IMPORTANT!
READ THIS INSTRUCTION MANUAL.
FAILURE TO READ, UNDERSTAND, AND FOLLOW MANUAL INSTRUCTIONS MAY RESULT IN DAMAGE TO THE INCUBATOR, INJURY TO OPERATING PERSONNEL, AND POOR EQUIPMENT PERFORMANCE.

CAUTION: ALL INTERNAL ADJUSTMENTS AND MAINTENANCE MUST BE PERFORMED BY QUALIFIED PERSONNEL.

March 1991
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Our PRODUCT SERVICE GROUP can supply you with technical information about proper setup, operation or troubleshooting of your equipment and fill your needs for spare or replacement parts, or provide you with on site service if required.

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When more extensive service is necessary, you can count on Forma for on-the-spot repairs by our trained professional field technicians. In addition to checking the reported problem, our technicians also check basic operation, like:

```
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Temperature              Recorders
CO₂ Levels               Blowers/Fans
R.H. Levels              Compressors
```

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1.1 Preliminary Inspection
1.2 Visible Loss or Damage
1.3 Concealed Loss or Damage
1.4 Responsibility for Shipping Damage
1.1 PRELIMINARY INSPECTION

This item was thoroughly inspected and carefully packed prior to shipment and all reasonable precautions were taken to ensure safe arrival of the merchandise at its destination. Immediately upon receipt, before the unit is moved from the receiving area, carefully examine the shipment for loss or damage. Unpack the shipment and inspect both interior and exterior for any in-transit damage.

1.2 VISIBLE LOSS OR DAMAGE

If any loss or damage is discovered, note any discrepancies on the delivery receipt. Failure to adequately describe such evidence of loss or damage may result in the carrier refusing to honor a damage claim. Immediately call the delivering carrier and request that their representative perform an inspection. Do not discard any of the packing material and under no circumstances move the shipment from the receiving area.

1.3 CONCEALED LOSS OR DAMAGE

If damage is discovered upon unpacking the shipment, stop further unpacking, retain all packaging material and immediately notify the delivering carrier, requesting that an inspection be performed as soon as possible. Again, under no circumstances move the shipment from the receiving area.

1.4 RESPONSIBILITY FOR SHIPPING DAMAGE

For products shipped F.O.B. Marietta, Ohio, the responsibility of Forma Scientific, Inc. ends when the merchandise is loaded onto the carrier’s vehicle.

On F.O.B. Destination shipments, Forma Scientific’s and the carrier’s responsibility ends when your Receiving Department personnel sign a free and clear delivery receipt.

Whenever possible, Forma Scientific, Inc. will assist in settling claims for loss or in-transit damage.
SECTION 2 - UNPACKING LIST

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2.1 Unpacking List
2.1 UNPACKING LIST

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

<table>
<thead>
<tr>
<th>STOCK #</th>
<th>DESCRIPTION</th>
<th>QUAN.</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>190247</td>
<td>Decontamination Kit</td>
<td>1</td>
<td>Maintenance</td>
</tr>
<tr>
<td>180001</td>
<td>Polypropylene Funnel</td>
<td>1</td>
<td>Fill &amp; Drain</td>
</tr>
<tr>
<td>246011</td>
<td>Vinyl Tubing 3/8&quot; ID</td>
<td>3'</td>
<td>Fill &amp; Drain</td>
</tr>
<tr>
<td>246010</td>
<td>Vinyl Tubing 3/16&quot; ID</td>
<td>6'</td>
<td>CO₂ Connection</td>
</tr>
<tr>
<td>55000</td>
<td>Stainless Steel Screws (Truss Head #10-32 x 1/2&quot;)</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>23052</td>
<td>Stainless Steel Wing Nuts (#10-32)</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>121034</td>
<td>Cam Latch (Nylon)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>127019</td>
<td>Stainless Steel Spacer (1/4&quot; Diameter x 9/16&quot;)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>550017</td>
<td>Stainless Steel Screw (Truss Head #8-32 x 1&quot;)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>23051</td>
<td>Stainless Steel Wing Nut (#8-32)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>600034</td>
<td>Snapper Hose Clamp (.375&quot;)</td>
<td>1</td>
<td>Extending CO₂ Board</td>
</tr>
<tr>
<td>285057</td>
<td>Wired Circuit Board Extender</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

