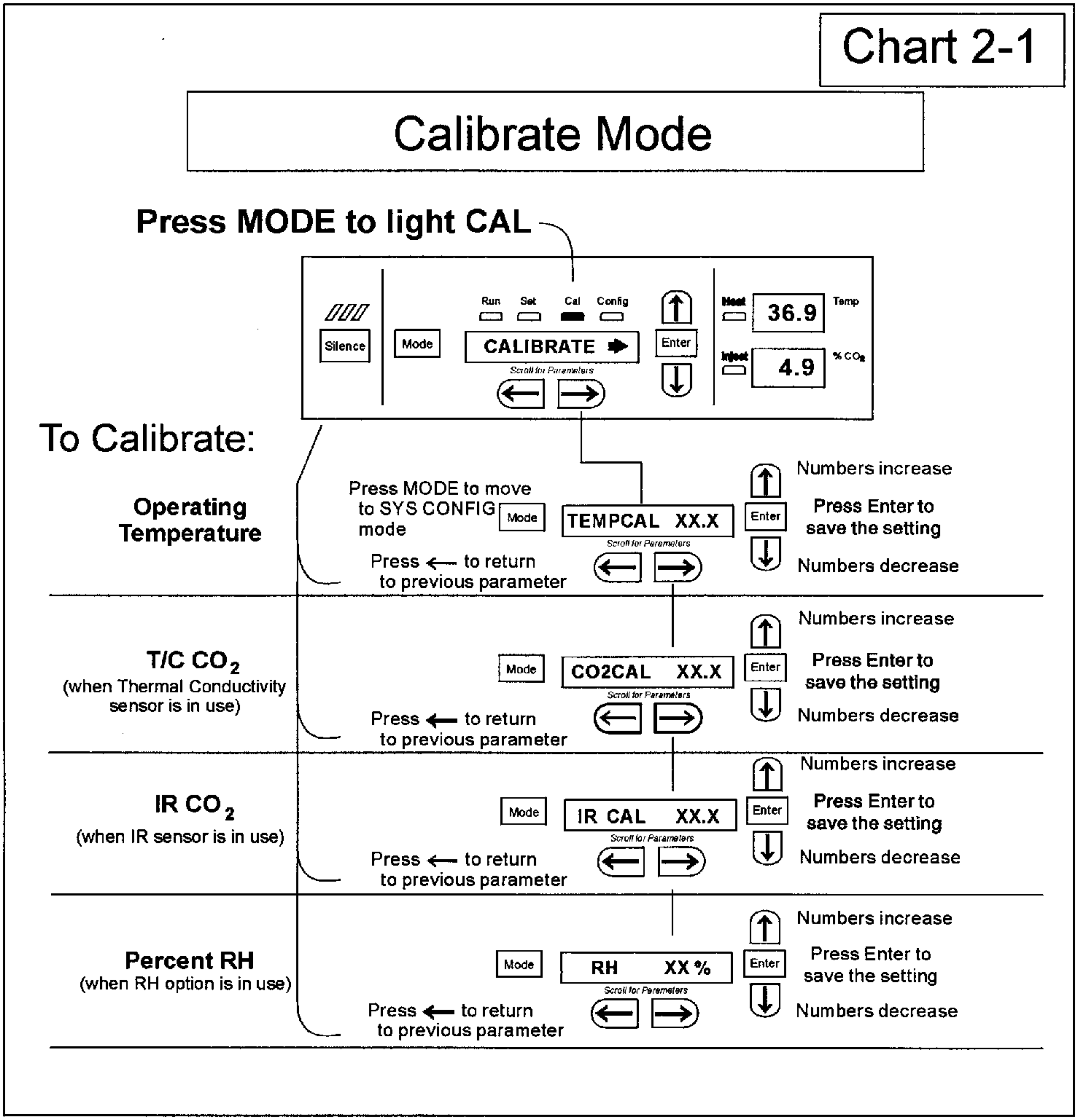


Chart 2-1
Calibrate Mode
Press MODE to light CAL
Run Set Cal Config
Silence
Mode
CALIBRATE
Scroll for Parameters
Enter
Heat
36.9
Temp
Inject
4.9
% CO2
To Calibrate:
Operating Temperature
Press MODE to move to SYS CONFIG mode
Mode
TEMPCAL XX.X
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save the setting
Numbers decrease
T/C CO2
(when Thermal Conductivity sensor is in use)
Mode
CO2CAL XX.X
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save the setting
Numbers decrease
IR CO2
(when IR sensor is in use)
Mode
IR CAL XX.X
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save the setting
Numbers decrease
Percent RH
(when RH option is in use)
Mode
RH XX %
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save the setting
Numbers decrease

# Section 3 - Configuration

## 3.1 Configuration Mode

Several features available in the Configuration Mode allow custom setup of the incubator. These features are listed and described below. All features may not be necessary in all applications, but are available if needed. To enter Configuration mode, press the Mode key until the Config indicator lights. Press the right and/or left arrow until the appropriate parameter appears in the message center. See Chart 3-1 for more detail.

### a. Turning the Audible Alarm ON/OFF

The audible alarm can be turned on or off. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until AUDIBLE XXX is displayed in the message center.
3. Press up/down arrow to toggle AUDIBLE ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to run mode or right/left to go to next/previous parameter.

### b. New HEPA Filter

When the REPLACE HEPA reminder is displayed and the visual alarm flashes, the specified time has elapsed and the HEPA filter should be replaced. To clear the display and reset the timer after replacing the HEPA filter with a new one, follow the steps below.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until NEW HEPA is displayed in the message center.
3. Press Enter to restart the timer and clear the REPLACE HEPA alarm.
4. Press the Mode key to return to Run Mode.

### c. Setting the REPLACE HEPA filter reminder

A HEPA filter replacement timer can be set for a specific amount of time, from 1 to 12 months of actual unit running time. Time will not accrue when the unit is turned off. The default time is 6 months. When the allotted time has run out, REPLACE HEPA appears in the display and the visual alarm flashes. To set the reminder, use the following procedure.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until REPL HEPA XX is displayed.
3. Press the up/down arrow to choose the number of months desired.
4. Press Enter to save the number.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

**Note:** After the reminder has been set, check the allotted time remaining by going to Config Mode, then pressing the right arrow until NEW HEPA XXX displays. This number is the remaining days before the filter replacement time specified runs out. For example, if 12 months was chosen in the REPL HEPA XX message screen, the NEW HEPA number would be 365 days.

### d. Setting an Access Code

A 3-digit Access Code can be entered to avoid unauthorized personnel from changing the setpoints, calibration, or configuration. A setting of 000 will bypass the access code. The factory setting is 000.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until ACC CODE XXX is displayed in the message center.
3. Press up/down arrow to change the access code.
4. Press Enter to save the access code.
5. Press the Mode key to return to the Run mode or right/left to go to next/previous parameter.

### e. Setting a Low Temp Alarm Limit (tracking alarm)

The low temp alarm limit is the deviation from the temperature setpoint which will cause a low temp alarm. The low temp alarm is variable from 0.5° below setpoint to 5° below setpoint. The factory setting is 1° below setpoint. A minus sign (-) in the display indicates that the alarm setting is below the setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until TEMP LO -X.X is displayed in the message center.
3. Press up/down arrow to change the low temp alarm limit.
4. Press Enter to save the low temp alarm limit.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### f. Enabling the Low Temperature Alarm to Trip Contacts

The low temperature alarm can be programmed to trip the remote alarm contacts. A setting of ON will cause this, a setting of OFF will not allow temp alarm to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until TMP RLY XXX is displayed.
3. Press the up/down key to toggle the setting ON/OFF.
4. Press Enter to save the setting
5. Press the Mode key to return to Run or the right/left arrow key to go to next/previous parameter.

### g. Setting a Low $CO_2$ Alarm Limit (tracking alarm)

The low $CO_2$ alarm limit is the deviation from the $CO_2$ setpoint which will cause a low $CO_2$ alarm. The setpoint is variable from 0.5% $CO_2$ below setpoint to 5.0% $CO_2$ below setpoint. The factory setting is 1.0% $CO_2$ below setpoint. A minus sign (-) in the display indicates that the alarm setting is below the setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until CO2 LO -X.X is displayed in the message center.
3. Press up/down arrow to change the low $CO_2$ alarm limit.
4. Press Enter to save the low $CO_2$ alarm limit.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### h. Setting a High $CO_2$ Alarm Limit (tracking alarm)

The high $CO_2$ alarm limit is the deviation from the $CO_2$ setpoint which will cause a high $CO_2$ alarm. The setpoint is variable from 0.5% $CO_2$ above setpoint to 5.0% $CO_2$ above setpoint. The factory setting is 1.0% $CO_2$ above setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until CO2 HI X.X is displayed in the message center.
3. Press up/down arrow to change the high CO2 alarm limit.
4. Press Enter to save the high CO2 alarm limit.
5. Press the Mode key to return to run mode or right/left to go to next/previous parameter.

### i. Enabling $CO_2$ Alarms to Trip Contacts

High and Low $CO_2$ alarms can be programmed to trip the remote alarm contacts. A setting of ON will cause this, a setting of OFF will not allow $CO_2$ alarms to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until CO2 RLY XXX is displayed in the message center.
3. Press up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### j. Setting a New Zero Number for T/C $CO_2$ Sensors

If a new T/C $CO_2$ sensor is being installed, the two numbers on the factory installed sticker on the T/C cell must be entered to calibrate the $CO_2$ in the unit.

**Note:** For the technician's convenience, a label containing the two numbers on the T/C cell is affixed inside the electronics drawer.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until T/CZ# XXXX is displayed in the message center.
3. Press up/down arrow to change the zero number to match the sticker.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### k. Setting New Span Number for T/C $CO_2$ Sensors

If a new T/C $CO_2$ sensor is being installed, the two numbers on the factory installed sticker on the T/C cell must be entered to calibrate the $CO_2$ in the unit.

**Note:** For the technician's convenience, a label containing the two numbers on the T/C cell is affixed inside the electronics drawer.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until T/CS# XXXX is displayed in the message center.
3. Press up/down arrow to change the span number to match the sticker.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### l. Setting a Low RH Alarm Limit

On units that have the RH option installed, a low RH alarm limit may be entered. The low RH alarm limit is the %RH in the cabinet which will cause a low RH alarm. The setpoint is variable from setpoint 0 to 90% RH The factory setting is 0% RH which will disable the alarm.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until RH LO XX is displayed in the message center.
3. Press up/down arrow to change the RH low alarm limit.
4. Press Enter to save the RH low alarm limit.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### m. Enabling RH Alarms to Trip Contacts

The low RH alarm can be programmed to trip the remote alarm contacts. A setting of ON will cause this, a setting of OFF will not allow the RH alarm to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until RH RLY XXX is displayed in the message center.
3. Press up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### n. Enabling Temp/RH to be Displayed

On units that are equipped with the RH option, the upper seven segment display on the control panel can be configured to display Temp continuously, RH continuously, or toggle between Temp and RH. If the units does not have RH, the upper display will always display temperature. If temperature is set to ON, and the RH is set OFF, temperature will be displayed continuously. If temperature is set to OFF and RH is set to ON, RH will be displayed continuously. If both are turned ON, the display will toggle between the two. The factory setting will default to toggle mode if the RH option is present.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until DISP TMP XXX or DISP RH XXX is displayed in the message center.
3. Press up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### o. Selecting a Primary Tank w/ Gas Guard Option

On units equipped with the Gas Guard option, a primary tank can be selected. The primary tank will be either Tank 1 or 2. The factory setting is Tank1 .

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until TNK SEL X is displayed in the message center.
3. Press up/down arrow to toggle setting between 1 and 2 .
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### p. Disabling the Gas Guard System

On units equipped with the Gas Guard option, the Gas Guard system may be turned ON, or OFF if it is not in use. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until GAS GRD XX is displayed in the message center.
3. Press up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### q. Setting a RS485 Communications Address (1535 compatible only)

On units that have the RS485 option, direct communication with the Model 1535 alarm system can be established. Each piece of equipment connected to the 1535 must have a unique address. An address of 0-24 can be entered for the incubator. A setting of 0 is an invalid address that the 1535 will ignore. The factory setting for the RS485 address is 0.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until RS485 XX is displayed in the message center.
3. Press up/down arrow to move the RS485 address.
4. Press Enter to save the RS485 address.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

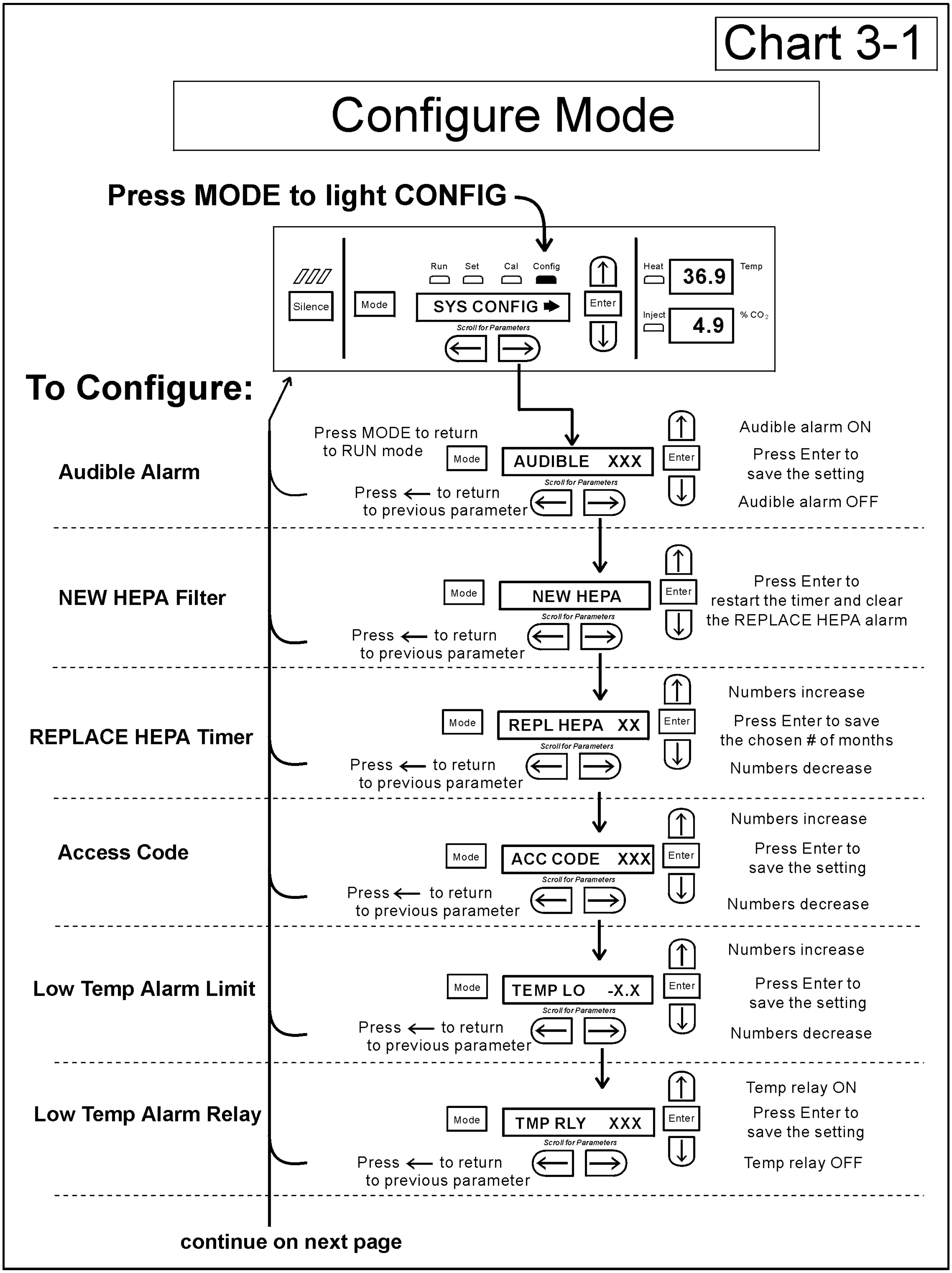



Chart3-1_1.cdr

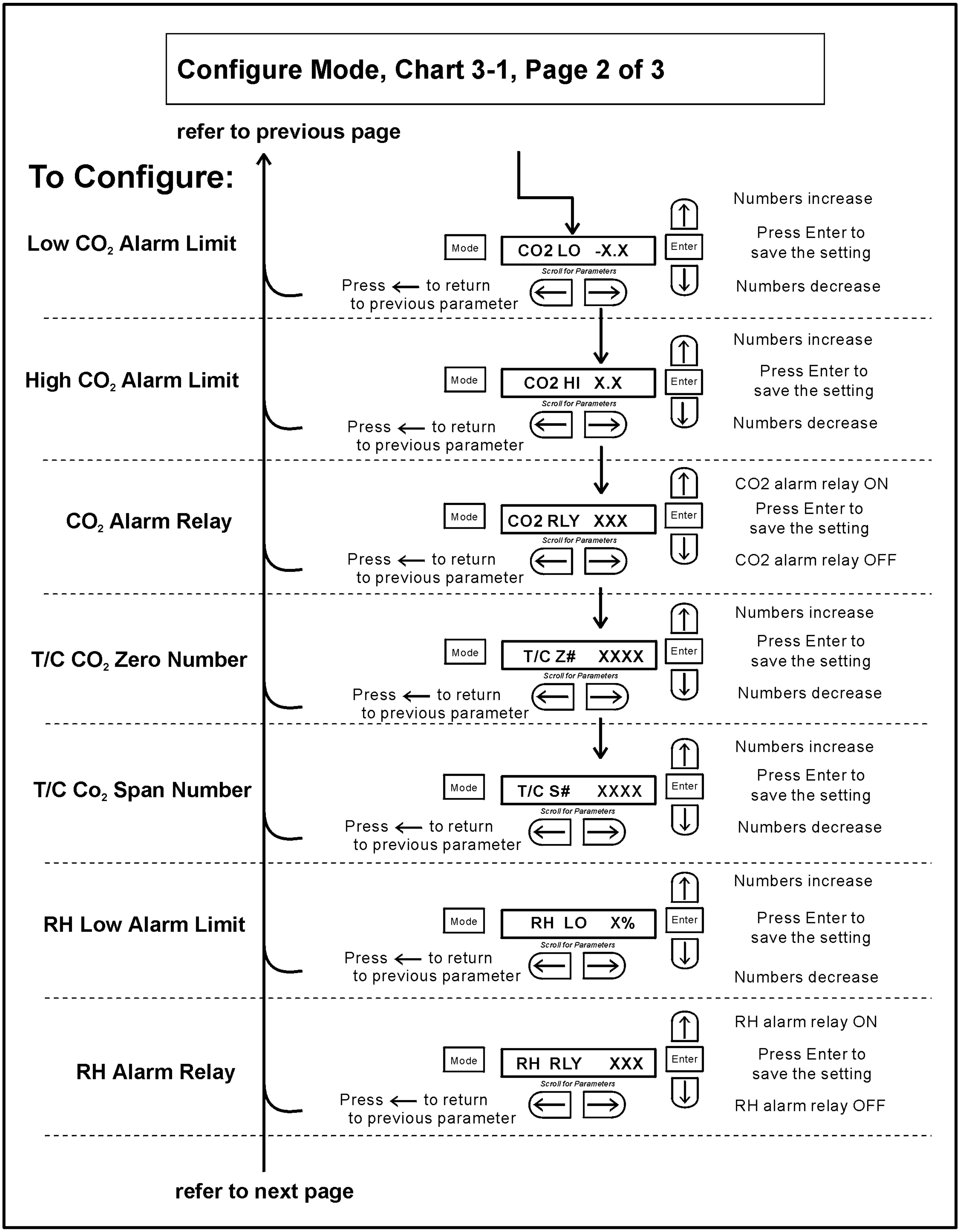



Chart3-1_2.cdr

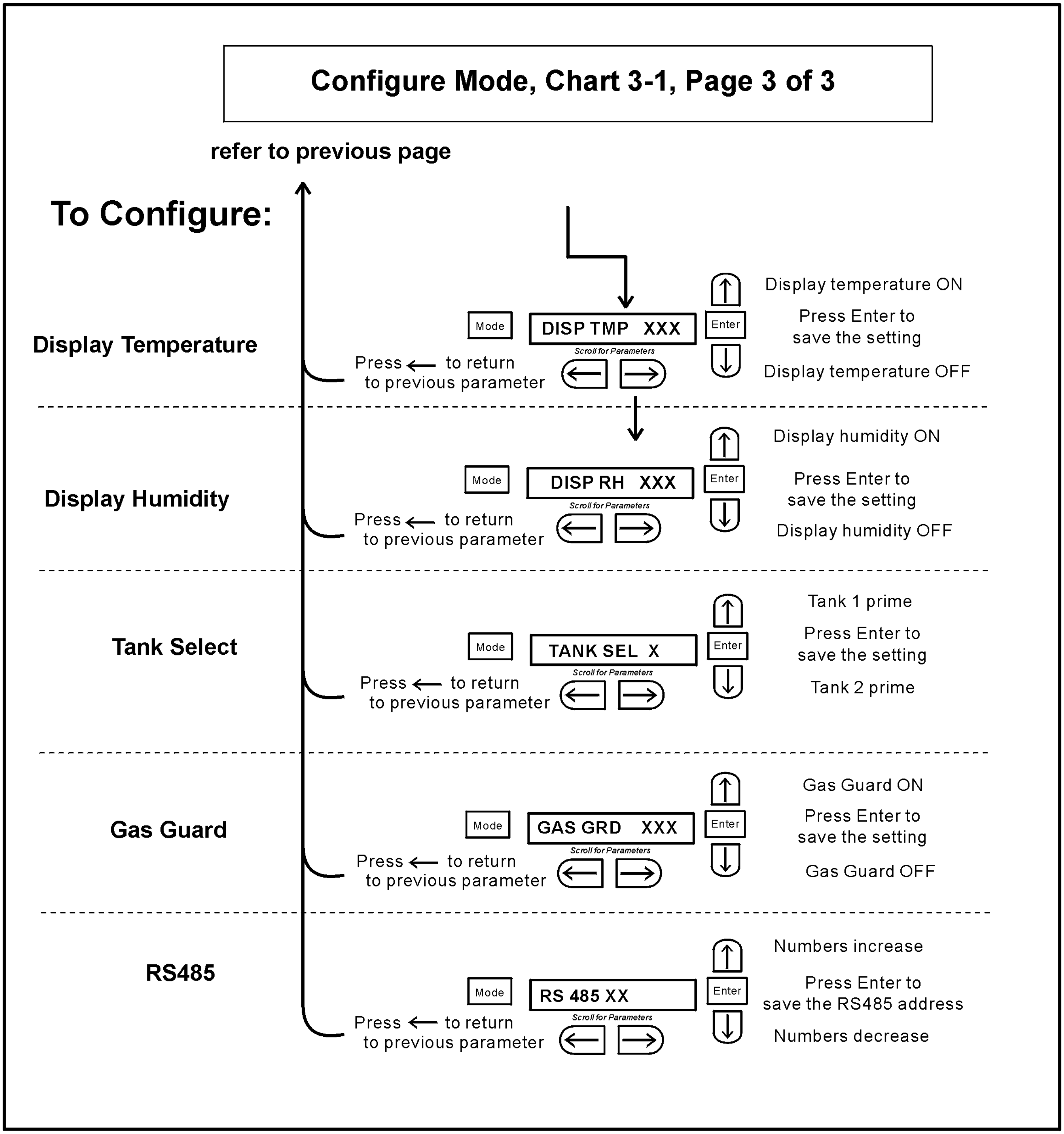



Chart3-1_3.cdr

# Section 4 - Alarms

## 4.1 Alarms

The Model 370/380 Series incubator alarm system is shown in the table below. When an alarm is active, the message appears in the LED message center. Pressing Silence disables the audible alarm for the ringback period. However, the visual alarm continues until the incubator returns to a normal condition. The alarms are momentary alarms only. When an alarm condition occurs and then returns to normal, the incubator automatically clears the alarm condition and the message center.