ALSO PACKED WITH EACH INCUBATOR

<table>
<thead>
<tr>
<th>STOCK #</th>
<th>DESCRIPTION</th>
<th>QUAN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>224140</td>
<td>Stainless Steel Shelves</td>
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</tr>
<tr>
<td>3113234</td>
<td>Shelf Brackets</td>
<td>4</td>
</tr>
<tr>
<td>3113224</td>
<td>Stainless Duct Channel, Top</td>
<td>1</td>
</tr>
<tr>
<td>3113222</td>
<td>Stainless Duct Sheet, Left</td>
<td>1</td>
</tr>
<tr>
<td>3113223</td>
<td>Stainless Duct Sheet, Right</td>
<td>1</td>
</tr>
<tr>
<td>130038</td>
<td>#6 Neoprene Stopper</td>
<td>1</td>
</tr>
<tr>
<td>7023546</td>
<td>Instruction Manual</td>
<td>1</td>
</tr>
</tbody>
</table>
SECTION 3 - INTRODUCTION

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3.1 The Water Jacket: Key Features
3.1 THE WATER JACKET: KEY FEATURES

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

A door heater which adjusts automatically for ambient conditions, providing a condensate-free inner door for unhampered viewing of the product in the chamber. The heated door eliminates unnecessary door openings which temporarily disturb temperature, humidity, and CO₂ control.

Ultra-flat, vibration-free shelves to provide optimum culturing conditions.

Direct-set CO₂, temperature, and alarm set points.

Digital readout of temperature and CO₂ levels in the chamber surrounding the product.

Sealed chamber to minimize CO₂ consumption.

Sealed water jacket to minimize water evaporation.

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

Plug-in CO₂, and Temperature/Alarm modules to facilitate servicing or replacement of a particular control module.

Self-diagnostic switches in the control modules to aid in troubleshooting the system and localizing problems.

The design of the water jacket also allows for EASE IN DISINFECTING or autoclaving with a minimum of unit downtime.

There are no cracks or crevices in, or around, the chamber walls to harbor hidden or hard-to-reach bacterial growth.

The stainless steel shelves, shelf channels, and duct sheets are easily removable without tools for cleaning and disinfection the entire interior.

The blower wheel is disposable and easily replaced.
Great consideration has been given to the importance of PRODUCT PROTECTION through the addition of the following:

An Add Water audible alarm and pilot light to alert the operator when the water level in the water jacket has become too low for efficient operation.

Audible and visual CO₂ alarms which are activated when the CO₂ percentage in the chamber deviates 1% above or below CO₂ control setpoint.

An overtemperature alarm system which is activated when chamber temperature rises above the pre selected alarm point.
SECTION 4 - INSTALLATION & START-UP

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4.13 Setting the Chamber Temperature
4.14 Setting the Overtemp Alarm Point
4.15 Zeroing the CO₂ Controller
4.16 Setting the CO₂ Content
4.1 LOCATION

Locate the unit on a firm, level surface capable of supporting the unit with water. (See WEIGHT SPECIFICATIONS, Section 8.2.) The incubator should be placed in a somewhat remote area of the laboratory, away from any centrifuges, sonicators, doors, windows, and air-conditioning or heating ductwork that might produce drafts. To help prevent microbial contamination, the incubator should also be removed from areas of excessive personnel traffic.

NOTE: ADEQUATE ROOM IS REQUIRED BEHIND THE INCUBATOR FOR CONNECTIONS OF: ELECTRICAL, GAS ETC.

4.2 PRELIMINARY DISINFECTING

Before installing the duct sheets and the shelves, remove the clear plastic film from the shelf brackets and duct sheets. Forma Scientific recommends disinfecting all interior surfaces (including both door gaskets) by washing them with ColdSpore™ or an equivalent laboratory disinfectant. Rinse the surfaces with sterile distilled water (50K Ohm to 1 Meg Ohm). Also disinfect the CO₂ sensor and the blower wheel, taking care not to saturate the sensor.

The duct sheets and shelves must be washed with the same disinfectant solution and rinsed with sterile distilled water prior to their installation in the chamber. Repeat rinsing until you are satisfied that all of the disinfectant-detergent has been removed. Proceed with the installation as noted.

For the complete disinfection process, refer to Section 6.2 of this manual.

4.3 INSTALLING THE #6 NEOPRENE STOPPER (Access Port)

Open incubator outer rear door and inner glass door. Locate opening in top left corner of interior chamber. Place beveled end of stopper in opening.
4.4 INSTALLING THE SHELF BRACKETS AND CAM LATCH ASSEMBLY TO THE DUCT SHEETS

NOTE: A PLASTIC COATING ON DUCT SHEETS AND SHELF BRACKETS PROTECTS THE FINISH DURING SHIPPING AND HANDLING. THE PLASTIC COATING MUST BE PEELED OFF BEFORE PROTECTED PARTS ARE INSTALLED.

1) Locate the plastic bag containing the #10-32 x 1/2 truss head screws and wing nuts (20 each).

2) With the duct sheet in a vertical position, align and mount the shelf brackets to the unflanged side of the duct sheets.

NOTE: Wing nuts go on the flanged side. For additional help, refer to FIGURE 4-1 on the following page.

CAM LATCH ASSEMBLY

1) Locate the bag containing (2) #8-32 x 1" stainless steel truss head screws, (2) #8-32 wing nuts, (2) stainless steel spacers and (2) cam latches (nylon).

2) Place stainless steel spacer (sleeve) over the #8-32 x 1" screw and insert it into the opening of the cam latch.

3) Locate the five (5) small adjustment holes at the top of each duct sheet. (Please refer to FIGURE 4-1)

4) Place cam latch on inside (or unflanged side) of duct sheet and position screw with spacer (sleeve) through the middle hole of the five hole adjustment.

NOTE: IF DUCT SHEETS APPEAR TO BE TOO TIGHT OR TOO LOOSE UPON INSTALLATION, THE CAM LATCH ASSEMBLY CAN BE RE-POSITIONED UP OR DOWN ONE HOLE FOR PROPER ALIGNMENT.

5) Secure screw on flanged side of duct sheet with #8-32 wing.

6) Repeat this procedure for other duct sheet.
INSTALLING THE SHELF BRACKETS,
DUCT SHEETS & CAM LATCH ASSEMBLY
(Figure 4-1)

REFERENCE HOLE(S)
(located on left end flange)

LEFT, STAINLESS STEEL DUCT SHEET

SHELF BRACKET

PROBE CLIP MOUNTING HOLES

TOP, STAINLESS STEEL CHANNEL

STAINLESS STEEL SCREW (6-32 x 1")

STAINLESS STEEL SPACER (SLEEVE) 1/4" dia. x 9/16"

NOTCHED FOR BRASS CO. SAMPLE TUBE

CAM LATCH (NYLON)

ADJUSTMENT HOLES (5 TOTAL)

STAINLESS STEEL WING NUT (8-32)

STAINLESS STEEL SCREWS
(6-32 x 1/2")

RIGHT, STAINLESS STEEL DUCT SHEET

STAINLESS STEEL WING NUT
(8-32)
4.5 INSTALLING THE DUCT SHEETS

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

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

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

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

3) Hook the top channel into the top opening of the right duct sheet. (Refer to FIGURE 4-1) The top channel must be positioned so that the brass CO₂ sample tube (mounted in ceiling of incubator) is aligned with the notched out area on the right rear side of the top channel. The round opening will align with the blower wheel when it is slid into place.

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

5) Turn cam latch to a vertical position (up against bottom side of top channel) to secure.

NOTE: IF DUCT SHEETS APPEAR TO BE TOO TIGHT OR TOO LOOSE UPON INSTALLATION, THE CAM LATCH ASSEMBLY CAN BE RE-POSITIONED UP OR DOWN ONE HOLE FOR PROPER ALIGNMENT.

4.6 INSTALLING THE SHELVES

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

Check leveling of the unit by placing a bubble-type level on one of the shelves. Turn the hex nut (located on the leveling leg) clockwise to lengthen the leveling leg, or raise the unit. Turning the hex nut counterclockwise will shorten the leg, or lower the unit.

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

CAUTION: TO PREVENT INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT, LOCK INNER GLASS DOOR AND SECURE OUTER DOOR BEFORE TIPPING UNIT TO ADJUST LEVELING FEET.