| Description | Message | Delay | Ringback | Relay |
|---|---|---|---|---|
| No alarm condition exists | SYSTEM OK or CLASS 100 | ----- | ----- | ----- |
| Temp > Otemp Set point | SYS IN OTEMP | 0 min. | 15 min. | Yes |
| Air Temp Sensor Fault (See Section 4.3) | AIR SNSR ERR | 0 min. | 15 min. | No |
| Temperature Controller Failure (See Sect. 4.2) | TMP CTRL ERR | 0 min. | 15 min. | YES |
| CO2 Sensor Fault (See Section 4.3) | CO2 SNSR ERR | 0 min. | 15 min. | No |
| Replace HEPA filter reminder-set time expired (See Section 3.1b & 3.1c) | REPLACE HEPA | 0 min. | ----- | No |
| Inner Door is Open | DOOR OPEN | 15 min. | 15 min. | No |
| CO2 is higher than CO2 High Tracking Alarm | CO2 IS HIGH | 15 min. | 15 min. | Programmable |
| CO2 is lower than CO2 Low Tracking Alarm | CO2 IS LOW | 15 min. | 15 min. | Programmable |
| TEMP is lower TEMP Low Tracking Alarm | TEMP IS LOW | 15 min. | 15 min. | Programmable |
| RH is lower than RH Low Limit Alarm (RH option) | RH IS LOW | 30 min. | 30 min. | Programmable |
| Tank 1 is low, switch to Tank 2 (Gas Guard only) | TANK1 LOW | 0 min. | ---- | No |
| Tank 2 is low, switch to Tank 1 (Gas Guard only) | TANK2 LOW | 0 min. | ---- | No |
| Both tanks are low (Gas Guard only) | TANK 1 and 2 LOW | 0 min. | 15 min. | No |

**- All alarm delays and ringback times are ±30 seconds -**

When multiple alarm conditions occur, active messages are displayed in the message center one at a time, updating at 5 second intervals. Pressing Silence during multiple alarms causes all active alarms to be silenced and to ring back in 15 minutes.

The TEMP IS LOW alarm is disabled when the Temp set point is 10°C. The $CO_2$ alarms are disabled when the $CO_2$ set point is 0.0%.

## 4.2 Temperature Controller Failure TMP CNTR ERR

In addition to other safety features designed into Model 370 Series incubators, a thermostat is also provided to monitor the cabinet's temperature. In the unlikely event of a temperature control failure, the thermostat will turn off all heaters at a cabinet temperature of 160°C, ±5%. This is intended to be a safety feature to protect the incubator, and is not intended to protect the cell cultures or the equipment inside the chamber should a temperature control failure occur. Should such a failure occur, contact the Technical Services Department or your local distributor.

## 4.3 Sensor Fault Alarms

The microprocessor in Model 370 Series incubators continually scans all available sensors to ensure that they are operating properly. Should an error be detected, the incubator will sound an alarm and display the appropriate message. Contact the Technical Services Department (1-888-213-1790) or your local distributor.

# PREVENTIVE MAINTENANCE

## Incubators

Your Forma equipment has been thoroughly tested and calibrated before shipment. Regular preventive maintenance is important to keep your unit functioning properly. The operator should perform routine cleaning and maintenance on a regular basis.
For maximum performance and efficiency, it is recommended the unit be checked and calibrated periodically by a qualified service technician.

The following is a condensed list of preventive maintenance requirements. See the specified section of the instruction manual for further details.

Thermo has qualified service technicians, using NIST traceable instruments, available in many areas. For more information on Preventive Maintenance or Extended Warranties, please contact us at the number listed below.

Cleaning and calibration adjustment intervals are dependent upon use, environmental conditions and accuracy required.

**Tips for all incubators:**

- Do NOT use bleach or any disinfectant that has high chloros
- Use sterile, distilled or demineralized water.
- Avoid spraying cleaner on the $CO_2$ sensor.
- Do not use powdered gloves for tissue cultures.

Millcreek Road, Box 649 • Marietta, Ohio 45750 USA • 740-373-4763
USA and Canada 888-213-1790 • Telefax: 740-373-4189 • http://www.services.controlenv@thermo.com

## Preventive Maintenance for Model 370/380 Series Incubators

| Refer to Manual Section | Action | Daily | Weekly | Monthly | 3 to 6 Months | Yearly |
|---|---|---|---|---|---|---|
| -- | Check $CO_2$ tank levels. | ✓ | | | | |
| -- | Inspect door latch, hinges and door gasket seal. | | | | | ✓ |
| 1.5j | Check water level in the humidity pan, ½” from top. | | ✓ | | | |
| 2 | * Verify and document $CO_2$, humidity and temperature calibration, as applicable (See Calibration). | | | | | ✓ |
| | Thoroughly clean the interior of the incubator (See Routine Maintenance). | | | | ✓ | |
| 1.5e, f, g | Replace HEPA, access port filter, air sample filter, and $CO_2$ filters*, if applicable (or as needed). | | | | | ✓ |
| 5.10 | Perform sterilization cycle as needed. | | | | | |

* Qualified service technicians only

## Section 5 - Routine Maintenance

***If the unit has been in service, turn it off and disconnect the power cord connector before proceeding with any maintenance.***

### 5.1 Cleaning the Incubator Interior

***Before using any cleaning method except those recommended by the manufacturer, users must check with the manufacturer that the proposed method will not damage the equipment.***

Use an appropriate disinfectant. All articles and surfaces must be thoroughly cleaned, rinsed with sterile water, and rough-dried.

***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.***
***Do not spray the T/C sensor with flammable solutions. The internal temperature of the $CO_2$ sensor is approximately 150°C when the unit is in operation. Allow sufficient time for the sensor to cool before cleaning.***

***Do not use strong alkaline or caustic agents. Stainless steel is corrosion resistant, not corrosion-proof.***
***Do not use solutions of sodium hypochlorite (bleach) as they may also cause pitting and rusting.***

A HEPA filter replacement kit (see parts list section) should be on-hand prior to cleaning the incubator interior.

1. Remove the shelves, access port filter assembly, HEPA filter, air sample filter and tubing, and the left and right duct sheets. Discard the HEPA filters and the access port filter assembly. See Figure 5-1.

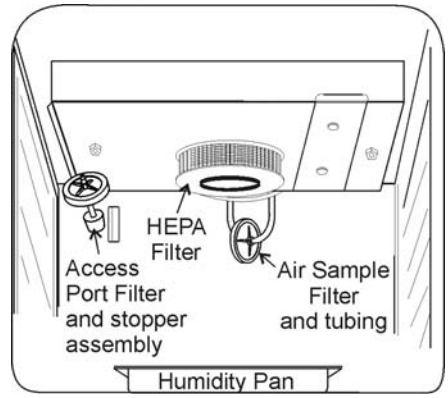


**Figure 5-1**

2. Wash the air sample filter tubing, shelves, and ducts with disinfectant, then rinse with sterile water. Optional: The shelves and ducts may be autoclaved.
3. Wash the inner door gasket with disinfectant. This gasket may be removed to be cleaned, or replaced.
4. Wash the cabinet interior with disinfectant, starting at the top and working down. Refer to the disinfectant directions for length of time needed before rinsing. Wash the inner door both inside and out. The cabinet and door must be rinsed with sterile water until the disinfectant has been removed. After the cabinet has been rinsed, spray with 70% alcohol.
5. Install the left and right ducts, inner door gasket, access port filter assembly, and air sample filter and tubing, spraying each with 70% alcohol.
6. Install a new HEPA filter.
7. Install the shelves and spray with 70% alcohol.

### 5.2 Cleaning the Cabinet Exterior

Clean the incubator exterior with a damp sponge or soft, well-wrung cloth and mild detergent dissolved in water. Dry with a soft cloth.

### 5.3 Cleaning the Glass Doors

The chamber glass door and the optional independent inner glass doors may be cleaned using the same disinfectant as used on the incubator interior. It is imperative that they be rinsed with sterile distilled water to remove the disinfectant residue. The doors should then be dried with a soft cloth.

**Some precautions in the cleaning and care of the incubator glass doors:**

Moisture leaches alkaline materials (sodium, Na) from the surface of the glass. Evaporation of the moisture concentrates the alkaline and may produce a white staining or clouding of the glass surface. Cleaning chemicals with a PH above 9 and heat (autoclaving) accelerate the corrosion process. Therefore, it is very important to rinse and dry the glass doors after cleaning. Autoclaving the glass doors should be avoided.

There is no simple method for repairing corroded glass. In most cases, the glass must be replaced.

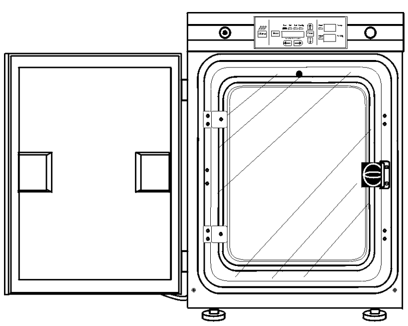
## 5.4 Cleaning the Humidity Pan

Clean the humidity pan with soap and water and a general-use laboratory disinfectant. Rinse with sterile water and spray with 70% alcohol. The pan may be autoclaved.

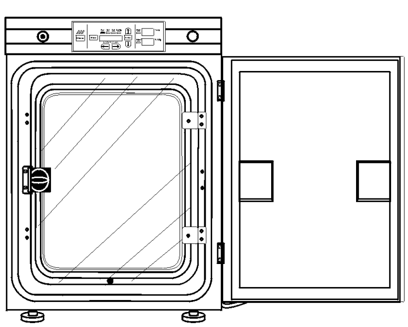
## 5.5 Reversing the Door Swing

For side-by-side operation or changing lab layouts, the inner and outer doors are field reversible. The procedure is written from the prospective of changing the door swing from a left to a right swing. See below. All screw holes are pre-drilled for reversing the door. The tools required are a Phillips and a flatblade screwdriver.

The door reversing procedure takes about 30 minutes.



left door swing



right door swing

1. Locate the small cover plate securing the door cord. Remove the screws from the plate and disconnect the door cord from the connector behind the plate.

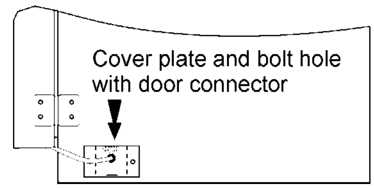



**Figure 5-2**

2. Remove the four screws securing the door hinges to the unit. Place the door on a padded surface to prevent scratches.
3. Remove the four screws securing the inner door hinges and the two Phillips screws located between the hinges. See Figure 5-3. Retain the screws.

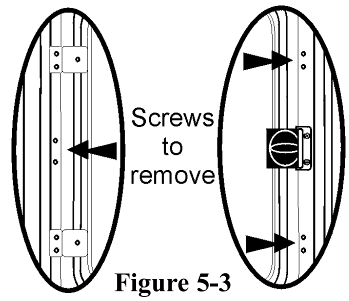



**Figure 5-3**

4. Remove the two screws securing the door strike and the four Phillips screws located on this side of the door (Figure 5-3). Retain the screws.
5. Move the door strike to the opposite side. Orient as Figure 5-4. Install the four nylon hole plugs into the holes on either side of the strike.

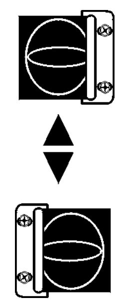
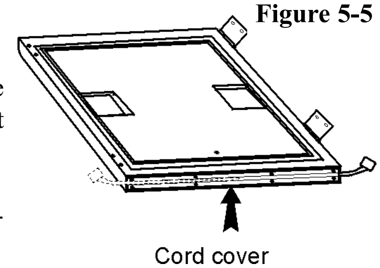


**Figure 5-4**

6. Rotate the inner door 180° and secure the door hinges to the unit. Install the two Phillips screws into the holes between the hinges.
7. Locate the cord cover on the bottom of the outer door. See Figure 5-5. Remove the eight screws securing the cover, arrange the cord toward the opposite side and reinstall the cover.

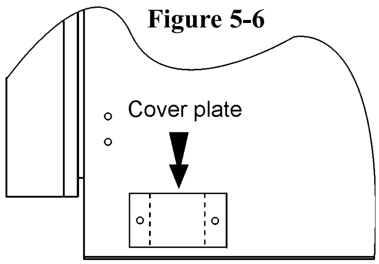
**Figure 5-5**




8. Remove the door handle by first carefully prying off the three nylon screw covers. Then remove the three screws. Set aside.
9. Remove the hinges from the outer door. Carefully pry off the nylon screw cover from between the hinges. Remove the screw.
10. Install the hinges on the opposite side of the door. Install the screw and screw cover between the hinges.

11. Install the door handle opposite the hinges. Install screw covers.
12. To secure the outer door to the unit, the Phillips screws on the side of the unit must be removed and installed on the opposite side.
13. Secure the outer door hinges to the unit.
14. Locate the small cover plate on the side of the unit. Refer to Figure 5-6. Remove the two screws and move this plate to the opposite side of the unit. Secure the plate.

Figure 5-6




15. Install the door cord to the connector. Secure the plate with the two screws. See Figure 5-2.
16. Return the unit to service.

## 5.6 HEPA Filter Maintenance

Replace the HEPA filter when the REPLACE HEPA reminder is displayed. The REPLACE HEPA reminder can be set to alarm after a specified time from 1 to 12 months. The reminder default is the factory recommended setting of 6 months. For details, see Sections 3.1b and 3.1c.

## 5.7 Replacing the Power Fuses

To access the only replaceable fuse in the incubator:

1. Turn off the incubator's power switch and unplug the power cord.
2. Remove the two screws from the top of the control panel.
3. Grasp the control panel on each side and pull straight outward.
4. Figure 5-8 shows the location of the fuse. See Table 5-1 below for replacement fuse specifications.
5. Slide the control panel back in, replace the screws and return the unit to service. If the fuse blows after restoring power to the incubator, contact the Technical Services Department.

## 5.8 Replacing Air Sample Filter

1. Connect one end of the air sample filter to the hose barb on the chamber ceiling.
2. Connect the other end of the filter to the metal tubing on the HEPA filter adapter (Figure-5-7).

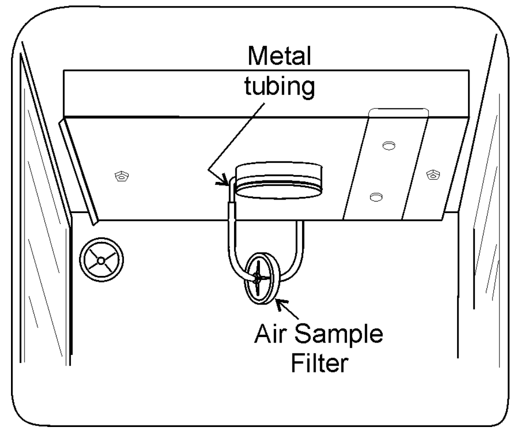



Figure 5-7

## 5.9 The Electronics Section

1. Turn off the incubator's power switch and unplug the power cord.
2. Remove the three screws from the back of the cabinet top.
3. Slide the top backward about an inch and lift it off.

**Table 5-1, Fuse Replacement Chart**

| Fuse Voltage | Manufacturers Part # | Amperage Rating | Rupture Speed | IEC Letter Code |
|---|---|---|---|---|
| 115VAC ACC | BUSS GMC-1.0A | 1.0 Amp | Time-Lag | T |
| 230VAC ACC | BUSS BK-GMC-500ma | 0.5 Amp | Time-Lag | T |

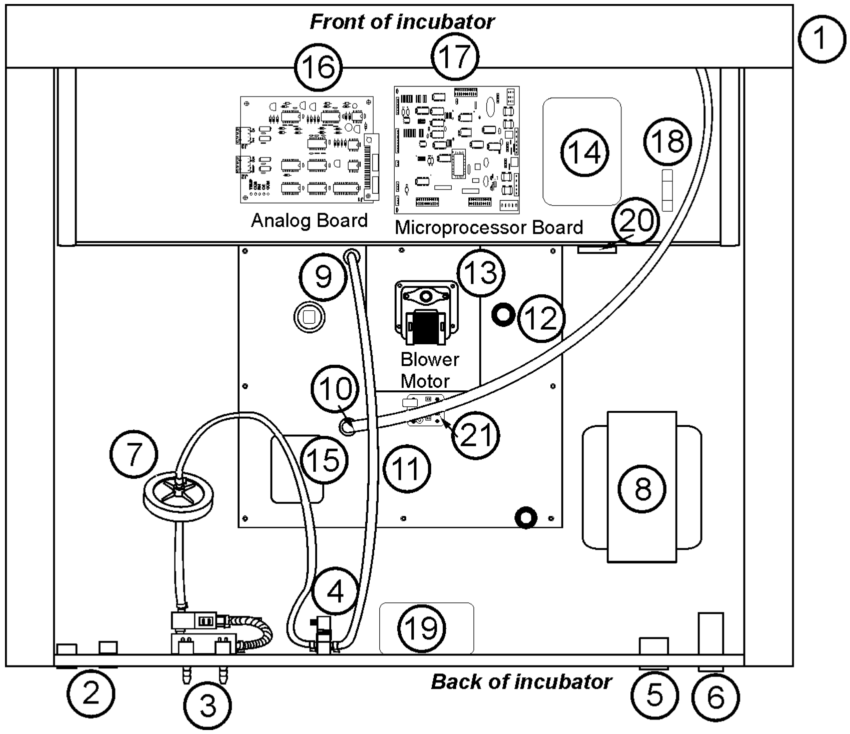



**Figure 5-8**

## a. Major Components

Refer to Figure 5-8. Some of the components shown in this illustration are factory installed options.