CAUTION: DO NOT ATTEMPT TO TILT THE INCUBATOR WITHOUT ASSISTANCE WHILE ADJUSTING THE LEVELING FEET.

4.8 CONNECTING TO POWER

With the incubator power switch OFF, connect the unit to an adequate power source. See Section 8.12 for specific power requirements. Turn power switch to the ON position.

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

4.9 PREPARING THE INCUBATOR FOR FILLING

NOTE: 450 ML of rust inhibitor was placed in the water jacket before the incubator was shipped. The rust inhibitor mixes with the distilled water during filling and provides a protective coating on the interior of the water jacket.

NOTE: The fill/drain fitting is located on the center front of the unit, directly above the door. This fitting is to facilitate filling and draining of the water jacket without having to move the unit. The vent hole, located directly below the fill/drain fitting, behind the front door, allows the air displaced by water entering the jacket to escape. It also prevents distortion of the chamber by allowing air to escape as the unit expands and contracts during heating and cooling.

CAUTION: DO NOT PLUG VENT. A PLUGGED VENT WILL DAMAGE THE WATER JACKET CHAMBER.
Remove the plastic protective cap from the fill/drain fitting. Check to see that the vent hole (located directly below the fill/drain fitting, behind the front door, is NOT covered or plugged.

1) Set the "TEMP SELECT" switch to the variable position and turn the temp control knob completely counterclockwise to keep the heater from coming on before the water jacket is filled.

2) Turn incubator on.

3) Press and hold the set button on the monitor "Alarm Module", and using the adjustment screwdriver supplied, adjust the overtemp alarm setpoint to a setting 2 or 3 degrees above the intended operating temperature. (See section 4.14)

4) Press and hold the CO₂ Set/Silence button and rotate the CO₂ setscrew until the display reads 00.0.

4.10 FILLING THE WATER JACKET

Listed below are two recommended methods of filling the water-jacketed incubator.

A: Funnel Method
B: Tap Fill Method

CAUTION: PURITY OF THE DISTILLED WATER USED IN THE WATER JACKET AND HUMIDIFIER MUST BE WITHIN THE 50K OHM TO 1 MEG OHM RANGE TO PROTECT, AND PROLONG THE LIFE OF THE STAINLESS STEEL WATER JACKET. USE OF TAP WATER, OR DISTILLED WATER OUTSIDE THE SPECIFIED RANGE, WILL DECREASE THE OPERATING LIFE OF THE UNIT AND WILL VOID THE WARRANTY.

1) To prevent mineral buildup and minimize corrosion, use 50K Ohm to 1 Meg Ohm distilled water to fill the water jacket.

2) To restrict fungal and bacterial growth, add ColdSpore™ to the water jacket water during filling.
A: FUnnel Method

NOTE: The funnel and vinyl tubing, necessary for filling are contained in the accessories bag included with each incubator.

1) Fit funnel into one end of the 3/8" I.D. vinyl tubing.

2) Remove plastic "protective" cap from fill/drain fitting.

3) Attach free end of funnel tubing to the fill/drain fitting.

4) Hold funnel above level of fill fitting and pour water into funnel until the "ADD WATER" alarm and light are deactivated.

NOTE: The water jacket holds approximately 12.9 gallons (49 liters) of water.

5) After the "ADD WATER" alarm and light are deactivated, add one additional liter of water. The incubator has now been properly filled.

6) Remove tubing from fitting and replace the plastic "protective" cap.

NOTE: Water seepage may occur from vent port when chamber temperature increases.
CAUTION: A HIGH RATE OF FLOW AND HIGH PRESSURE CAN CAUSE
DISTORTION AND DAMAGE TO THE INCUBATOR CHAMBER WALLS.

NOTE: The vinyl tubing necessary for filling is contained in the accessories bag included with each incubator. The kit contains three feet of 3/8" I.D. vinyl tubing, if the distilled water outlet is more than three feet from the incubator, more tubing, and a connector will be required.

CAUTION: PURITY OF THE DISTILLED WATER USED IN THE WATER OHM TO 1 MEG OHM RANGE TO PROTECT, AND PROLONG THE LIFE OF THE STAINLESS STEEL WATER JACKET. USE OF TAP WATER, OR DISTILLED WATER OUTSIDE THE SPECIFIED RANGE, WILL DECREASE THE OPERATING LIFE OF THE UNIT AND VOID THE WARRANTY.