1. Power Switch - left of control panel on side of unit
2. RS 485 and remote alarm contacts - connectors and auxiliary wire through-port
3. $CO_2$ manifold and supply tank connectors - gas guard system, a factory installed option
4. $CO_2$ gas solenoid
5. Accessory outlet, 75 watts maximum
6. Filtered line cord connector
7. $CO_2$ microbiological filter
8. Main power transformer
9. $CO_2$ Sensor, IR / T/C
10. Sample port into the chamber
11. $CO_2$ injection tubing
12. Overtemperature thermostat
13. Blower motor
14. DC power supply
15. IR $CO_2$ sensor board
16. Analog output board, 4-20 mA, 0-1 Volt, 0-5 Volt
17. Microprocessor board
18. Fuse
19. Component fan
20. Component fan thermostat
21. RH board

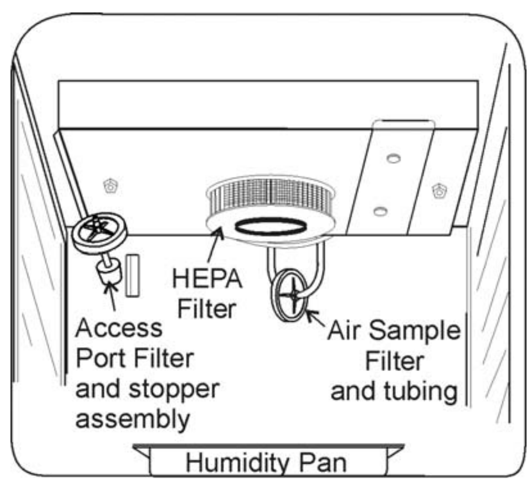
# Sterilization Cycle

## Information You Need to Know Before Starting a Cycle

- The Sterilization Cycle requires approximately 12 hours - heat-up (2-4 hours), sterilize (2 hours), and cool down (6-8 hours). Additional time is needed to verify the calibration of temperature and $CO_2$ after the cycle is complete.
- During the Sterilization Cycle, the incubator updates the temperature to the analog output board and the 1535, however $CO_2$ will be fixed at setpoint and RH will be fixed at RH Low Limit plus 1%.
- A HEPA filter replacement kit (see the spare parts list) should be on hand prior to initiating the Sterilization Cycle.

## Information About the Cycle

- Pre-cleaning may be required. In order to avoid odors, stains on the interior, baked-on material, etc., wipe off all visible signs of spills.
- Odor may occur during the Sterilization Cycle and is considered normal.
- The Steri Cycle is not intended to sterilize other items; instruments, etc., from the lab.
- During the cycle, the unit chamber becomes hot enough to melt samples, instruments, dishes, etc., left inside the unit. The items listed below also need to be removed.
  1) HEPA filter
  2) Air sample filter
  3) Access port filter assembly
  4) Water in the humidity pan
  5) Temp/RH recorder probe, if applicable
  6) IR sensor, if applicable
- During the Sterilization Cycle, discoloration of some materials may occur. For example, stainless steel turns a straw color after a period of exposure to high temperatures. This is normal.



# Checkpoints

| What if? | Then |
|---|---|
| Cycle does not initiate or terminates in mid-cycle | Check for alarms: SYS IN OTEMP, AIR SNSR ERR, TMP CTRL ERR |
| Units are stacked | Sterilize one unit at a time, the other may not be used during cycle |
| No action is taken within 1 minute, following display prompt | Unit returns to normal operation, SYSTEM OK |
| Need to cancel cycle in progress | Hold down green cycle initiation button for 3 seconds |
| Water is not removed from humidity pan during cycle | Steam is produced and may cause burns |
| Listed components are not removed before initiating cycle | Components cannot withstand the sterilization cycle temperatures and are destroyed |
| Unit is not powered off before removing the I/R sensor, if applicable | Damage to the sensor may result |
| Dummy I/R sensor is not installed properly | The sensor cable cannot withstand sterilization cycle temperatures and is destroyed |
| The outer door is opened during the heat or sterilization phases | An outer door alarm occurs: CLOSE DOOR in the display, plus an audible (cannot be silenced) and visual alarm. |
| The outer door is open longer than 20 seconds during phases listed above | Cycle is canceled, unit goes to CANCELED COOL PHASE* |
| The outer door is open during the cool down phase when the temp is 60°C or greater | An outer door alarm occurs |
| Power interruption during the HEAT PHASE | HEAT PHASE resumes if the chamber temperature was less than 90°C when power was interrupted<br>HEAT PHASE resumes if the chamber temperature was greater than 90°C when power was interrupted, and the temperature dropped less than 1°C<br>CANCELED COOL PHASE* starts if the chamber temp drop is more than 1°C |
| Power interruption during the STERILIZATION PHASE | HEAT PHASE begins if the chamber temperature has not dropped below 139°C STERILIZATION PHASE starts again when the chamber temperature reaches 140°C<br>CANCELED COOL PHASE* starts if the chamber temp dropped below 139°C |

** For further information on CANCELED COOL PHASE, see page 5-9.*

## 5.10 Sterilization Cycle

***The Sterilization Cycle will heat the incubator interior surfaces to 140°C. Contact with any surface inside the outer door during this cycle may result in burns.***

1. Empty the humidity pan of water and place the pan back into the incubator. Remove any samples, instruments, dishes, etc.from the chamber.
2. Press and hold the large green sterilization cycle button on the right side of the unit (Figure 5-9) for approximately 3 seconds until the LED lights.

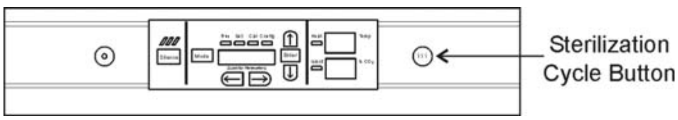
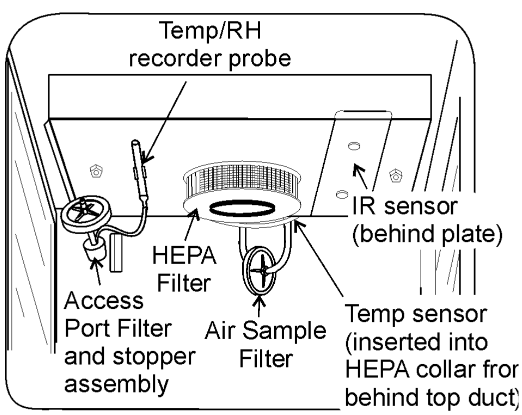



**Figure 5-9**

3. Enter the access code, if applicable. An access code is recommended to prevent accidental cycle initiation.
4. **Pre Sterilization with T/C $CO_2$ sensor** - The display toggles between “REMOVE HEPAs”, “REMOVE WATER” and “PRESS ENTER”. If Enter is not pressed within 1 minute, the display returns to “SYSTEM OK”.
5. Remove the HEPA filter, air sample filter and access port filter assembly (Figure 5-10). Tubing can remain in the unit during the sterilization cycle. In addition, remove the temp/RH recorder probe and IR sensor, if applicable. Discard the filters.

**Figure 5-10**




**Pre Sterilization with IR $CO_2$ sensor** - If an IR sensor is connected, the display toggles between “POWER OFF” and “REMOVE IR”. If power is not turned off within 1 minute, the display returns to “SYSTEM OK”.

**Note:** To remove the IR sensor, if applicable, first power the unit off. Then turn the two 1/4-turn fasteners on the top duct until the cover plate is disengaged. Secured on the inside of the plate is a dummy sensor (Figure 5-11).

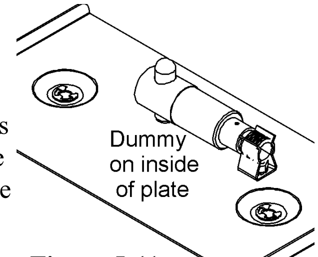
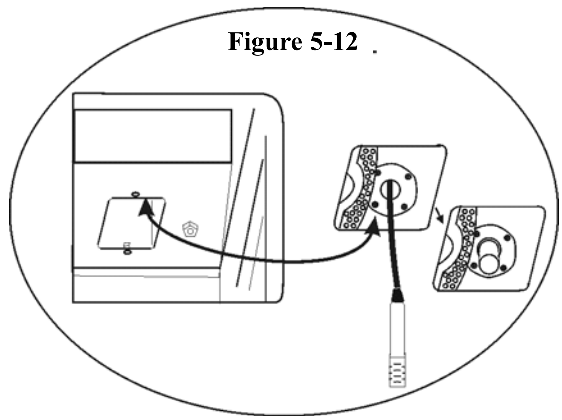



**Figure 5-11**

Grip the IR sensor and carefully pull it downward. Unscrew the cable from IR sensor (Figure 5-12). Set the sensor aside. See Step 9 for the IR sensor disinfection procedure. Connect the dummy sensor to the cable. Fit the installed dummy sensor up into the previous sensor location.

**Figure 5-12**



When the power is turned on with the IR sensor removed, the display toggles between “REMOVE HEPAs”, “REMOVE WATER”, and “PRESS ENTER”. If “ENTER” is not pressed within 1 minute, the display toggles between “POWER OFF” and “REPLACE IR”. When the unit is powered back on with the IR sensor reinstalled, the display returns to “SYSTEM OK”.

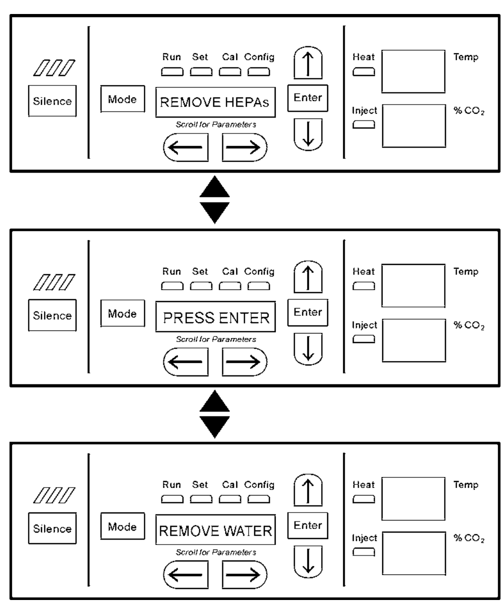



**Figure 5-13**

6. After ENTER is pressed, the Heat Phase initiates. The green LED flashes and the display toggles between “STERILIZING” and “HEAT PHASE”. During this period, the HEAT light will be on and the cabinet heats to sterilization temperature.

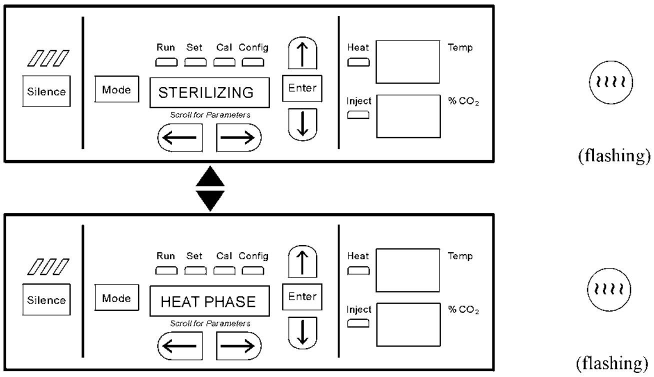



**Figure 5-14**

7. When the air temperature in the unit reaches 140.0°C, the Sterilization Phase begins and the display changes to “STERILIZING”.

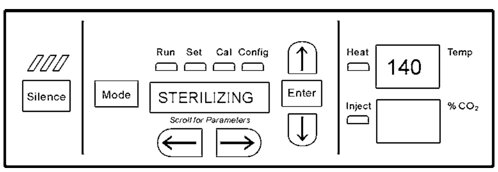



**Figure 5-15**

8. After approximately 2 hours, a 5-second audible tone sounds, signaling that sterilization is complete. The Cool Phase begins. The display toggles between “STERILIZ-ING” and “COOL PHASE”.

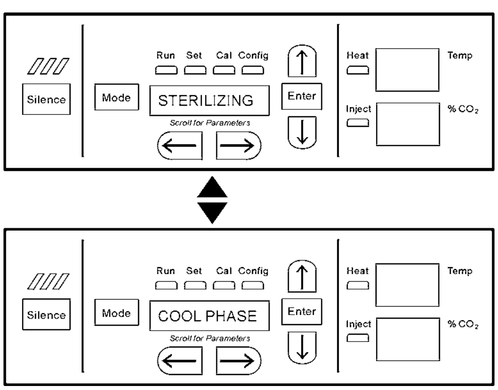



**Figure 5-16**

9. **Completed Sterilization Cycle with T/C $CO_2$ sensor** - When the temperature cools down to the original set operating temperature or 30°C, whichever is higher, the display toggles between “CYC COMPLETE”, “REPL HEPAs”, and “PRESS ENTER”. The green LED is lighted but no longer flashes.

**Completed Sterilization Cycle with IR $CO_2$ sensor** - When the temperature cools down to the original set operating temperature or 30°C, whichever is higher, the display toggles between “CYC COMPLETE”, “POWER OFF”, and “REPLACE IR”. The green LED is lighted but no longer flashes.

Clean the IR sensor with either isopropanol or Lysol No-Rinse Sanitizer. When using isopropanol, simply spray the sensor (do not saturate) and allow to dry. With Lysol, spray the sensor (do not saturate) and allow to sit for a couple of minutes. Wipe dry with a clean, soft cloth.

***Do not saturate the sensor or immerse the sensor in a cleaner.***

Power the unit off, open the chamber, and remove the IR plate. Pull down on the dummy, unscrew the cable from the top of the dummy and install the dummy into the clip on the plate. See Figure 5-11. Screw the cable onto the top of the IR sensor. The cable is keyed and can only be inserted one way. Reinstall the sensor by pushing it as far as it will go into the hole.

After the unit is powered back on with the IR sensor reinstalled, the display toggles between “CYC COM-PLETE”, “REPL HEPAs”, and “PRESS ENTER”.

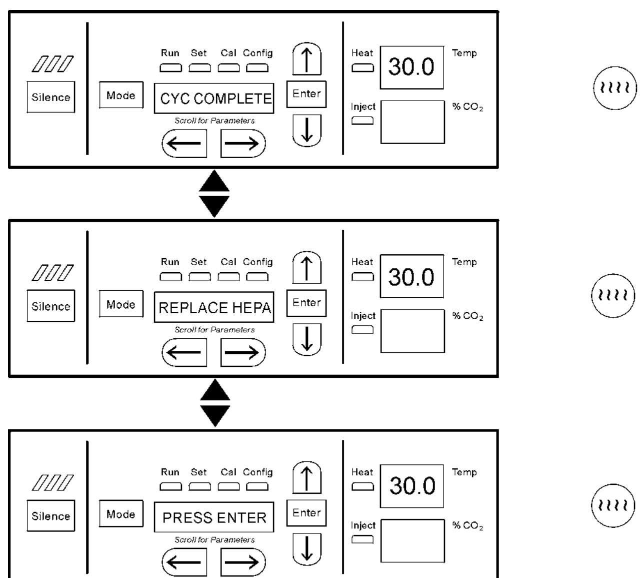



**Figure 5-17**

10. Open the chamber and install a new HEPA filter, air sample filter and access port filter assembly. Press ENTER.

11. When ENTER is pressed, the LED goes out, the display returns to “SYSTEM OK”, and the HEPA filter replace-ment timer is reset.

12. Fill the humidity pan with 3 liters of sterile distilled water within the recommended purity range (See Section 1.5j).
13. Allow to stabilize for at least 12 hours at the required temperature and $CO_2$ level.
14. It is recommended that the temperature and $CO_2$ calibrations be verified periodically during the first week of returning the unit to service.

***The high temperature sterilization cycle may cause the T/C $CO_2$ sensor output to change significantly. (This is normal and does not indicate damage to the sensor.) Therefore it is essential that the $CO_2$ calibration is verified before returning the unit to service.***

**Note:** If an independent instrument is not available, the following procedure may be performed. After the Sterilization Cycle and before $CO_2$ is allowed to enter the cabinet;

1) Fill and install the humidity pan,
2) Allow to stabilize at the desired operating temperature for at least 12 hours,
3) Calibrate the display to 0.0%.

***CANCELED COOL PHASE -** The display toggles between "CYC CANCELED" and "COOL PHASE"*

- *With T/C $CO_2$ sensor*

  *When the temperature cools down to the original set operating temperature or 30°C, whichever is higher, the display toggles between "CYC CANCELED", "REPL HEPAs", and "PRESS ENTER". The green LED is lighted but no longer flashes.*

- *With IR $CO_2$ sensor*

  *When the temperature cools down to the original set operating temperature or 30°C, whichever is higher, the display toggles between "CYC CANCELED", "POWER OFF", and "REPLACE IR". The green LED is lighted but no longer flashes. After the unit is powered back on with the IR sensor reinstalled, the display toggles between "CYC CANCELED", "REPL HEPAs" and "PRESS ENTER".*

# Section 6 - Factory Options

## 6.1 Connections to External Equipment

### a. Connecting the Remote Alarm Contacts

A set of relay contacts is provided to monitor alarms through an RJ11 telephone style connector on the back of the cabinet. Refer to Figure 6-5 for the location of the alarm connector. The 12-foot telephone cord (P/N 190388) and RJ11-to-screw terminal conversion box (190392) are available through our service department.

The remote alarm provides a NO (normally open) output, an NC (normally closed) output and COM (common). Refer to Figure 6-1.

The contacts will trip on a power outage or an overtemperature condition. The contacts may also be programmed to trip or not trip on temperature alarms, $CO_2$ alarms, and RH alarms. See Section 3.1, Configuration Mode.

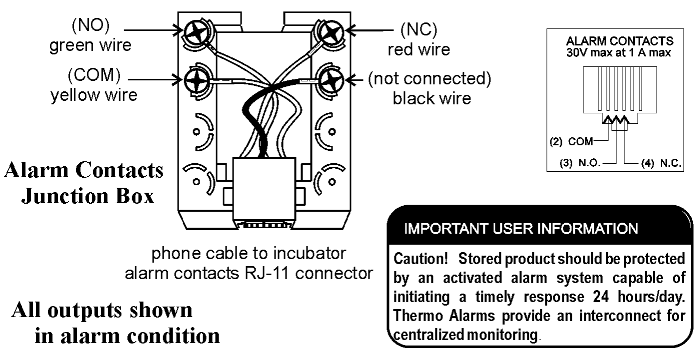



Figure 6-1


### b. Connecting the RS485 Interface (1900085)

All incubator models can be purchased with the RS485 communications option. This option allows the incubator to be directly connected to a Model 1535 alarm system without the use of a communications module. A junction box is provided with each RS485 option. Refer to Figure 6-2 for wiring details. Figure 6-5 shows the location of the RS485 connector on the back of the incubator cabinet.

To allow the incubator and the 1535 to communicate, an address must be allocated on the 1535. Refer to Section 5.8 of the 1535 operating manual. The same address number must be assigned to the incubator. Refer to Section 3.1 of this manual.

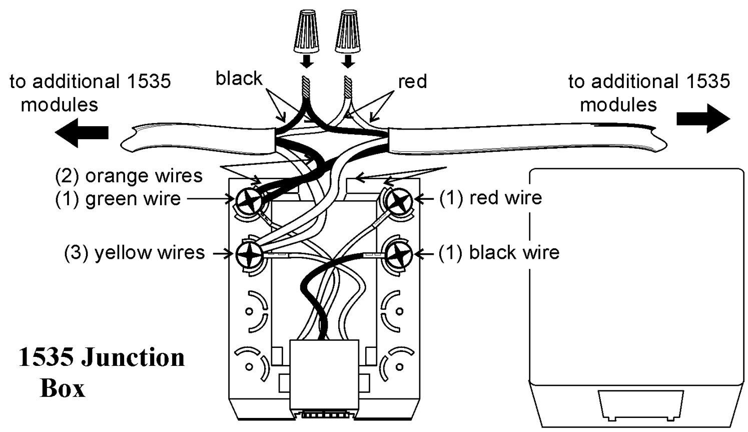



Figure 6-2

### c. Connecting the Analog Output Boards (190512, 190543, 190544)

***The electronics section contains hazardous voltages. Only qualified personnel should access this area.***

The analog output board is an option that allows the incubator to output analog signals representing the air temperature of the cabinet, $CO_2$ content, and relative humidity, depending upon which systems are in the incubator. There are three different analog output board options available : 0-1V, 0-5V, or 4-20mA signals. Negative display readings will output 0V. The outputs do not have isolated grounds. See Table 6-1 for output specifications of the three boards.

For the 0-1V and 0-5V boards, the recording device must supply a load >/=1000ohm. For the 4-20mA board, the recorder must supply a load of </=100 ohm.

To wire in the analog output board, use a shielded 22 gauge, 3-conductor wire (P/N 73041), maximum length 50 ft (15.2m).

This wire is readily available from other vendors including Alpha P/N 2403 and Deerborn P/N 972203.