CAUTION: MAKE CERTAIN THAT THE WATER JACKET VENT HOLE (LOCATED DIRECTLY BELOW THE FILL/DRAIN FITTING, BEHIND THE FRONT DOOR) IS NOT COVERED OR PLUGGED. THE VENT HOLE MUST BE OPEN AT ALL TIMES TO PERMIT EXPANDING AIR TO ESCAPE, OR DAMAGE TO THE INCUBATOR CHAMBER WILL RESULT.

1) Remove plastic "protective" cap from fill/drain fitting.

2) Connect 3/8" I.D. vinyl tubing between fitting and distilled water tap.

3) Open tap until water flows steadily into water jacket.

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

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

5) Using the funnel method, add one additional liter. The incubator has now been properly filled.

6) Remove vinyl tubing and reinstall the plastic "protective" cap.
4.11 CONNECTING THE CO₂ SUPPLY

For the most economical use of CO₂, a main supply of liquid CO₂ is recommended. The liquid CO₂ should be supplied from tanks WITHOUT SIPHON TUBES to ensure that only CO₂ gas enters the incubator injection system. It also recommended that a two-stage pressure regulator with indicating gauges be installed at the supply cylinder outlet. The high pressure gauge should have an indicating range of 0 to 2000 PSIG to monitor tank pressure; and the low pressure gauge should have an indicating range of 0 to 30 PSIG to monitor actual input pressure to the incubator injection system. A suitable two-stage pressure regulator is available from Forma Scientific, Stock #965010.

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

TO CONNECT THE CO₂ SUPPLY:

The CO₂ fitting is located on the backside of the control panel. Securely attach the 3/16" I.D. vinyl CO₂ line to the serrated fitting, and check the connection for leaks. If a metal line is to be used, the serrated fitting can be replaced and the desired 1/8 MPT fitting can be added.

4.12 FILLING THE HUMIDITY RESERVOIR OR PAN

CAUTION: DO NOT USE PLASTIC PANS FOR HUMIDIFICATION AS THEY WILL HAVE AN UNPREDICTABLE EFFECT ON HUMIDITY AND CO₂ LEVELS IN THE INCUBATOR. USE ONLY THE FLOOR OF THE UNIT OR THE OPTIONAL STAINLESS STEEL HUMIDITY PAN.

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

Listed below are two recommended methods of providing elevated humidity in the chamber. Before selecting one of these methods, please refer to Section 5.2 Overview of Humidification and CO₂.

CAUTION: FREQUENT DOOR OPENINGS WILL CAUSE HUMIDITY LOSS FROM CHAMBER AND MAY RESULT IN DESICCATION OF THE PRODUCT. RECOVERY TIME WILL ALSO BE AFFECTED!
1) The reservoir in the bottom of the incubator can be filled with at least 3/4" of sterile distilled (50K ohm to 1 Meg Ohm) water.

2) The optional humidity pan (Forma Stock #237001) will hold 6.375 quarts or (6 liters) of sterile distilled (50K ohm to 1 Meg ohm) water.

NOTE: This pan may be autoclaved.

The humidity pan may be placed either on the floor, or installed in the bottom set of shelf brackets.

NOTE: RECOVERY TIMES ARE APPROXIMATELY 20% LONGER WHEN THE HUMIDITY PAN IS PLACED IN THE BOTTOM SHELF BRACKETS.

The best humidity and temperature response from the humidity pan is obtained when the pan is placed directly on the incubator floor.

The water level in the humidity reservoir should be checked frequently. If a disinfectant is added to the water in the reservoir, it should be changed once a week to help prevent microbial contamination. If no disinfectant is added to the sterile distilled water (50K ohm to 1 Meg Ohm), the water should be changed at least twice a week.

It is very important that the water level in the reservoir or pan be kept relatively constant, as extreme fluctuations or "dry-outs" will have an adverse effect on the humidity level and CO₂ control in the chamber.

CAUTION: WHEN INSTALLING THE HUMIDITY PAN, EXERCISE CARE TO AVOID TEARING THE INNER DOOR GASKET.
4.13 SETTING THE CHAMBER TEMPERATURE

Before the initial temperature setting is made, push in on the "Push to Set" button on the alarm monitor module, and using the screwdriver on the control panel, turn the overtemp set screw until the display shows a temperature that is 2 to 3 degrees above the desired operating setpoint. The overtemp safety may be reset after the chamber temperature has stabilized at setpoint.

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

If a value other than 37C is desired, set the switch to the Variable position, and set the temperature control knob to the desired setpoint. Any temperature between 5 degrees C above ambient to 60 degrees C may be selected.

4.14 SETTING THE OVERTEMP ALARM POINT

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

1) Push in on the Push to Set button on the alarm monitor module.

2) Using the screwdriver mounted on the control panel, turn the set screw until the desired overtemp alarm point is shown on the digital display. The overtemp setpoint can be set within 0.1 degree of operating setpoint, but it is recommended that it not be set within 0.5 of setpoint.

NOTE: The overtemp safety should be checked quarterly to insure proper operation. To check the overtemp control, push in on the Push to Set button on the alarm monitor module, and turn the set screw counterclockwise until the overtemp safety light and audible alarm are activated. Reset the overtemp safety after the test.
4.15 ZEROING THE CO₂ CONTROLLER

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

TOOLS REQUIRED:

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

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

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

STEP 2: ADJUST THE ZERO SET POT

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

2.2 When the adjustment is complete, turn on the CO₂ at the supply.

2.3 Turn the CO₂ setpoint to the desired %.

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

3.1 Allow the incubator to reach setpoint and control (inject light will cycle) for a minimum of 30 minutes.
3.2 Check the CO₂ level with a FYRITE until two consecutive readings agree. If the FYRITE and display are not within plus or minus 1.0%, consult the factory. See Section 6.9 for correct FYRITE sampling procedure.

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

4.16 SETTING THE CO₂ CONTENT

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

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

2) Check the CO₂ control zero (See Section 4.15 for detailed instructions).

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

NOTE: If the unit is in overtemp and a CO₂ injection occurs, a brief, high CO₂ percentage will appear on the digital display due to the shut down of the internal fan during overtemp. The high CO₂ percentage occurs only at the sensor. CO₂ throughout the chamber will remain normal.
SECTION 5 - OPERATION

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5.1 Operation
5.2 Overview of Humidification and CO₂
5.3 Control Panel
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5.5 Alarm/Monitor Module
SECTION 5 - OPERATION

5.1 OPERATION

The water jacket is filled with approximately 12.9 gallons (49 liters) of water through the fill fitting located on the front of the unit. The water is then warmed by the chamber heater, providing very stable heating of the incubator chamber. Not only does the water stay at a constant temperature with a minimum of heater on-time, but it also acts effectively as insulation from ambient temperature conditions.

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

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

5.2 Overview of Humidification and CO₂

Of all the ways to measure incubator CO₂ levels, Forma's thermal conductivity method represents the best combination of economy, accuracy and reliability possible today.

Thermal conductivity of the incubator atmosphere is affected not only by the quantity of CO₂ present, but by the quantity of water vapor present in the incubator atmosphere as well. This effect is linearly related to the absolute humidity of the atmosphere (See graph on page 42).

In monitoring the effects of CO₂, absolute humidity must be held constant so any change in thermal conductivity is caused only by a change in the CO₂ concentration. Under the worst circumstances, a change in absolute humidity could cause such a significant change in thermal conductivity that the controller could shift the CO₂ content by as much as 4%.
Maintaining the water level inside the incubator is a relatively simple procedure. We cannot emphasize strongly enough the importance of keeping the humidity in the incubator constant. Any water pan, used in lieu of flooding the incubator floor, must be stainless steel and at least 187 square inches of surface area. Our tests indicate that smaller pans, bowls or non-metallic pans do not provide adequate humidification, which can lead to incubator humidity variations with ambient humidity shifts, resulting in CO₂ changes in the incubator.

When operating a dry incubator, as opposed to a humidified one, ambient humidity fluctuations will affect CO₂ calibrations. Since the fluctuations possible in extreme ambient changes have less effect on the total absolute humidity, the CO₂ calibration can be affected by as much as 1.5%.

When a change in humidity or temperature is needed, the CO₂ control can be easily zeroed for the new condition.