**Table 6-1, Analog Output Board Specifications**

| | **190512 4-20 mA** Output Scaling 4-20 mA Equals | **190544 0-1V** Output Scaling 0-1 V Equals | **190543 0-5V** Output Scaling 0-5V Equals |
|---|---|---|---|
| Temperature | 12.5-162.5°C | 0.0-150.0°C | 0.0-150.0°C |
| RH | 0-100 %RH | 0-100 %RH | 0-100 %RH |
| $CO_2$ | 0.0-100.0 %$CO_2$ | 0-100.0 %$CO_2$ | 0-100.0 %$CO_2$ |

***Accuracy of the output at the board terminal strip to the incubator display is ±1 unit. There is no calibration from the incubator. Calibration to the incubator display must be at the instrument connected to the output board.***

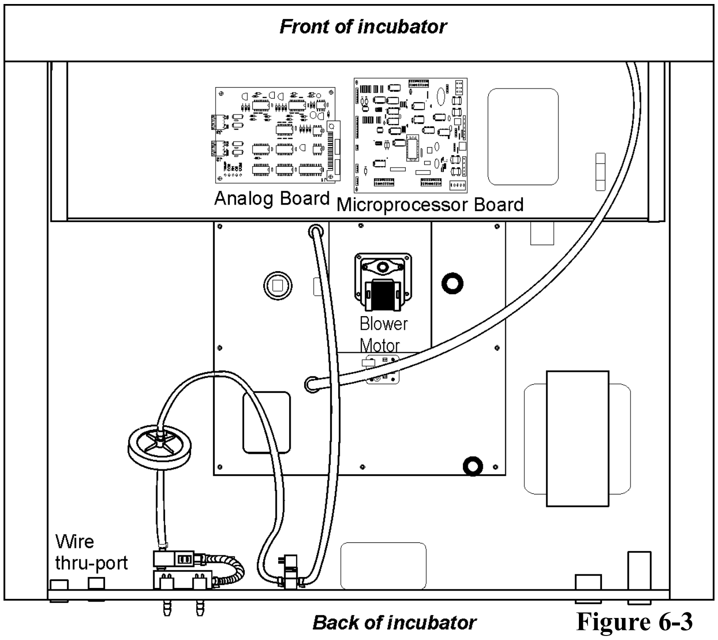



**Figure 6-3**

To install the analog board:

1. Turn off the incubator and unplug it from the wall outlet.
2. Remove the screws from the back of the cabinet top to access the electronics area. Slide the top back and off.
3. Locate the Analog Output board. Refer to Figure 6-3.
4. Each system monitored (Temp, $CO_2$, RH) requires two conductors (Refer to Figure 6-4). Feed the wires through the auxiliary wire through-port (see above) on the back panel. This port is a circular fitting adjacent to the remote alarm and RS485 connectors.

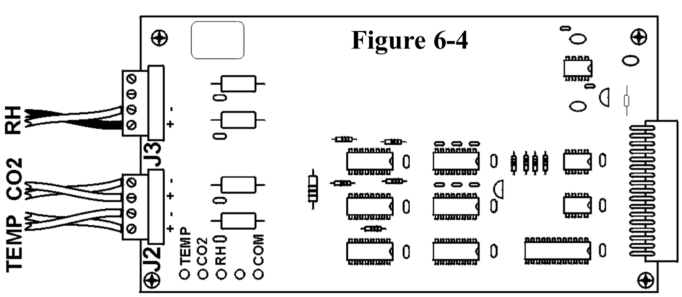



**Figure 6-4**

5. Strip the ends of each conductor and wire it to the appropriate terminals of connectors J2 and/or J3 on the analog board. (Refer to Figure 6-4)
6. When wiring is completed, slide on the top of the unit.
7. Secure with screws removed earlier and return the unit to service.

## 6.2 $CO_2$ Gas Guard (1900086)

***$CO_2$ can be lethal in high concentrations. Refer to warnings in Section 1.5k of this manual.***

The 370 Series incubators can be equipped with a built-in Gas Guard system that will operate with a $CO_2$ gas supply. The Gas Guard uses two pressure switches to continuously monitor the pressures of two independent $CO_2$ supplies and automatically switches from one supply to the other when the supply pressure drops below 10 psig (0.690 bar). The Gas Guard's design does not facilitate use by multiple incubators.

The $CO_2$ gas supplies must be equipped with two-stage pressure regulators with gauges. The high pressure gauge at the tank should have a 0-2000 psig range and the low pressure gauge should have a 0-30 psig range. The gas supply to the incubator must be maintained at 15 psig (1.034 bar). Gas pressures below 15 psig will cause nuisance alarms to occur on incubators equipped with the built-in Gas Guard.

### a. Connecting the $CO_2$ Gas Supplies

The $CO_2$ inlets for the Gas Guard are located on the rear of the cabinet. Using 1/4" ID tubing, connect one of the $CO_2$ supply tanks to the fitting labeled CO2 Inlet #1 Tank. Connect the second $CO_2$ supply tank to the fitting labeled CO2 Inlet #2 Tank. Install 3/8" hose clamps to secure the 1/4" ID tubing to the fittings on the rear of the drawer. (Refer to Figure 6-5)

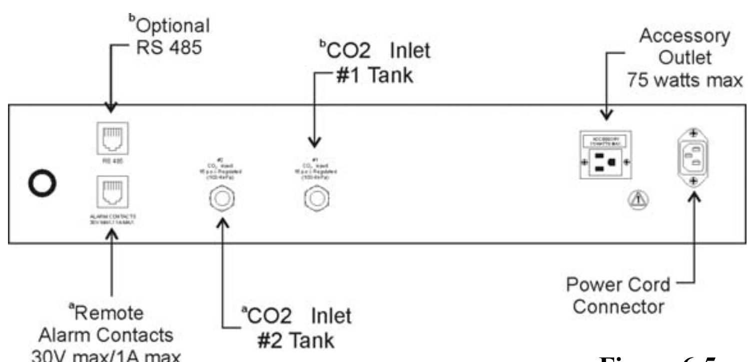



**Figure 6-5**

*[a] RJ-II telephone style connectors*

*[b] Used with the optional Gas Guard System*

### b. De-activating the Gas Guard

The built-in Gas Guard is turned ON when shipped from the factory. In addition, the Tank Sel for the Gas Guard is specified as Tank 1 when shipped. Refer to Section 3, Configure Mode, to de-activate the Gas Guard or change the Tank Sel from #1 to #2. If the Gas Guard system is not used, the incubator will function normally by supplying $CO_2$ from the supply tank connected to Inlet #1.

### c. Operation of the $CO_2$ Gas Guard

With the Gas Guard in operation, the incubator will use the gas supplied by the tank connected to Inlet #1 until the pressure drops below 10 psig (0.690 bars). At this time, the Gas Guard automatically switches to the gas supplied through $CO_2$ Inlet #2.

In addition, the incubator automatically changes the Tank Sel in Configure Mode from 1 to 2 to indicate that the incubator is now using gas supplied through Inlet # 2. If the gas supply to Inlet #1 is replenished, the incubator will continue to operate using the gas supplied through Inlet #2 unless the operator changes the Tank Sel from #2 to #1 through Configure Mode. Refer to Section 3, Configuration.

Audible and visual alarms occur on the control panel when the gas guard switches from one supply to the other. The audible alarm sounds until the operator presses the Silence key on the control panel. The visual alarm in the Message Center will read Tank 1 Low while the audible alarm is sounding, but the message will be removed when the operator presses the Silence key. However, the 'Tank Low' indicator on the control panel will stay lighted until the condition is resolved. The unit will operate normally.

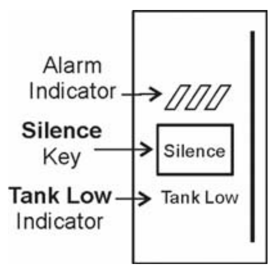



**Figure 6-6**

***Both the audible and visual alarms described above do not ring back after the Silence key is pressed.***

If the Gas Guard system does not detect an adequate gas supply at CO2 Inlet #1 or Inlet #2, a visual and audible alarm will again occur on the control panel. The visual alarm in the Message Center will read Tank 1&2 Low. The audible alarm will continue to ring until the Silence key is pressed. The audible alarm will ring back every 15 minutes after the alarm is silenced if the Gas Guard continues to detect that both gas supply pressures are below 10 psig (0.690 bars).

## 6.3 Humidity Readout (1900091)

The 370/380 Series incubators can be equipped with a humidity sensor to monitor the relative humidity inside the chamber. The sensor is located on the chamber ceiling and provides a signal that is displayed in 1% increments on the control panel. The humidity readout can be displayed continuously or toggles with the temperature readout. In addition, a low alarm limit can be set on the humidity readout, which will detect when the humidity pan runs dry. Refer to Section 3, Configuration.

### a. Factors Affecting the Humidity Level in the Chamber

- Water level in the humidity pan
- Frequency of door openings
- The humidity pan is located on the bottom of the chamber versus on a shelf.

***Incubators equipped with a Thermal Conductivity $CO_2$ sensor rely on a constant level of relative humidity in order to accurately measure and control the $CO_2$ concentration in the incubator.***

### b. Accuracy of the Humidity Readout

The sensor is capable of measuring relative humidity from 10% to 100% with an accuracy of ±5% above 90%. See Section 2, Calibration, for details on calibrating the humidity readout.

# Section 7 - Specifications*

*Specifications are based on nominal voltages of 115V or 230V in ambients of 22°C to 25°C.

| | |
|---|---|
| **Temperature** | |
| Control | ±0.1°C Microprocessor PID Control |
| Setpoint | Digital - Touch pad, 0.1°C |
| Range | +5°C above ambient to 50°C |
| Uniformity | ±0.3°C @ +37°C |
| Tracking alarm | User programmable (low) indicator |
| Overtemp | Tracking, user programmable, action, and indicator |
| Display | Digital, LED, 0.1°C increments |
| **Temperature Safety** | |
| Type | Extreme temperature safety, action, and indicator |
| Sensor | Thermostat, independent of temperature control system |
| Indicator | Message center, audible and visual alarms |
| **Relative Humidity** | |
| Control | Humidity pan - natural vaporization |
| Humidity with pan | 95% RH at 37°C |
| Display | Optional in 1% increments |
| Alarm | Low RH with optional RH monitor |
| **$CO_2$** | |
| Control | ±0.1% microprocessor PID control |
| Sensor | T/C or IR |
| Readability | 0.1% |
| Range | 0 to 20% |
| Inlet pressure | 15 psig |
| Display | Digital LED, 0.1% increments |
| **Shelves** | |
| Dimensions | 18.5” x 18.5” (47cm x 47cm) |
| Construction | Stainless steel (belt sanded, both sides) |
| Surface area | 2.4 sq. ft. per shelf |
| Max. per chamber | 36.0 sq. ft. |
| Standard | 4 |
| Maximum | 15 |

**Construction**

| | |
|---|---|
| Interior volume | 6.5 cu. ft. |
| Interior | Type 304 stainless steel shiny finish |
| Exterior | 18 gauge cold roll steel |
| Outer door gasket | Four-sided molded, magnetic Santoprene |
| Inner door gasket | Bulb, silicone |
| Insulation | Mineral wool |

**Fittings**

| | |
|---|---|
| Access port | 1-1/4 inch removable silicone plug |
| $CO_2$ inlet | 1/4” barbed |
| Sample port | Front mounted barbed |

**Electrical**

| | |
|---|---|
| 115 Volt models | 115VAC, 50/60 Hz, 1PH, 9.6 FLA (Operating range 90-125VAC) |
| 230 Volt models | 230VAC, 50/60 Hz, 1 PH, 4.4 FLA (Operating Range 180-250VAC) |
| Power switch/circuit breaker | 2 Pole, 12.0 Amp |
| Accessory outlet | Voltage equal to the cabinet input. 75 Watts maximum, 0.5ma leakage current |
| Alarm contacts | Deviation of temperature, $CO_2$, power, NO and NC |

**Dimensions**

| | |
|---|---|
| Exterior | 26.1” W x 39.5” H x 25.0” F-B (66.3cm x 100.3cm x 63.5cm) |
| Interior | 21.3” W x 26.8” H x 20.0” F-B (54.0cm x 68.1cm x 50.8cm) |

**Weight**

| | |
|---|---|
| Net weight | 260 lbs (118kg) |
| Net shipping weight | 315 lbs (143kg) |

**Copper Options**

| | |
|---|---|
| Perforated shelf | Customer Installed: Stock no. 224166 - solid copper |
| Humidity pan | Customer Installed: Stock no. 237015 - solid copper |
| Copper interior components kit | Factory installed: Replace stainless steel duct work, shelves, and humidity pan with solid copper Stock no. 1900095 |

**Optional Data Outputs**

| | |
|---|---|
| Analog | Factory installed: Stock no. 190544 - 0-1 volt |
| Analog | Factory installed: Stock no. 190543 - 0-5 volt |
| Analog | Factory installed: Stock no. 190512 - 4-20mA |
| Digital | Factory installed: Stock no. 1900085 - RS-485 (Compatible with Model 1535 Alarm Monitor only) |

**Certifications**

Refer to the Declaration of Conformity at the back of this manual

**Safety Specifications**

Indoor Use Only
Altitude - 2,000 meters
Temperature - 5°C to 40°C
Humidity - 80% RH at or below 31°C, decreasing linearly to 50% RH at 40°C
Mains Supply Fluctuations - Mains supply voltage fluctuations not to exceed ±10% of the nominal voltage
Installation Category II [1]
Pollution Degree 2 [2]
Class of Equipment I

---

1 Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500V for a 230V supply and 1500V for a 120V supply.

2 Pollution degree describes the amount of conductive pollution present in the operating environment. Pollution degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

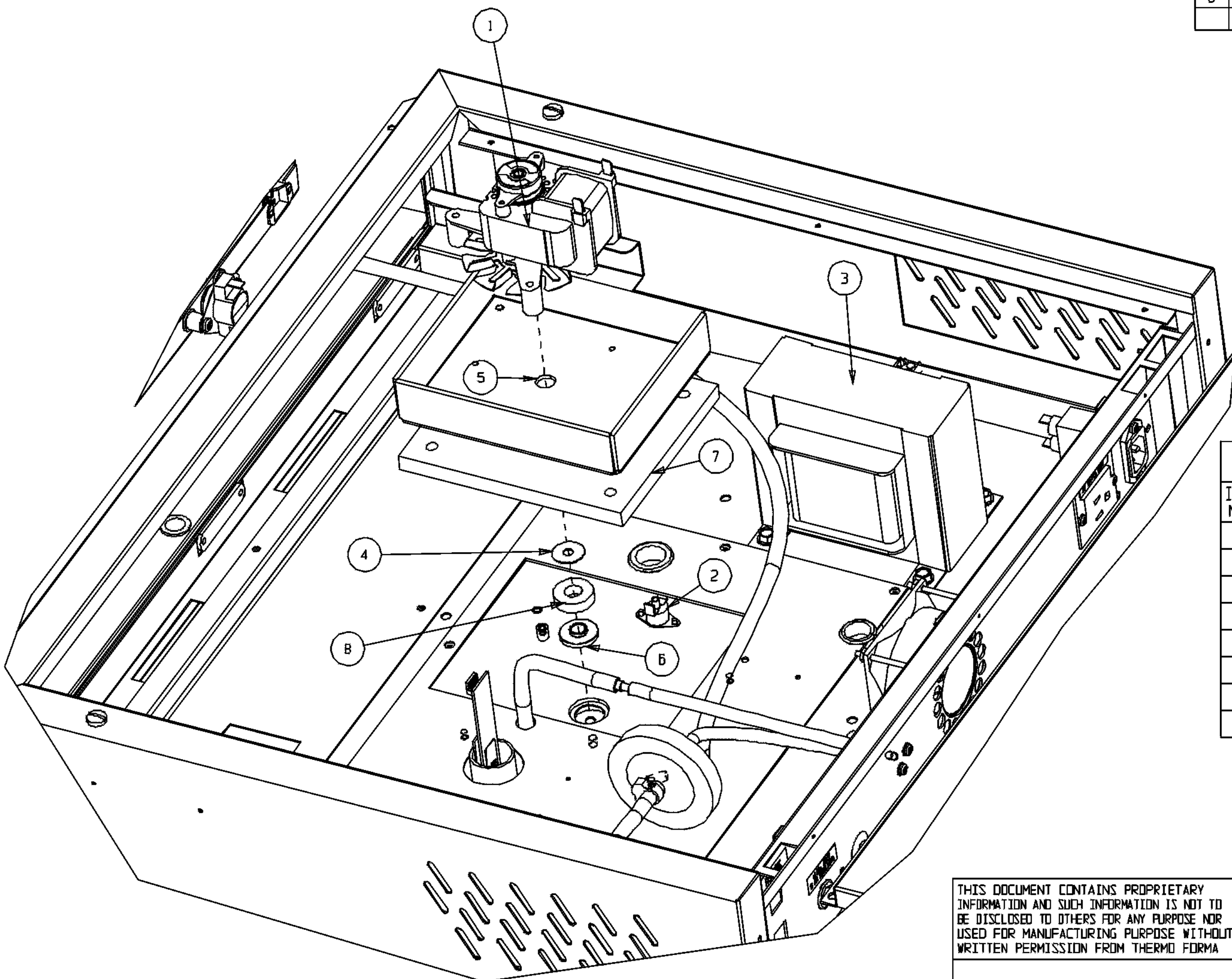
## Section 8 - Spare Parts

| Part Number | Description |
|---|---|
| 190699 | Removable feather gasket |
| 190670 | Duct sheet and shelf channel kit |
| 191650 | Micro board, (main control) |
| 230135 | Fuse, 1A, TD, 5 x 20mm (accessory outlet, 115V) |
| 230120 | 0.5A fuse, TD, 5 x 20mm (accessory outlet, 230V) |
| 156117 | Motor, 2-pole, 115VAC, 50/60 Hz |
| 190793 | Display board |
| 290184 | Probe, 2252 Ohm/25°C, 1/8 x2 |
| 224166 | Copper shelf |
| 224175 | Stainless steel shelf |
| 130077 | Stopper with 3/8” hole |
| 290168 | Thermal conductivity (T/C) type $CO_2$ sensor |
| 231204 | Infrared type $CO_2$ sensor |
| 250087 | $CO_2$ valve kit with assorted fittings |
| 231203 | RH sensor assembly (RH display option) |
| 230180 | 12A, DPDT circuit breaker switch (power) |
| 400119 | Switcher, 40W, 12, 5, -12V |
| 196018 | 34 position control to display ribbon cable |
| 360213 | Pressure switch (Gas Guard option) |
| 250121 | Gas valve (Gas Guard option) |
| 190512 | 4-20mA output board |
| 190543 | 0-5V output board |
| 190544 | 0-1V output board |
| 420104 | 1KVA transformer |
| 360239 | Inner door switch |
| 360230 | Outer door switch |
| 360236 | Sterilization initiation switch |
| 100115 | Blower wheel |

| Part Number | Description |
|---|---|
| 190985 | Access port filter assembly |
| 770001 | Disposable filter, 99.97% ($CO_2$ line, air sample) |
| 760175 | HEPA filter, 5.5” diameter |
| 760199 | HEPA2 VOC Filter Replacement Kit (760200 HEPA$^2$, 117036 silicone plug, 101018 O-ring) |
| 1900094 | HEPA2 VOC Filter Replacement Kit (760200 HEPA$^2$, 190985 access port filter, 770001filter) |

DWG. NUMBER: 370-200-2-B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 0 | N/A | 4/10/01 | DCB | DCB | | RELEASE FOR PRODUCTION |
| | | | | | | |




| BILL OF MATERIALS | | | |
|---|---|---|---|
| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
| 1 | 156117 | BLOWER MOTOR | 1 |
| 2 | 400150 | THERMOSTAT | 1 |
| 3 | 420104 | 1 KVA TRANSFORMER | 1 |
| 4 | 730077 | TEFLON WASHER | 2 |
| 5 | 1900302 | MOTOR MOUNT | 1 |
| 6 | 1900315 | BLOWER SHAFT BUSHING | 1 |
| 7 | 140300_PT3 | BLOWER INSULATION 370 1 OF 3 | 1 |
| 8 | 730069_370 | SILICONE WASHER | 1 |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Thermo Forma

Box 649, Marietta, Ohio 45750

MODEL/PART NAME: 370 SERIES STERI-CYCLE INCUBATOR

DWG TITLE: ASSEMBLY

DWN: DALE | CAD: DCB | APPD: | DATE: 4/6/01 | SCALE: 0.375

MATERIAL: -

PAINT: ANTIQUE WHITE

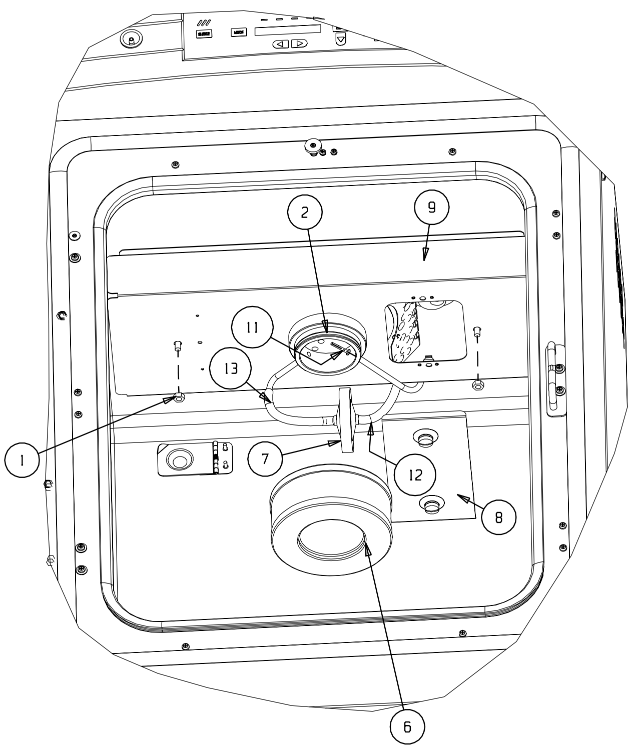
TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX=± .xxx=±

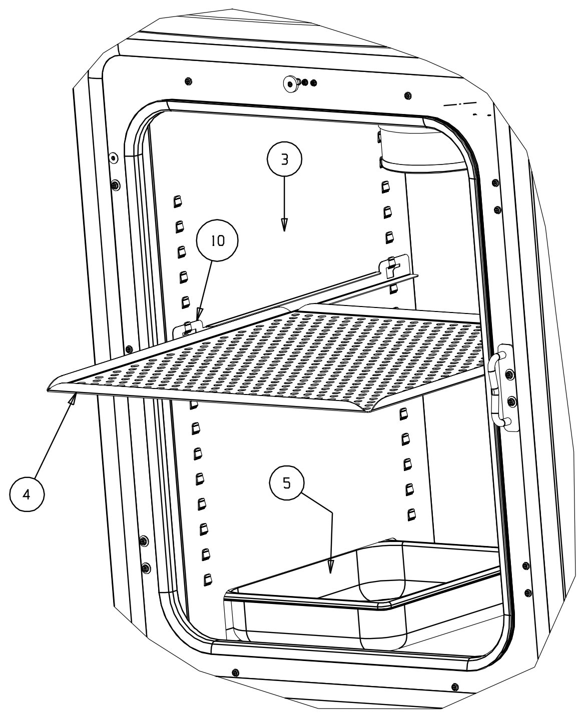
DRAWING NUMBER 370-200-2

SIZE B

DWG. NUMBER: 370-200-3-B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 0 | N/A | 4/11/01 | DCB | DCB | DNF | RELEASE FOR PRODUCTION |
| 1 | IN-2942 | 05-14-01 | DCB | KDG | LDN | REMOVED TOP ROW OF TABS FROM DUCT SHEET |
| 2 | IN-3124 | 07-30-03 | JNL | KDG | CCS | CHANGED 290137 PROBE TO 290184 |




## BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 23004 | 1/4-20 SS HEX NUT (4) | 2 |
| 2 | 101013 | 3" SILICONE O-RING | 1 |
| 3 | 190723 | MODULAR W/J DUCT SHEET | 2 |
| 4 | 224175 | INC. SHELF - 2B BRUSHED BACK | 1 |
| 5 | 237016 | HUMIDITY PAN | 1 |
| 6 | 760175 | 5.500" HEPIA FILTER | 1 |
| 7 | 770001 | DISPOSIBLE HEPIA FILTER 1/4 (8) | 1 |
| 8 | 1900097 | ACCESS PLATE | 1 |
| 9 | 1900311 | 370 SERIES TOP DUCT SUB-ASSEMBLY | 1 |
| 10 | 190664-31-1 | SHELF CHANNEL | 2 |
| 11 | 290184 | TEMPERATURE SENSOR | 1 |
| 12 | FLTRD_AIR_2 | 244020 SILICONE TUBE 6" | 1 |
| 13 | FLTRD_AIR_3 | 244020 SILICONE TUBE 5" | 1 |

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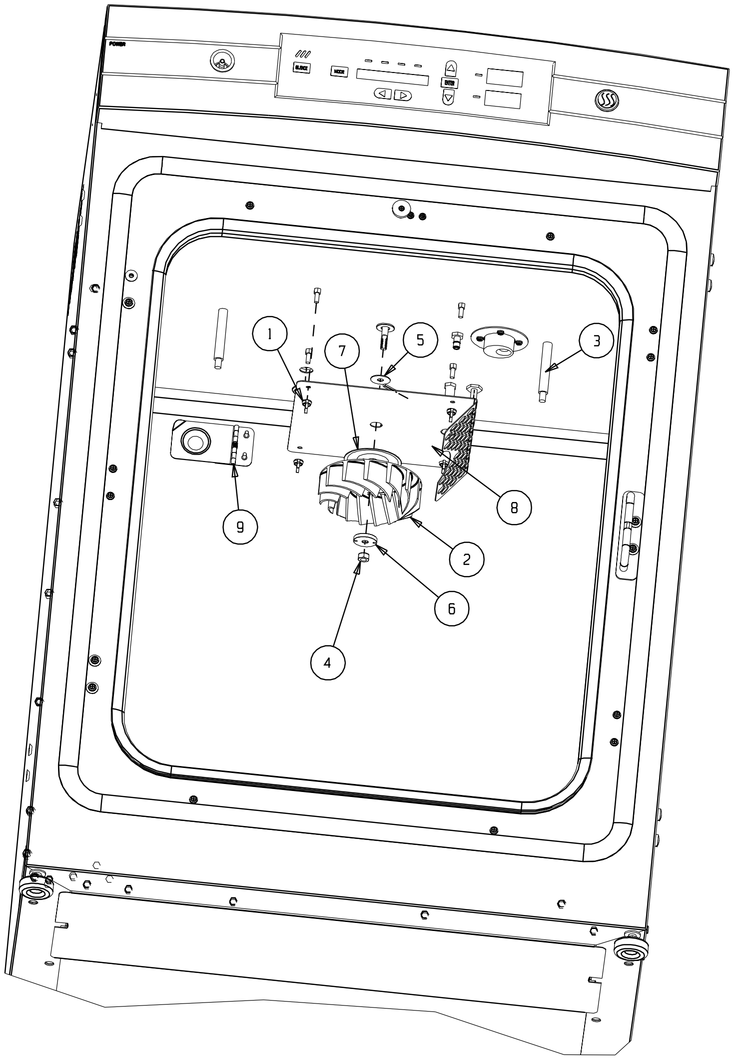
ELECTRON CORPORATION

| | | | | |
|---|---|---|---|---|
| MODEL/PART NAME: 370 SERIES STERI-CYCLE INCUBATOR | | | | |
| DWG TITLE: ASSEMBLY | | | | |
| DWN: DALE | CAD: DCB | APPD: DNF | DATE: 4/6/01 | SCALE: 0.200 |
| MATERIAL: - | | | | |
| PAINT: WHITE | | | | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED ANGLES: ± DECIMAL: .XX=± .xxx=± | DRAWING NUMBER 370-200-3 | SIZE B | | |

DWG. NUMBER: 370-200-4-B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 0 | N/A | 4/11/01 | DCB | DCB | | RELEASED FOR PRODUCTION |
| 1 | IN-3124 | 07-30-03 | JNL | KDG | CCS | CHANGED 290137 PROBE TO 290184 |




## BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 23051 | #8-32 S.S. WING NUT | 4 |
| 2 | 100115 | VORTEX BLOWER WHEEL CW | 1 |
| 3 | 127066 | 2.250" SPACER 1/4"-20 | 2 |
| 4 | 610075 | 1/4"-20 SS LEFT- HANDED NUT | 1 |
| 5 | 730077 | TEFLON WASHER | 2 |
| 6 | 1900083 | BRASS FAN ADAPTER | 1 |
| 7 | 1900111 | BLOWER WHEEL PLATE | 1 |
| 8 | 1900320 | CLASS 100 PLATE | 1 |
| 9 | 1900322 | ACCESS PORT FLAP ASSEMBLY | 1 |
| 10 | 290184_370 | TEMPERATURE SENSOR | 1 |

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MODEL/PART NAME: 370 SERIES STERI-CYCLE INCUBATOR

DWG TITLE: ASSEMBLY

| DWN: DALE | CAD: DCB | APPD: | DATE: 4/6/01 | SCALE: 0.218 |
|---|---|---|---|---|

MATERIAL: -

PAINT: WHITE

Thermo
ELECTRON CORPORATION

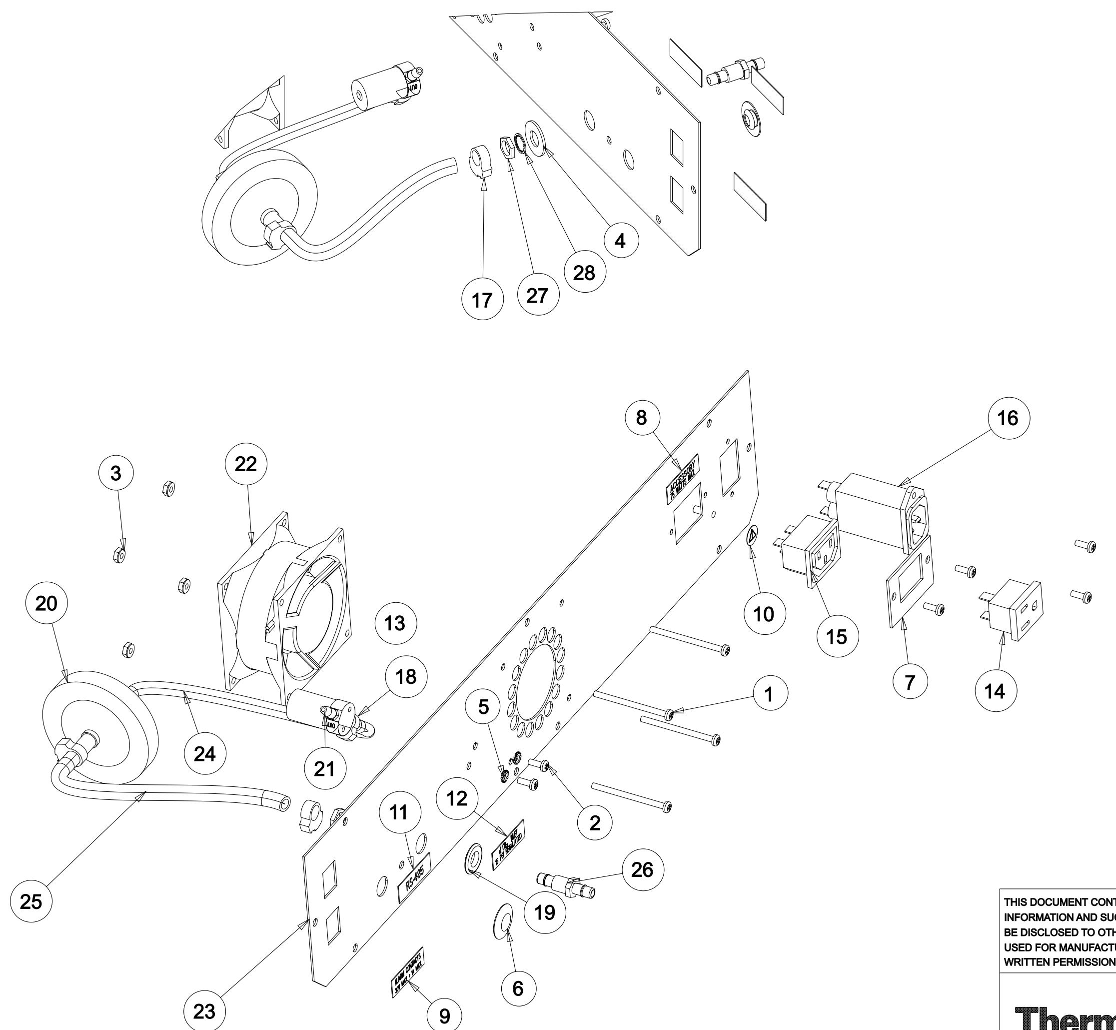
TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX=± .xxx=±

DRAWING NUMBER: 370-200-4

SIZE: B

DWG. NUMBER: 370-200-5 -B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 0 | N/A | 4/17/01 | DCB | DCB | DNF | RELEASE FOR PRODUCTION |
| 1 | IN-2947 | 06/25/01 | JRH | JRH | MSB | SWITCHED CO2 INLET TO OTHER HOLE |
| 2 | PIP-029 | 08-29-01 | WCW | PDK | KDG | REVISED OUTLET MOUNT |
| 3 | SI-9181 | 05-19-04 | GLM | KDG | CCS | CHG'D. 250085 CLIPPARD VALVE TO ASCO |



## BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 22011 | #6-32 x 2 SS PHP SCREW | 4 |
| 2 | 22049 | #6-32 X 3/8 SS PHP SCREW | 6 |
| 3 | 23001 | #6-32 ZP LKWASH HEX NUT | 4 |
| 4 | 23024 | 3/8" SS FLAT WASHER | 1 |
| 5 | 23058 | #6 SS EXT TOOTH LOCKWASHER | 2 |
| 6 | 34014 | 1/2" SNAP-IN HOLE PLUG (BLACK) (370/380 ONLY) | 1 |
| 7 | 190994 | ACCESSORY OUTLET MOUNT | 1 |
| 8 | 220259 | ACCESS OULET LABEL | 1 |
| 9 | 220381 | ALARM CONTACT LABEL | 1 |
| 10 | 220490 | REFER TO MANUAL LABEL | 1 |
| 11 | 220565 | RS-485 LABEL | 1 |
| 12 | 220566 | CO2 #1 LABEL (370/380 ONLY) | 1 |
| 13 | 250085 | SOLENOID VALVE 12V (371, 381 ONLY) | 1 |
| 14 | 460024 | SNAP-IN OUTLET, WHITE | 1 |
| 15 | 460138 | POWER OUTLET | 1 |
| 16 | 460180 | 15 AMP RFI ENTRY | 1 |
| 17 | 600034 | SNAPPER CLAMP .375 | 3 |
| 18 | 600063 | SNAPPER CLAMP .312 | 1 |
| 19 | 730044 | SHOULDER WASHER .375" ID | 1 |
| 20 | 770001 | DISPOSABLE HEPA FILTER 1/4 | 1 |
| 21 | 840008 | 5/32 TUBING ADAPTER | 2 |
| 22 | 900135 | 3.15" SQUARE FAN | 1 |
| 23 | 1900313-16-1 | BACK PANEL STUD DETAIL | 1 |
| 24 | 370-CO2-INLET-2 | 72015 3/16" VINYL TUBING 6" | 1 |
| 25 | 370_CO2_INLET_1 | 950013 VINYL INLET TUBE 370 , 8" | 1 |
| 26 | 840020_FITTING | .250 BULKHEAD FITTING | 1 |
| 27 | 840020_NUT | .375 NUT BULKHEAD FITTING | 1 |
| 28 | 840020_WASHER | .375 IT WASHER BULKHEAD FITTING | 1 |

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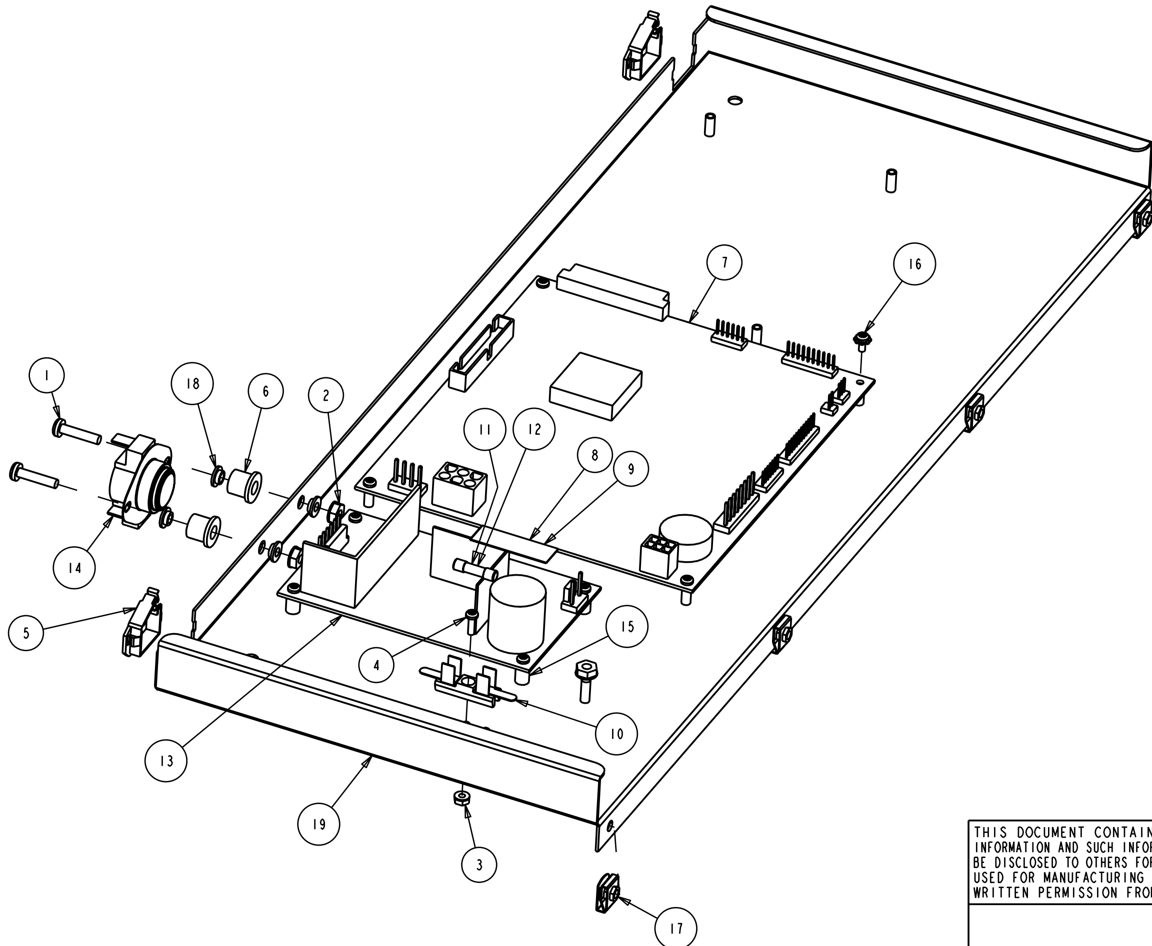
| | | | | |
|---|---|---|---|---|
| MODEL/PART NAME: 370 INCUBATOR | | | | |
| DWG TITLE: 370 BACK PANEL ASSEMBLY | | | | |
| DWN:DALE | CAD: DCB | APPD: | DATE: 3/26/01 | SCALE: 0.375 |
| MATERIAL: - | | | | |
| PAINT: N/A | | | | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED ANGLES: DECIMAL: .XX=%%p .xxx=%%p | | DRAWING NUMBER 370-200-5 | | SIZE B |

Thermo
ELECTRON CORPORATION
Controlled Environment Equipment
Box 649, Marietta, Oh 45750

DWG. NUMBER: 370-200-6-B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 0 | N/A | 3/28/01 | DCB | DCB | DNF | RELEASED FOR PRODUCTION |
| 1 | IN-2994 | 10-25-01 | WCW | PDK | LDN | CHG. FROM 22130 & 23029 TO 590032 |
| 2 | IN-3048 | 09-25-02 | GJG | KDG | | ADDED (4) 515084 SPACERS |




## BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 22015 | #8-32 X 3/4 SS PHP SCREW | 2 |
| 2 | 23002 | #8-32 ZP LKWASH HEX NUT | 3 |
| 3 | 23006 | #4-40 ZP LKWASH HEX NUT | 1 |
| 4 | 59007 | #4-40 X 3/8 SS PHP SCREW | 1 |
| 5 | 111037 | NYLON WIRE SADDLE | 2 |
| 6 | 120048 | NYLON BEARING 1/4' X 7/16' | 2 |
| 7 | 191650 | 370 SERIES INCUBATOR MICRO BOARD | 1 |
| 8 | 220359 | 1 AMP FUSE LABEL | 1 |
| 9 | 220488 | .5 AMP FUSE | 1 |
| 10 | 230105 | FUSE BLOCK 5 X 22 MM | 1 |
| 11 | 230120 | FUSE_.5A_5X22MM | 1 |
| 12 | 230135 | FUSE_1A_5X22MM | 1 |
| 13 | 400119 | SWITCHER | 1 |
| 14 | 400151 | THERMOSTAT 160 F | 1 |
| 15 | 515084 | 1/4 DIA. X 3/8L SS SPACER | 4 |
| 16 | 590032 | #4-40 X 1/4 SS PHP EXT SEMS SCREW | 8 |
| 17 | 610055 | #8-32 CLIPNUT | 4 |
| 18 | 730058 | NYLON SHOULDER WASHER | 4 |
| 19 | 1900312-15-1 | COMPONENT TRAY SUB-ASSEMBLY | 1 |

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Thermo Forma
Box 649, Marietta, Ohio 45750