One additional note: Temperature changes have little affect on CO₂ calibration, but do cause large changes in the absolute humidity which is reflected in changes in CO₂ calibration.

5.3 CONTROL PANEL

1) FILL/DRAIN FITTING AND VENT HOLE

The fill/drain fitting is located on the center front of the unit, directly above the door. This fitting is to facilitate filling and draining of the water jacket without having to move the unit. The vent hole, located directly below the fill/drain fitting, behind the front door, allows the air displaced by water entering the jacket to escape. It also prevents distortion of the chamber by allowing air to escape as the unit expands and contracts during heating and cooling. Under no circumstances should the vent be plugged.

2) POWER SWITCH AND PILOT LIGHT

The main power switch controls the ON/OFF power to the unit. The power pilot light is activated when the power switch is on, and the unit is receiving power.
3) CIRCUIT BREAKER (RESET)

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

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

When the Variable/37°C switch is set to the 37°C (up) position, chamber temperature will automatically be maintained at +37 degrees C. If necessary, the 37°C control can be calibrated via the calibration screw located at the lower left side of the temperature control dial. See Section 7.3 for recalibration instructions for the 37 degrees C setting.

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

5) GAS SAMPLE PORT

A sample port for checking CO₂ percentage by independent means (e.g. FYRITE or similar CO₂ measuring device). See Section 6.9 for details on the proper use of the FYRITE.

IMPORTANT:

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

6) SETPOINT ADJUSTMENT TOOL

A small screwdriver, located adjacent to the sample port, has been provided for setting the CO₂ and overtemp setpoints. Pull out on the knob to release the screwdriver.
5.4 CO₂ MODULE

1) CO₂ POWER SWITCH

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

2) CO₂ CONTROLLER AND DIGITAL DISPLAY

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

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

3) AUDIBLE CO₂ ALARM AND PILOT LIGHT

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

4) SET/SILENCE PUSH BUTTON

When pushed, the set/silence button will silence the CO₂ alarm and de-energize the alarm light. The alarm will remain deactivated until another alarm condition occurs. This button must be pushed to set or display the CO₂ setpoint.

5) ALARM DISABLE SWITCH

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

When the switch is in the DISABLE position, the CO₂ alarm is completely disabled. When the switch is set to the NORMAL position, the alarm system is operative and can be silenced via the set/silence button.
6) **CO₂ INJECT LIGHT**

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

7) **CO₂ ZERO ADJUSTMENT**

The CO₂ zero adjustment is used for zeroing the CO₂ controller to specific control conditions. It is the ONLY user calibration adjustment on the CO₂ module. All internal adjustments are for qualified service personnel ONLY.

5.5 ALARM/MONITOR MODULE

1) **OVERTEMPERATURE CONTROLLER AND PUSH TO SET BUTTON**

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

2) **OVERTEMP ALARM AND PILOT LIGHT**

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

3) **ADD WATER PILOT LIGHT AND AUDIBLE ALARM**

The add water pilot light and audible alarm are activated whenever the water level in the water jacket is low. The alarm will be deactivated only when approximately 1 liter of water has been added through the fill/drain fitting. (See Sections 4.10).
Moisture Effect on CO$_2$ Control Calibration

FIGURE 5.1
SECTION 6 - ROUTINE MAINTENANCE

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6.1 Installing the Decontamination Kit
6.2 Disinfecting the Incubator Interior
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6.7 Overview of the Fyrite CO₂ Analyzer
6.8 Fyrite Operating Precautions
6.9 Operating the Fyrite
6.10 Checking the Fyrite Fluid Strength
6.11 Raising or Lowering the Fyrite Fluid Level
INSTRUCTIONS FOR INSTALLING DECONTAMINATION KIT #190028

1) DISCONNECT INCUBATOR FROM POWER SUPPLY.

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

3) Remove blower wheel. To remove the blower wheel, grasp it as shown in Figure #1 and pull down firmly.

4) Match blower wheel from kit with blower wheel that was removed in Step #3. IMPORTANT! THE BLOWER WHEEL REPLACEMENT MUST BE AN IDENTICAL MATCH. Place new blower wheel over motor shaft and push blower wheel up against snap ring (if present). Confirm that blower wheel rotates freely.

5) Next locate and remove the four wing nuts that secure the motor mounting plate to the incubator ceiling, shown in Figure #2.