MODEL/PART NAME: 370 SERIES INCUBATOR

DWG TITLE: CONTROL PANEL TRAY ASSY

DWN: DALE | CAD: DCB | APPD: LDN | DATE: 3/28/01 | SCALE: 0.500

MATERIAL: -

PAINT: N/A

TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX=± .XXX=±

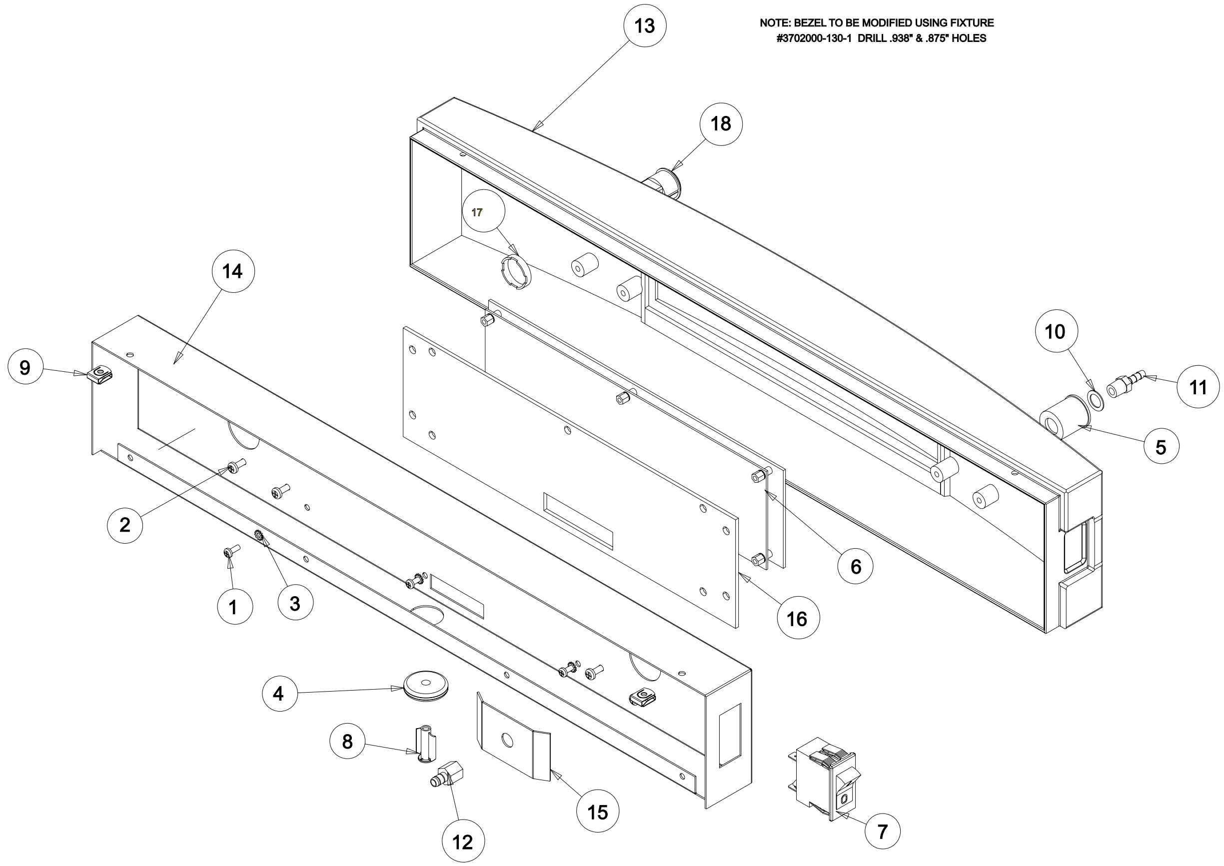
DRAWING NUMBER: 370-200-6

SIZE: B

DWG. NUMBER: 370-200-7 -B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 0 | N/A | 3/28/01 | DCB | DCB | DNF | RELEASE FOR PRODUCTION |
| 1 | N/A | 12-26-01 | KDG | KDG | LDN | CORRECT STK#360326 TO STK#360236 |
| 2 | SI-3154 | 11-10-03 | GLM | KDG | | CHANGED MOUNTING OF MAGENTIC SWITCH |

NOTE: BEZEL TO BE MODIFIED USING FIXTURE
#3702000-130-1 DRILL .938" & .875" HOLES




## BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 22049 | #6-32 X 3/8 SS PHP SCREW | 6 |
| 2 | 22053 | #8-32 X 1/2 SS PHP SCREW | 8 |
| 3 | 23058 | #6 SS EXT TOOTH LOCKWASHER | 6 |
| 4 | 114011 | 1-1/4" X 1/4" ID GROMMET | 1 |
| 5 | 190294 | PLASTIC RECESS | 1 |
| 6 | 190793 | INSERT PANEL | 1 |
| 7 | 230180 | CIRCUIT BREAKER SWITCH | 1 |
| 8 | 360230 | MAGNETIC SWITCH | 1 |
| 9 | 610055 | #8-32 CLIPNUT | 2 |
| 10 | 730060 | .416 SS WASHER | 1 |
| 11 | 840035 | 3/16" HOSE TO 1/8" MPT ADAPTER | 1 |
| 12 | 840065 | 1/4" HOSE TO 1/8" FPT ADAPTER | 1 |
| 13 | 180172_MOD | PLASTIC BEZEL, MODIFIED | 1 |
| 14 | 1900312-31-1 | CONTROL PANEL FRONT | 1 |
| 15 | 1900312-31-3 | SAMPLE PORT MOUNT | 1 |
| 16 | 1900330-31-1 | INSERT SPACER | 1 |
| 17 | 360236_NUT | SWITCH NUT | 1 |
| 18 | 360236_SCSWITCH | GREEN PUSHBUTTON SWITCH | 1 |

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Thermo
ELECTRON CORPORATION
Controlled Environment Equipment
Box 649, Marietta, Oh 45750

MODEL/PART NAME: 370 SERIES INCUBATOR

DWG TITLE: CONTROL PANEL BEZEL ASSEMBLY

| DWN: DALE | CAD: DCB | APPD: DNF | DATE: 3/28/01 | SCALE: 0.312 |
|---|---|---|---|---|

MATERIAL: -

PAINT: N/A

TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX=%%p
.xxx=%%p

DRAWING NUMBER: 370-200-7

SIZE: B

DWG. NUMBER: 370-200-8-B

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
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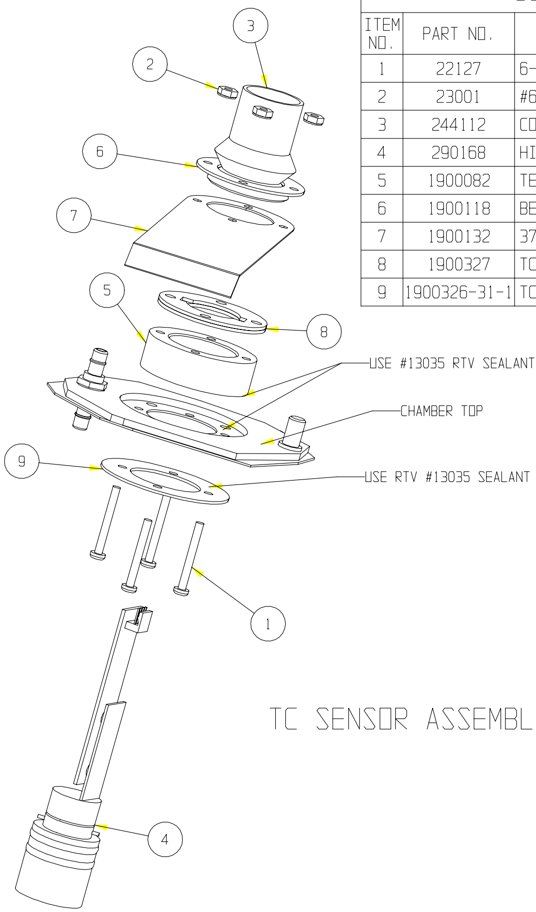
| 0 | N/A | 04-24-01 | DCB | DCB | LDN | RELEASED FOR PRODUCTION |
| 1 | IN-2915 | 07-06-01 | JGL | KDG | LDN | ADDED 1900118 RING & NUTS TO TC SENSOR |
| 2 | IN-2967 | 09-27-01 | JGL | KDG | LDN | TC SENSOR, ADDED 1900132 HEATER PLATE |

## BILL OF MATERIALS

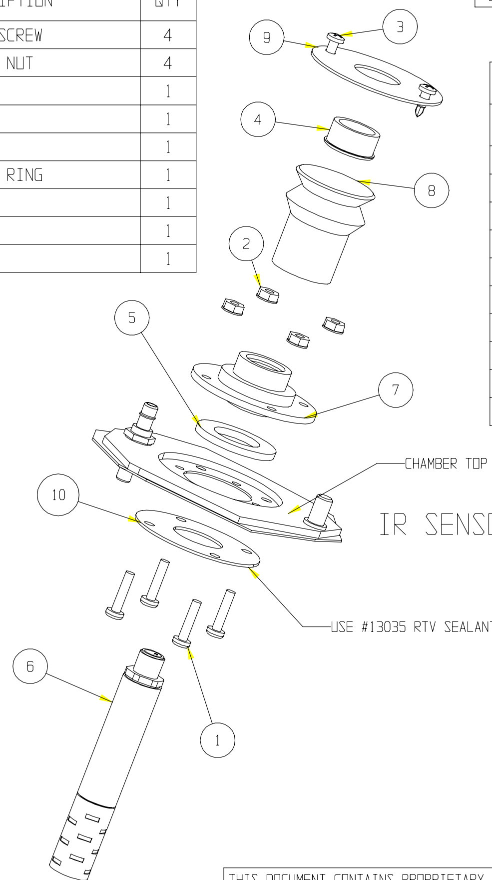
| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 22127 | 6-32 x1.250 SS PHP SCREW | 4 |
| 2 | 23001 | #6-32 ZP LKWASH HEX NUT | 4 |
| 3 | 244112 | CONVOLUTED TUBE | 1 |
| 4 | 290168 | HI-TEMP TC SENSOR | 1 |
| 5 | 1900082 | TEFLON TC MOUNT | 1 |
| 6 | 1900118 | BELLOWS RESTRAINING RING | 1 |
| 7 | 1900132 | 370 TC HEATER PLATE | 1 |
| 8 | 1900327 | TC STOP RING | 1 |
| 9 | 1900326-31-1 | TC ADAPTER RING | 1 |




TC SENSOR ASSEMBLY

## BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 22015 | #8-32 X 3/4 SS PHP SCREW | 4 |
| 2 | 23002 | #8-32 ZP LKWASH HEX NUT | 4 |
| 3 | 24030 | #8 X 1/2" TEKS SCREW | 2 |
| 4 | 30088 | 7/8" SNAP BUSHING | 1 |
| 5 | 103034 | GASKET | 1 |
| 6 | 231204 | IR SENSOR | 1 |
| 7 | 231205 | IR SENSOR MOUNT | 1 |
| 8 | 244112 | CONVOLUTED TUBE | 1 |
| 9 | 1900340 | IR STOP 370 | 1 |
| 10 | 1900325-31-1 | IR ADAPTER RING | 1 |




IR SENSOR ASSEMBLY

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Thermo Forma
Box 649, Marietta, Ohio 45750

| | | | | |
|---|---|---|---|---|
| MODEL/PART NAME: 370 SERIES INCUBATOR | | | | |
| DWG TITLE: CO2 SENSORS | | | | |
| DWN: DALE | CAD: DCB | APPD: LDN | DATE: 3/27/01 | SCALE: 0.500 |
| MATERIAL: - | | | | |
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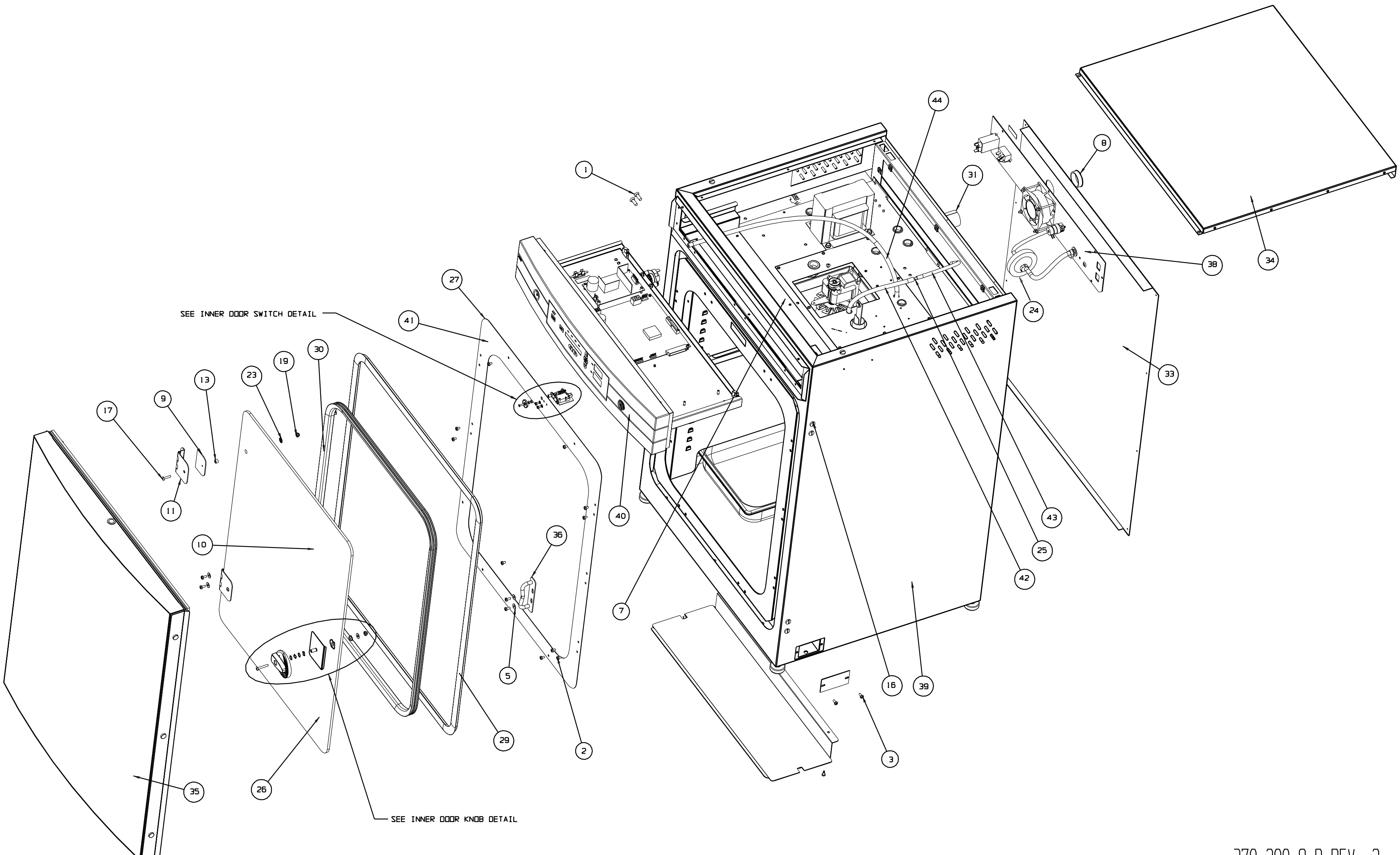
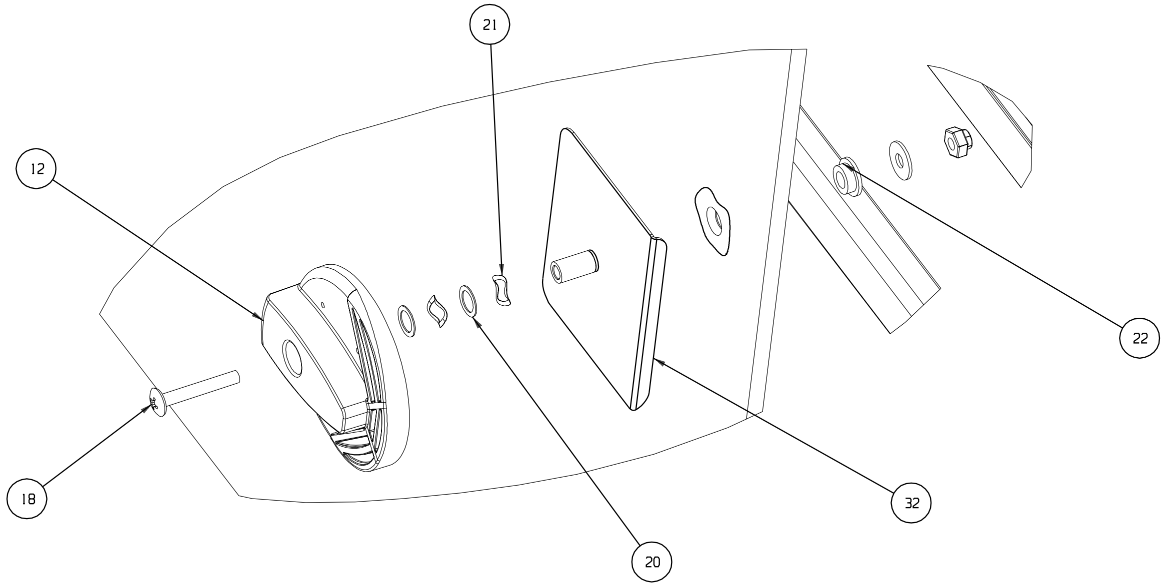
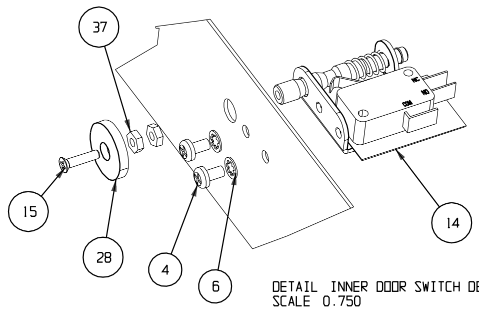



370-200-9-D REV. 2
Page 1 of 2




DETAIL INNER DOOR KNOB
SCALE 0.750




DETAIL INNER DOOR SWITCH DETAIL
SCALE 0.750

| BILL OF MATERIALS | | | |
|---|---|---|---|
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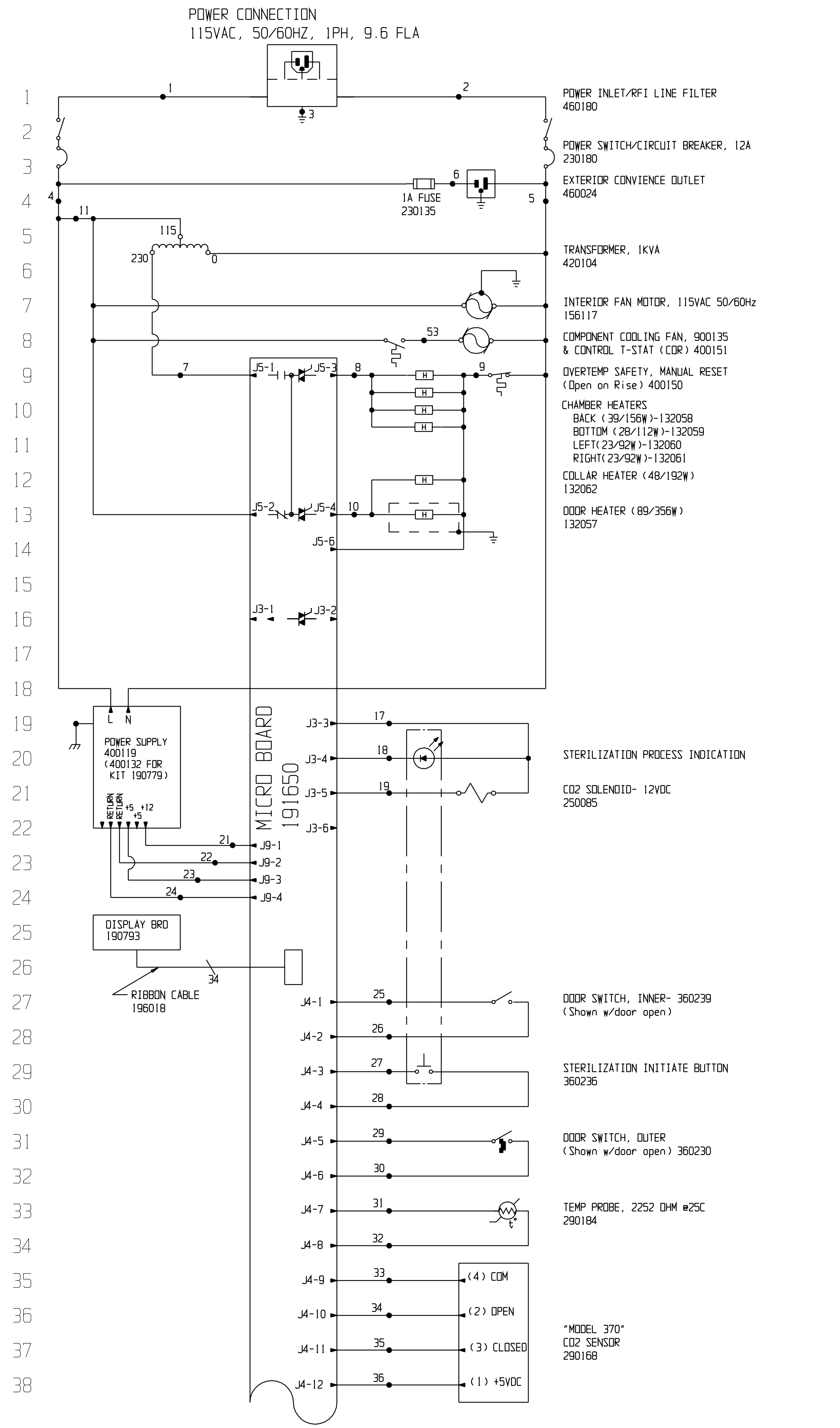
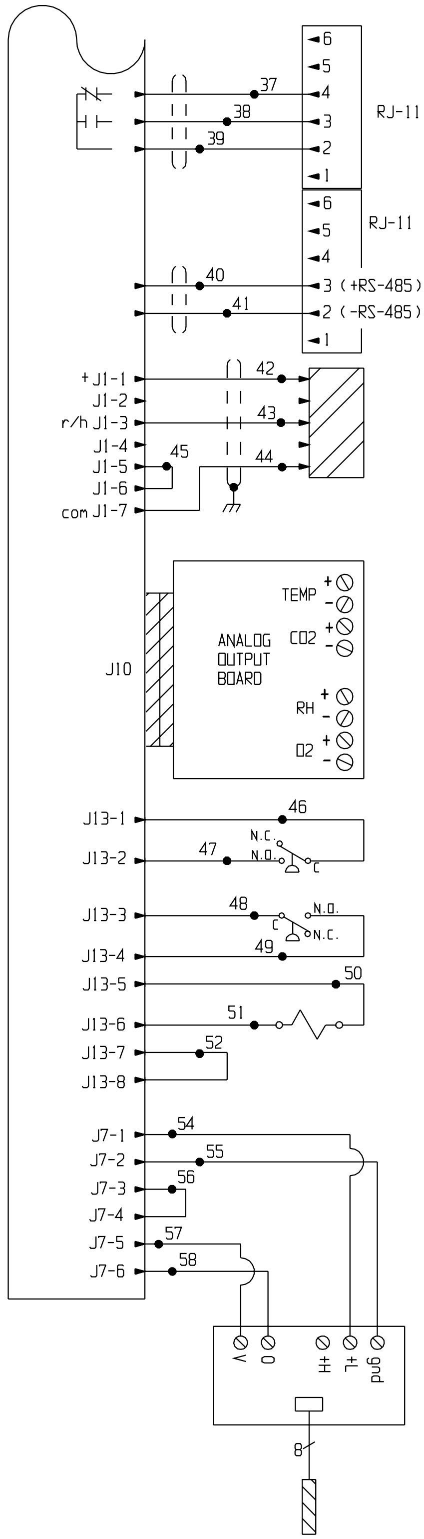
| 1 | 20058 | #1/4-20 X 3/4 SS FHP UC SCREW | 4 |
| 2 | 22051 | #8-32 X 1/4 SS PHP SCREW | 10 |
| 3 | 22052 | #8-32 X 3/8 SS PHP SCREW | 5 |
| 4 | 22115 | #6-32 X 1/4 SS PHP SCREW | 2 |
| 5 | 23021 | #8 SS FLAT WASHER | 7 |
| 6 | 23030 | #6 INTERNAL LOCK WASHER SS | 2 |
| 7 | 23051 | #8-32 S.S. WING NUT | 4 |
| 8 | 30077 | 1-1/2" SNAP BUSHING | 1 |
| 9 | 103115 | INNER DOOR HINGE GASKET | 2 |
| 10 | 105066 | 20.5 X 26.875 X .23 THK. TEMPER GLASS | 1 |
| 11 | 116109 | SS HINGE .693 HINGE HEIGHT | 2 |
| 12 | 120072 | ULTRA HIGH TEMP. KNOB | 1 |
| 13 | 125022 | TEFLON SPACER 11/32" O.D. | 2 |
| 14 | 360239 | INTERLOCK SWITCH | 1 |
| 15 | 490026 | 4-40 x 1/2 FHP SS SCREW | 1 |
| 16 | 550050 | 1/4-20 X 1/2" NYLON BH SCREW | 6 |
| 17 | 550054 | #8-32 X 3/4 TRUSS HD PHILLIPS SCREW | 2 |
| 18 | 550055 | #8-32 X 1-1/8 TRUSS HD PHILLIPS SCREW | 1 |
| 19 | 610079 | 8-32 SS 'FLEXLOC' LOCKING NUT | 3 |
| 20 | 730056 | .285 ID SS FLAT WASHER | 3 |
| 21 | 730057 | WAVE WASHER .288" ID X .407 OD | 2 |
| 22 | 730073 | TEFLON SHOULDER WASHER | 1 |
| 23 | 730086 | 1/2 OD SILICONE SEAL WASHER #8 | 2 |
| 24 | 770001 | DISPOSIBLE HEPIA FILTER 1/4 | 1 |
| 25 | 840026 | 3/16" X 1/4" TUBING REDUCER | 1 |
| 26 | 1900304 | INNER DOOR ASSEMBLY | 1 |
| 27 | 1900318 | INTERIOR FRONT TRIM | 1 |
| 28 | 1900338 | 3/4 O.D INNER DR SWITCH STRIKE | 1 |
| 29 | 103102_370 | HEATBREAK GASKET SILICONE | 1 |
| 30 | 103108_370 | INNER DOOR SILICONE GASKET | 1 |
| 31 | 180115_6 | PORT LINER, TEFLON STRIP 6"LONG | 1 |
| 32 | 1900182-16-1 | INNER GLASS DOOR KNOB PLATE W/ THRU HOLE MOUNT | 1 |
| 33 | 1900307-31-1 | EXTERIOR BACK | 1 |
| 34 | 1900308-16-1 | TOP COVER ASSEMBLY | 1 |
| 35 | 1900314-01-2 | EXTERIOR DOOR ASSEMBLY | 1 |
| 36 | 1900333-15-1 | INNER DOOR STRIKE ASSEMBLY | 1 |
| 37 | 23005A | #4-40 SS HEX NUT | 2 |
| 38 | 370-200-5 | 370 BACK PANEL ASSEMBLY | 1 |
| 39 | 3701000-01-1 | EXTERIOR WRAP ASSEMBLY | 1 |
| 40 | 3702000-01-3 | FRONT CONTROL PANEL ASSEMBLY | 1 |
| 41 | 3705000-01-1 | INNER FACE PLATE ASSY | 1 |
| 42 | INJCT_TUBE_1 | CO2 INJECT TUBE VINYL #72015 6" | 1 |
| 43 | INJCT_TUBE_2 | CO2 INJECT TUBE #244020 10" | 1 |
| 44 | SMPL_TUBE_370 | SAMPLE TUBE SILICONE #244020 30" | 1 |

370-200-9-D REV. 2




Electrical Schematic
Model:
370 and 380
Heat Sterilization
Incubator

370-70-0-D REV. 3
Page 1 of 3




REMOTE ALARM CONNECTIONS
(shown in alarm state)

"OPTIONAL" RS-485 OUTPUT KIT
1900085

"OPTIONAL" RH SENSOR KIT
1900091

"OPTIONAL" ANALOG OUTPUT KITS
190512 (4 to 20mA)
190543 (0 to 5VDC)
190544 (0 to 1VDC)

"OPTIONAL" GAS GUARD KIT
1900086 (CO2)

PRESSURE SWITCH #1 (TANK EMPTY)
360213

PRESSURE SWITCH #2 (TANK EMPTY)
360213

SOLENOID, 3 WAY- 12VDC
250121

"MODEL 380"
IR CO2 SYSTEM
231204

## WIRE REFERENCE CHART

| NO. | GA. | COLOR | NO. | GA. | COLOR | NO. | GA. | COLOR |
|---|---|---|---|---|---|---|---|---|
| 1 | 16 | BROWN | 21 | 18 | RED | 42 | 22/3 | BLACK |
| 2 | 16 | BLUE | 22 | 18 | GREEN | 43 | 22/3 | RED |
| 3 | 16 | GRN/YEL | 23 | 18 | ORANGE | 44 | 22/3 | GREEN |
| 4 | 16 | BLACK | 24 | 18 | GREEN | 45 | 22 | BLACK |
| 5 | 16 | WHITE | 25 | 22 | BLUE | 46 | 20 | RED |
| 6 | 18 | BLACK | 26 | 22 | BLUE | 47 | 20 | RED |
| 7 | 16 | YELLOW | 27 | 22 | BROWN | 48 | 20 | BLUE |
| 8 | 18 | ORANGE | 28 | 22 | BROWN | 49 | 20 | BLUE |
| 9 | 18 | RED | 29 | 22 | YELLOW | 50 | 20 | ORANGE |
| 10 | 18 | BLUE | 30 | 22 | YELLOW | 51 | 20 | ORANGE |
| 11 | 18 | RED | 31 | 22 | RED | 52 | 20 | BLACK |
| 12 | -- | ---- | 32 | 22 | RED | 53 | 18 | BROWN |
| 13 | -- | ---- | 33 | 22 | GREEN | 54 | 24/4 | BLACK |
| 14 | -- | ---- | 34 | 22 | GRAY | 55 | 24/4 | WHITE |
| 15 | -- | ---- | 35 | 22 | PURPLE | 56 | 24 | BLACK |
| 16 | -- | ---- | 36 | 22 | ORANGE | 57 | 24/4 | RED |
| 17 | 18 | ORANGE | 37 | 22/3 | BLACK | 58 | 24/4 | GREEN |
| 18 | 18 | BLACK | 38 | 22/3 | RED | 59 | | |
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| 20 | -- | ---- | 40 | 22/2 | RED | | | |
| | | | 41 | 22/2 | BLACK | | | |

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 3 | IN-3124 | 08-04-03 | JNL | KDG | CCS | CHANGED 290137 TEMP. PROBE TO 290184 |
| 2 | IN-2970 | 09-04-01 | GLM | KDG | LDN | CHG. HARNESS FOR MICRO TO SENSE VOLTAGE LOSS |
| 1 | IN-2915 | 04-03-01 | GLM | KDG | DNF | CHANGED 130625 COOLING FAN TO 900135 |
| 0 | N/A | 1-23-01 | GLM | GLM | DNF | RELEASED PRODUCTION |

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ELECTROSTATIC
SENSITIVE DEVICES

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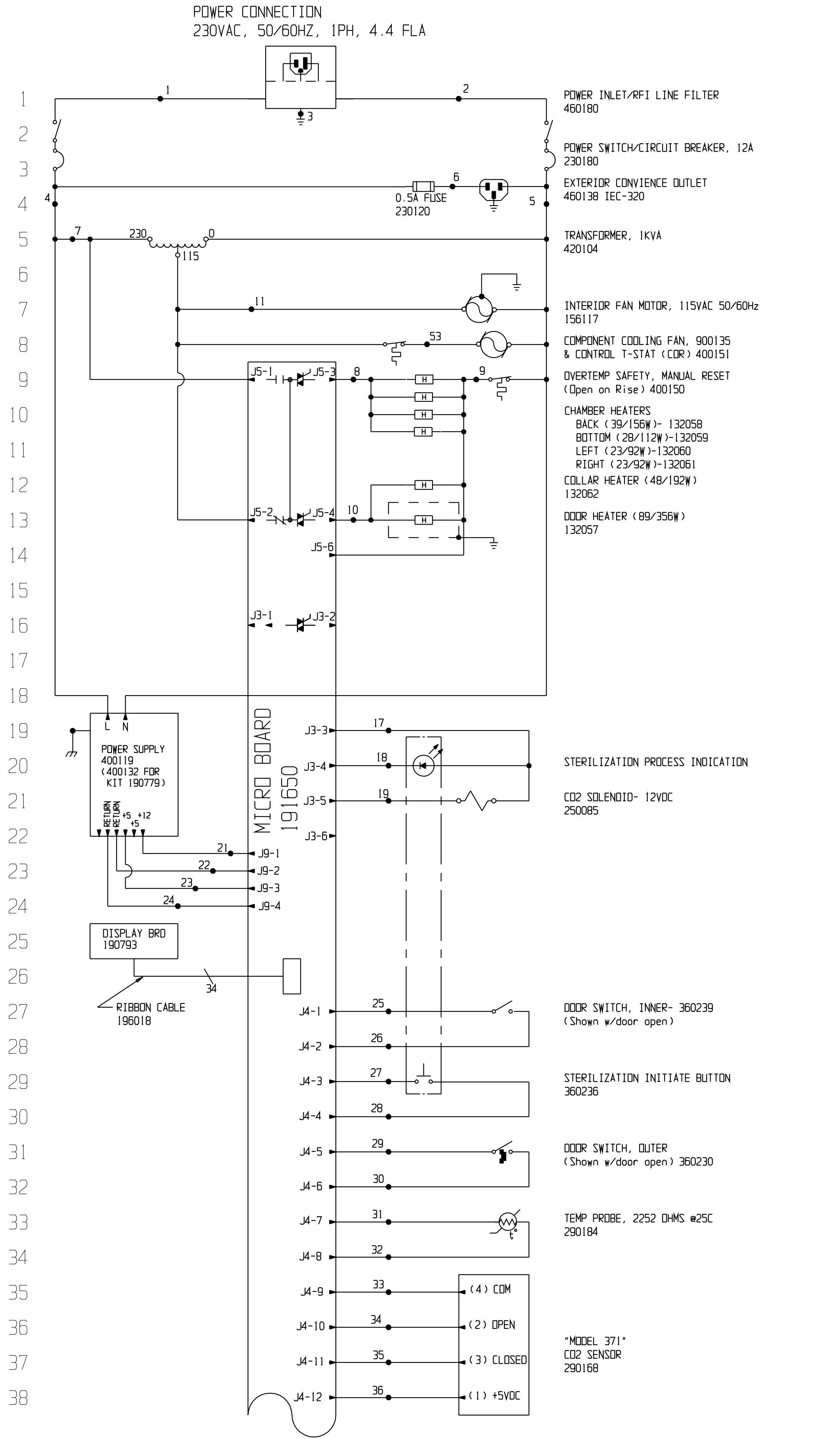
Thermo
ELECTRON CORPORATION

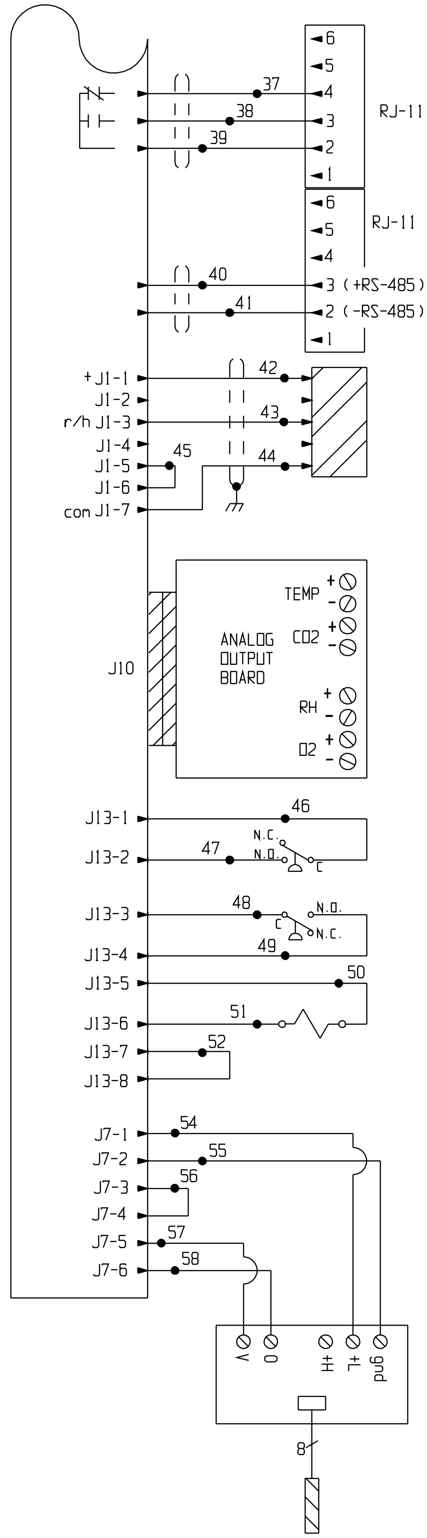
MODEL/PART NAME: 370 & 380 HEAT STERILIZATION INCUBATOR
DWG TITLE: ELECTRICAL SCHEMATIC
DWN: GLM | CAD: GLM | APPD: DNF | DATE: 9-12-00 | SCALE: NONE
MATERIAL:
PAINT COLOR:
TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX=± .XXX=±
DRAWING NUMBER 370-70-0
SIZE D

Electrical Schematic
Model:
370 and 380
Heat Sterilization
Incubator




Electrical Schematic
Model:
371 and 381
Heat Sterilization
Incubator

371-70-0-D REV. 3
Page 1 of 3

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(shown in alarm state)

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190544 (0 to 1VDC)

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1900086 (CO2)

PRESSURE SWITCH #1 (TANK EMPTY)
360213

PRESSURE SWITCH #2 (TANK EMPTY)
360213

SOLENOID, 3 WAY- 12VDC
250121

"MODEL 381"
IR CO2 SYSTEM
231204

Electrical Schematic
Model:
371 and 381
Heat Sterilization
Incubator

WIRE REFERENCE CHART

| NO. | GA. | COLOR | NO. | GA. | COLOR | NO. | GA. | COLOR |
|---|---|---|---|---|---|---|---|---|
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| 3 | 16 | GRN/YEL | 23 | 18 | ORANGE | 44 | 22/3 | GREEN |
| 4 | 16 | BLACK | 24 | 18 | GREEN | 45 | 22 | BLACK |
| 5 | 16 | WHITE | 25 | 22 | BLUE | 46 | 20 | RED |
| 6 | 18 | BLACK | 26 | 22 | BLUE | 47 | 20 | RED |
| 7 | 16 | YELLOW | 27 | 22 | BROWN | 48 | 20 | BLUE |
| 8 | 18 | ORANGE | 28 | 22 | BROWN | 49 | 20 | BLUE |
| 9 | 18 | RED | 29 | 22 | YELLOW | 50 | 20 | ORANGE |
| 10 | 18 | BLUE | 30 | 22 | YELLOW | 51 | 20 | ORANGE |
| 11 | 18 | RED | 31 | 22 | RED | 52 | 20 | BLACK |
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| 15 | -- | ---- | 35 | 22 | PURPLE | 56 | 24 | BLACK |
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| 17 | 18 | ORANGE | 37 | 22/3 | BLACK | 58 | 24/4 | GREEN |
| 18 | 18 | BLACK | 38 | 22/3 | RED | 59 | | |
| 19 | 18 | YELLOW | 39 | 22/3 | WHITE | 60 | | |
| 20 | -- | ---- | 40 | 22/2 | RED | | | |
| | | | 41 | 22/2 | BLACK | | | |

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 3 | IN-3124 | 08-04-03 | JNL | KDG | CCS | CHANGED 290137 TEMP. PROBE TO 290184 |
| 2 | IN-2970 | 09-04-01 | GLM | KDG | LDN | CHG. HARNESS FOR MICRO TO SENSE VOLTAGE LOSS |
| 1 | IN-2915 | 04-02-01 | GLM | KDG | DNF | CHG. 130625 FAN TO 900135 & REV. FLA |
| 0 | N/A | 1-23-01 | GLM | GLM | DNF | RELEASED FOR PRODUCTION |

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ELECTRON CORPORATION

MODEL/PART NAME: 371 & 381 HEAT STERILIZATION INCUBATOR
DWG TITLE: ELECTRICAL SCHEMATIC
DWN: GLM | CAD: GLM | APPD: DNF | DATE: 9-12-00 | SCALE: NONE
MATERIAL:
PAINT COLOR:
TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX=± .XXX=±
DRAWING NUMBER 371-70-0 | SIZE D

Electrical Schematic
Model:
371 and 381
Heat Sterilization
Incubator

# Effective Heat Sterilization in $CO_2$ Incubators

Volume 4, Number 3

Key Words

- Class 100 air
- Contamination control
- Contamination elimination
- HEPA filtration
- Incubator

**Thermo Electron Corporation's Heat Sterilization White Paper**

*Dr. Joseph P. Dalmasso, President, Apex Laboratories, Inc., Apex, NC*

**Abstract**

Contamination control and elimination have been a major concern in cell culture laboratories for over 100 years. Though other technologies have been developed over this period for instruments, devices, and textiles, dry heat sterilization has emerged as the most useful contamination elimination technology for equipment chamber surfaces. A dry heat sterilization cycle has now been validated for Thermo Electron Corporation's Steri-Cycle® $CO_2$ Incubators. This sterilization cycle readily eliminates the vegetative microorganisms, as well as persistent fungal spores, of concern in cell culture laboratories. Cycle time is based on validation procedures using commercially available spore suspensions calibrated for dry heat resistance. The spores were inoculated onto chamber wall, door, and gasket materials. The inoculated materials were exposed at the minimum temperature (the coolest, and therefore least lethal) observed in the incubator as determined by extensive mapping studies.

The validated cycle time was based on the longest average time required to achieve a six-log reduction of the most resistant spore batch tested. This exposure time was then more than doubled to establish a sterilization cycle that exceeds the requirements for medical instruments.

**Introduction**

To best understand the efficacy and significance of dry heat processes as they matured in early 20th century hospitals, a brief overview of heat sterilization is presented.

Heat, notably in the form of fire, was the original method of destroying all life. In the late 1800s, microorganisms began to be recognized as causative agents of disease. In rapid parallel, methods to destroy germs on instruments, bandages, and other products were developed, with the most effective being heat processes.

In 1878, Sternberg showed that pathogenic bacteria (vegetative or non-spore forming cells) were killed in 10 minutes at a relatively benign temperature of 62C to 70C (143.6F to 158F), whereas spore formers required 5 minutes exposure to moist heat at 100C (212F). As early as the 1880s, comparisons of dry heat and moist heat processes were conducted on anthrax spores (Perkins, J. J., 1969). These early observations of the extreme physical and chemical resistance of bacterial spores, as compared to non-spore formers (vegetative cells), had important consequences. The use of spores from selected bacterial strains became the indicator organisms of choice for dry heat, steam, and other disinfection and sterilization processes.

Dry heat, recognized as an efficient process, evolved from simple ovens to double wall convection ovens to modern high-efficiency, forced air ovens. Dry heat was very effective for moisture sensitive items such as cutting edge instruments (scalpels), dry chemicals, oils, and glycerine. Early work with dry heat convection ovens showed that instruments and glassware were readily sterilized due to their excellent heat conducting properties. For packaged items, the slow and uneven penetration of dry heat and resultant long exposure times made the process less desirable than steam for hospital applications.

Refinements of moist heat processes evolved from boiling water to steam cabinets to the modern autoclave. Moist heat processes, especially with the advent of the autoclave, became the sterilization method of choice in hospitals. This was because pressurized steam readily penetrated wrapped instruments and other packaged items, thus permitting rapid turnaround and an assurance of sterility. Settings of 15 to 20 lbs. (6.8 kg to 9.1 kg) pressure for 20 to 30 minutes became recognized as effective process parameters by the turn of the century. Unfortunately, steam must be contained in a pressure vessel, making it inappropriate for equipment surface sterilization.

Dry heat specifications continued to be debated due to the poor penetration of dry heat for various load configurations. About 1930, an upper limit of 160C (320F) was set for dry heat cycles because instruments of the day could lose their temper at higher temperatures (AAMI ST-50, 1995). Empirical work showed that various bacterial spores could be readily killed at temperature ranges of 120C to 180C (248F to 356F), showing dry heat to be effective when exposure conditions were controlled. However, there were few heat transfer studies on loads, and a widely accepted standard of 1 hour at 160C was adopted for instruments and instrument packs. The U.S. Pharmacopeia (USP) later recommended 170C (338F) for 120 minutes; the American Dental Association (ADA) currently recommends 160C (320F) for 120 minutes (AAMI ST-50, 1995). These recent guidelines, plus the early work done at the 120C to 180C (248F to 356F) range, show that no single time/temperature parameter was mandated. Quite simply, higher process temperatures meant faster instrument throughput, which was a pragmatic and often necessary approach in hospitals.

Historically, dry heat is a proven process. Long process times for wrapped loads currently limit the use of dry heat in hospitals. However, the dry heat process proves ideal for surfaces.

Incubators, such as the Steri-Cycle Series (figure 1), have been designed for dry heat sterilization through the following:

- Improved heat transfer systems that use mechanical air circulation
- Radiant wall heaters to replace electric coils
- High efficiency insulation and gasketing to minimize temperature loss and ensure uniformity


figure 1–Steri-Cycle $CO_2$ Incubator designed for heat sterilization

### Considerations When Conducting Dry Heat Validations

The Association for the Advancement of Medical Instrumentation (AAMI) and ADA process guideline recommendations are directed to sterilization of wrapped loads for health care and industrial applications. While the principle of using dry heat to sterilize empty chambers is sound, the time/temperature guidelines are not applicable. Because sterilizing an empty incubator with shelves is strictly a surface process, validation testing to allow the use of fixed exposure cycles (time and temperature) is a forthright process. Bacterial spores calibrated for dry heat processes can be utilized directly on incubator chamber materials and the time required to achieve sterilization determined empirically.

Variables associated with the dry heat sterilization process are as follows (AAMI ST-50, 1995):

- **Temperature.** This is the most important variable; the effect of temperature on lethality is related to time.
- **Time.** This term refers to the “interval” or “exposure time” at a pre-determined temperature that will result in sterilization.
- **Airflow and Distribution.** Uniform distribution of air results in uniform transfer of heat throughout the incubator. Further, hot air flowing over surfaces reduces microorganism resistance by way of dehydration, which results in reduced sterilization times.
- **Load Configuration.** Load size and density are very important when considering dry heat sterilization of objects. An empty incubator presents a “no load” condition because the interior wall, shelf, and door components are readily heated by the circulating hot air.

Also critical is the indicator organism used to validate the system. Suspensions of *Bacillus subtilis* spores calibrated for dry heat processes are used to validate sterilization of the chamber interior (U.S. Pharmacopeia XXIV, Chapter 1035). Note that spores of *Bacillus stearothermophilus* are only specified as indicators for use under saturated steam conditions and are not the indicator of choice for dry heat processes (ANSI/AAMI/ISO 11134, 1995).

Typically, commercially available dry heat biological indicators, which consist of *Bacillus subtilis* spores inoculated onto filter paper strips and packaged in glassine envelopes, are used to monitor the sterilization of dry heat loads in health care and industrial settings (U.S. Pharmacopeia XXIV, Official Monograph). These commercially available indicators are relatively easy to use; however, they are not as appropriate as direct inoculation and testing of chamber materials for validation of the empty chamber.

Materials onto which indicator spores are inoculated are also important. The calibrated spores are inoculated onto the materials used in the manufacture of the incubator chamber (stainless steel, glass, and silicone gasketing) to precisely define the sterilization cycle. This surface application of resistant spores parallels the presence of microbial contaminants found in working laboratories. The inoculated carriers are then directly tested in the incubator during sterilization cycles.

### Test Methods

**Temperature Mapping—Minimum Chamber Temperature and Uniformity.** Because temperature is critical in dry heat processes, the chamber was thoroughly mapped with thermocouples to measure uniformity at target temperatures and to identify the coolest, and therefore least lethal, location in the incubator. The lowest temperature was the benchmark temperature used when conducting the sterilization studies (figure 2).

Lethality tests, using inoculated materials, were conducted in an area of constant temperature (middle shelf) that was adjusted to mimic the minimum temperature established for the incubator. The temperature used for testing was =135C (275F). A typical Steri-Cycle $CO_2$ Incubator exhibits a minimum chamber temperature of 135.2C (275.4F) during the sterilization cycle. By using a Steri-Cycle unit for these tests, the inoculated carriers were subjected to any normal temperature vagaries characteristic of each test run.

**Materials.** Stainless steel, glass, and silicone gasket components were cut into pieces to act as carriers onto which the resistant spores were to be inoculated. The carriers were made from the following materials:

- Grade 304 stainless steel
- High quality glass from microscope slides
- Silicone gasket material used as the door interface

Carriers were washed to simulate normal incubator cleaning prior to inoculation.

**Resistant Spore Preparations.** Suspensions of *Bacillus subtilis* var. *niger* spores—ATCC #9372 (American Type Culture Collection, 1999) or NRRL B4418—were purchased from three prominent manufacturers in the United States. The most resistant suspension available was requested from each vendor at the time of purchase. Spore preparations met resistance guidelines recommended in the USP Chapter 1035; $D_{160C}$ values were as follows:

1.4 minutes for Vendor #1
2.6 minutes for Vendor #2
2.0 minutes for Vendor #3

=> $D_{160C}$ refers to *decimal reduction* and describes the time, in minutes and at 160C (320F), required to reduce a population of organisms by 90% (or one log). A six-log reduction cycle reduces the population of resistant spores by 99.9999%.

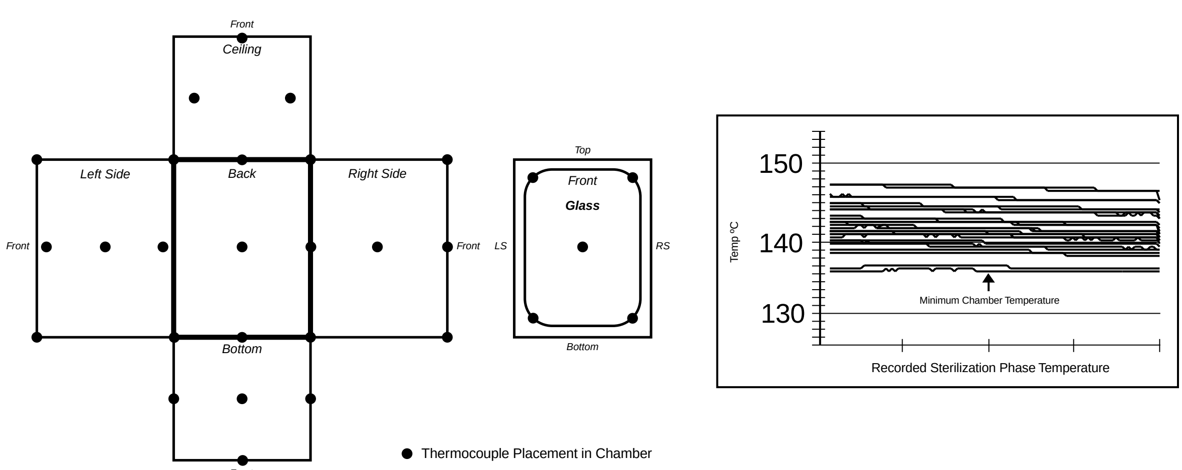


figure 2–Temperature mapping used to determine the benchmark testing temperature

**Inoculation of Carriers.** Carriers made from each of the three materials—stainless steel, glass, and silicone—were inoculated with each of three commercial suspensions of *B. subtilis* spores and allowed to dry. Carriers were stored under ambient conditions and used within 16 hours of preparation.

Control carriers were prepared at the same time. These carriers remained under ambient conditions until the end of each study. Upon completion of each study, the carriers were processed to remove and count the number of viable spores. Counts performed at the end of each test period are more indicative of the number of viable cells undergoing the validation process, thus ensuring a more accurate lethality calculation.

**Exposure—Rationale.** Tests for establishing a sterilization cycle (minimum six-log reduction of indicator spores) will be conducted using growth/no growth criteria as evidence of complete kill of inoculated carriers.

Sets of inoculated carriers (=1E6 spores per carrier)[1] will be subjected to increasing process times at the incubator target temperature. As exposure time increases, a point will be reached where no viable spores survive the process. This will be illustrated when exposed, inoculated carriers fail to show growth after being placed in nutrient recovery medium and incubated for seven days.

Using the results from several growth/no growth studies, a cycle time that consistently achieves sterilization can be established. Such cycle determinations are possible because *B. subtilis* spores exposed to dry heat processes die in a linear manner, which is affirmed by data supplied with vendor spores.

**Exposure—Method.** Direct inoculation of incubator walls and shelves, followed by spore recovery using swabbing methods, can be used to characterize the lethal processes during a cycle. However, this method shows an inherent variability and less than 100% recovery.

The method of choice in this study was the following:

- Inoculate pieces of the construction materials with =1E6 resistant indicator spores.

- Subject the inoculated materials to dry heat cycles.

- Culture each inoculated piece in liquid growth media.[2]

The following procedure was used.

1. The incubator was turned on and allowed to reach the setpoint and stabilize as determined by use of calibrated thermocouples.

2. All inoculated carriers for each study were quickly placed into the stabilized incubator chamber. Each set of carriers consisted of

   - 9 glass carriers—3 inoculated with Vendor #1 spores, 3 inoculated with Vendor #2 spores, and 3 inoculated with Vendor #3 spores

   - 9 stainless steel carriers inoculated as above

   - 9 silicone carriers inoculated as above

3. After the inoculated carriers were exposed for a minimal time period, the door was quickly opened and one complete set of carriers removed for cultivation.

4. Carriers were immediately cultured as noted in the *Culturing and Incubation* section.

5. Another carrier set was removed and cultured after an additional exposure segment (i.e., 7 minutes).

This procedure continued until all sets of carriers were removed and cultured. Testing was conducted simultaneously on sets of inoculated carriers so that spore or materials differences could be observed. Also, by testing all components and spores simultaneously, any effect from door openings or subtle incubator performance variations would be negligible.

**Culturing and Incubation.** Each exposed carrier was cultured into soybean casein digest broth immediately upon removal from the incubator. As recommended in USP, carriers were incubated for 7 days at 30C to 35C (86F to 95F) (U.S. Pharmacopeia XXIV, Chapter 55). This incubation period is necessary to ensure that sublethally injured microorganisms have adequate time in a nutritive environment for repair and outgrowth. The 48 hours generally allowed for outgrowth of routinely cultured organisms (non-injured organisms) is not adequate for the development of lethal cycles.

[1] *"Greater than or equal to" 1E6 or 1 x $10^6$ or 1,000,000 spores*

[2] *Injured organisms are most likely to survive and grow if placed directly into liquid growth medium (soybean casein digest broth is recommended). An accurate endpoint of the lethality cycle can be determined using this method.*

### Test Results

Figure 3 summarizes the results of triplicate test runs, each comparing all materials versus all vendor spore preparations. At the extreme, spores from Vendor #1 demonstrated a uniformly lower resistance to the dry heat process, while spores from Vendor #2 showed the greatest resistance. These results paralleled the resistance data supplied by the respective vendors.

The average values refer to the combined average of all vendor spores for each material type. With respect to materials differences, spores inoculated onto silicone material required a slightly longer exposure time to ensure complete kill of spores. Overall, the three materials are quite similar with respect to the effect they exert on surface microorganisms being subjected to a dry heat process. These data were used to establish a sterilization cycle. The longest average exposure time to achieve a six-log reduction on the worst case material was 41 minutes (Vendor #2, spores on glass). To ensure the greatest margin of sterility assurance, this 41 minute cycle was doubled to yield an 82 minute cycle (figure 4). This conservative approach, essentially a 12-log reduction, is advocated by AAMI for surgical instruments and implantable devices. To create an additional sterilization margin, the net cycle time at sterilization temperature was extended to 120 minutes.

Using this process, Steri-Cycle $CO_2$ Incubators will eliminate vegetative microorganisms (e.g., *E. coli*, *Pseudomonas* species, staph, strep, and *Mycoplasma* species) as well as fungal spores (e.g., *Aspergillus* and *Penicillium* species) before a half cycle is reached (Sykes, G., 1965).

A temperature profile of the complete sterilization process shows an additional margin of effectiveness (figure 4). During the gradual ramp up to the target temperature and the early segments of the cool down cycle, the considerable heat near the target temperature also contributes to microbial destruction.

### Conclusion

With the validation of a sterilization cycle specific to Steri-Cycle $CO_2$ Incubators, the user can be assured of complete contamination elimination.

The cycle was established using nationally recognized guidelines and commercial spore suspensions calibrated specifically for dry heat validations. Six-log reduction times, which result in the destruction of high levels of resistant indicator spores, were more than doubled to meet stringent sterilization standards established for the health care industry. As a result, the user can initiate the single pre-programmed sterilization cycle and return to a sterile incubator after a few hours. No pans of water are required, and the maintenance-free stainless steel and glass chamber

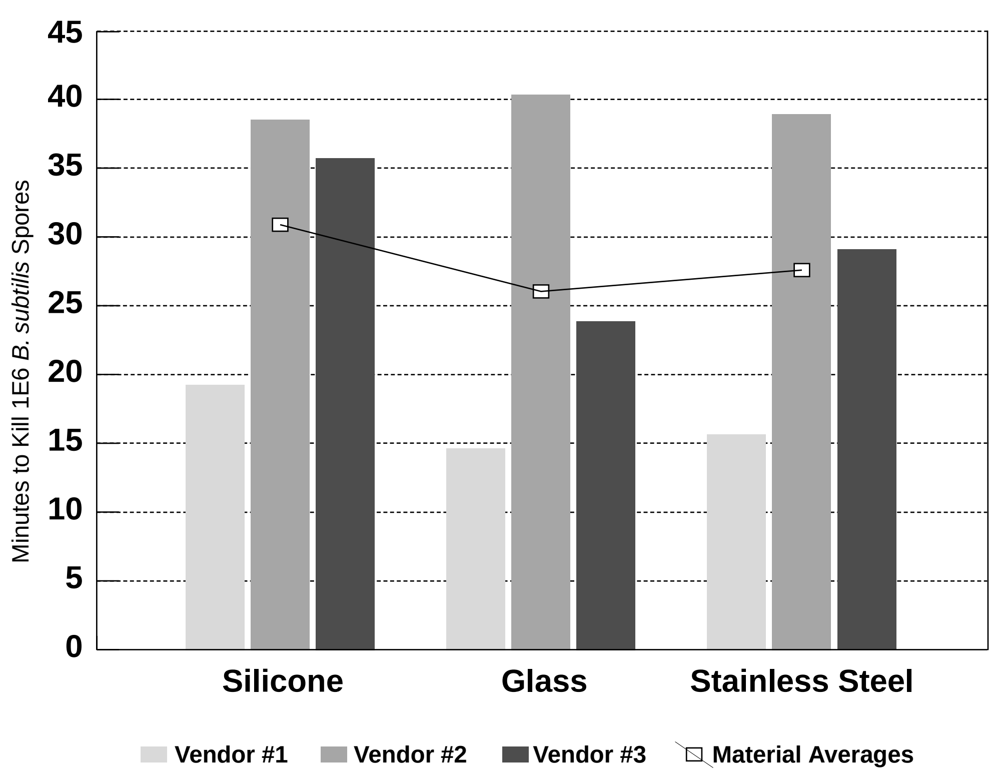


figure 3–Triplicate test run results

ensures that no corrosive copper salts or toxic chemicals need to be removed.

The efficient directed air distribution system that provides precise temperature uniformity for cell culture applications also ensures uniform distribution of sterilizing dry heat.

Thermo Electron has selected one of the oldest recognized methods for sterilization and has effectively adapted the process to the complete line of Steri-Cycle $CO_2$ Incubators. The result is an efficient, reliable, and convenient process for tomorrow's laboratory.

### About the Author

Dr. Dalmasso earned a PhD in Microbiology and Immunology from The Ohio State University. He has more than 30 years of experience in university teaching and research, medical microbiology, food technology, and sterilization cycle development in the medical device and pharmaceutical industries. Apex Laboratories, Inc. is an independent laboratory that provides contract and validation services to the food, pharmaceutical, and medical device industries.

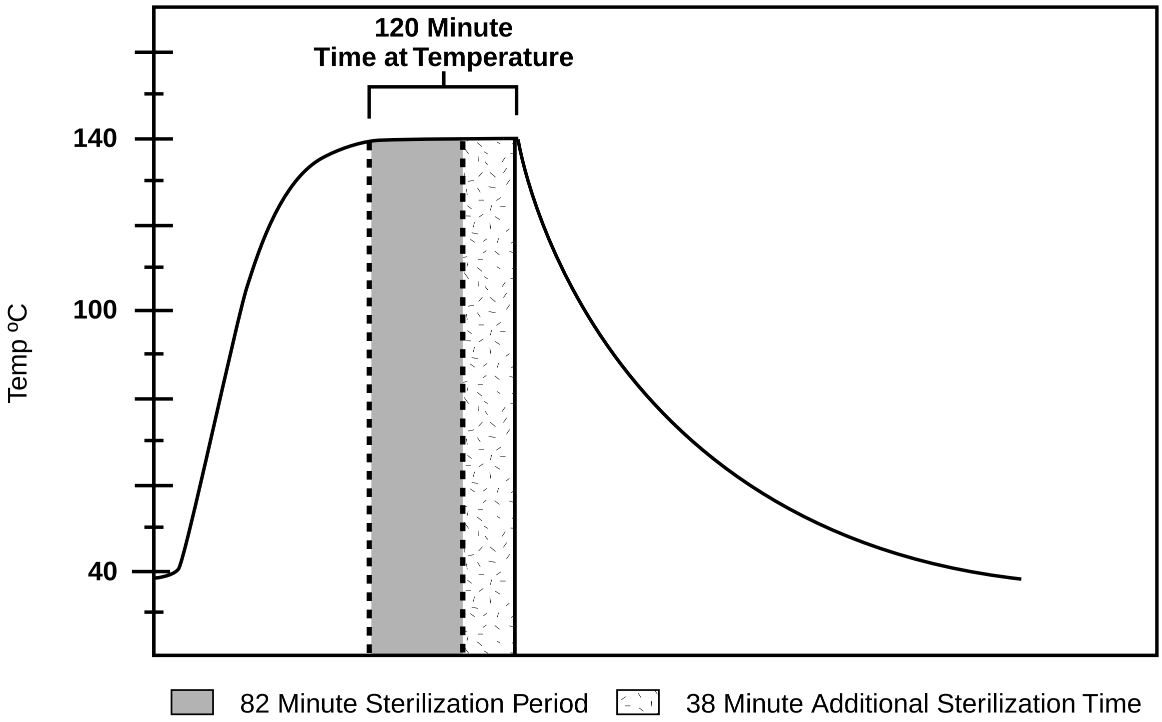


figure 4–Typical control temperature profile of the sterilization process

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Association for the Advancement of Medica Instrumentation: www.aami.org

U.S. Pharmacopeia: www.usp.org

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