6) Carefully pull blower motor assembly down into chamber area. NOTE: ON SOME MODELS, THE BLOWER MOTOR ASSEMBLY MAY DROP DOWN ONLY 1-1/2 TO 2 INCHES.

7) Slide the motor mounting gasket over the motor mounting plate, as shown in Figure #3. Discard gasket.

8) Install the new motor mounting gasket over the four studs, located on the incubator ceiling, as shown in Figure #4.

NOTE: THE MOTOR MOUNTING GASKET MUST LIE FLAT BETWEEN THE MOTOR MOUNTING PLATE AND THE INCUBATOR CEILING. TIGHTEN ALL FOUR WING NUTS FIRMLY TO ENSURE A GOOD SEAL.
THE FOLLOWING STEPS APPLY TO AUTOMATIC CO₂ AND AUTOMATIC O₂/CO₂ INCUBATORS.
FOR CONSTANT FLOW INCUBATORS, SKIP TO STEP #12.

9) Remove the two wing nuts and large flat washer that secures the CO₂ sensor, shown in Figures #5 & #6. Allow sensor to drop down into chamber area. Disconnect sensor at electrical connector.

10) Peel o-ring off sensor and replace it with the new o-ring provided in kit, shown in Figure #7.

11) Electrically reconnect CO₂ sensor. Reinstall CO₂ sensor to original position. Tighten wing nuts firmly to ensure proper sealing.

12) Reinstall blower channel, duct sheets and shelves. Reconnect incubator to power supply.
6.2 DISINFECTING THE INCUBATOR INTERIOR

The incubator can be easily disinfected in about 30 minutes. Forma recommends the use of ColdSpore™. Dilute with sterile distilled water (50K Ohm to 1 Meg Ohm).

1) Remove shelves and duct sheets, and clean all interior surfaces, taking care not to saturate the CO₂ sensor.

2) Rinse the surfaces at least twice with sterile distilled water (50K Ohm to 1 Meg Ohm), or until you are satisfied that all of the disinfectant-detergent has been removed.

3) Thoroughly clean the door gasket.

4) Clean inside of glass door with solution, and rinse with sterile distilled water (50K Ohm to 1 Meg Ohm).

5) Wash or autoclave the shelves and duct sheets with solution.

6) Rinse with sterile distilled water.

   REPEAT RINSING UNTIL YOU ARE SATISFIED THAT ALL OF THE DISINFECTANT-DETERGENT HAS BEEN REMOVED.

7) If desired, all surfaces can then be rubbed or sprayed with 70% alcohol.

8) Reinstall the duct sheets and shelves.

NOTE: AFTER COMPLETING THE DECONTAMINATION PROCEDURE, IT IS RECOMMENDED THAT THE INCUBATOR BE RUN FOR 24 HOURS TO ASSURE REMOVAL OF TRACE VAPORS, BEFORE PLACING ANY VALUABLE CONTENTS INSIDE THE INCUBATOR CHAMBER.

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

CAUTION: DO NOT USE STRONG ALKALINE OR CAUSTIC AGENTS. STAINLESS STEEL IS CORROSION RESISTANT, NOT CORROSION PROOF.
CAUTION: DO NOT USE SOLUTIONS OF SODIUM HYPOCHLORITE (PUREX, CLOROX, ETC.) AS THEY MAY CAUSE PITTNG AND RUST.

6.3 CLEANING THE CABINET EXTERIOR

The incubator exterior may be cleaned with soap and water and a general use laboratory disinfectant. A cleaning chart has been provided at the rear of the manual. Information about disinfectants, recommended by Forma Scientific, Inc. is included as a supplement to this manual.

6.4 DRAINING THE WATER JACKET

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

1) Disconnect the unit from the power supply.

2) Remove the plastic "protective" cap from the fill/drain fitting and attach the 3/8" I.D. vinyl tubing. Attach funnel to open end of tubing.

3) Prime the water line by holding the tubing straight up and pouring water slowly into the funnel until the tubing is completely filled.

4) Quickly drop the water line to a drain or large bucket. If the tube has been filled correctly, the water should siphon out of the jacket.

5) See Section 4.10 to fill the water jacket.

6.5 CHANGING THE CO₂ FILTER
(For Qualified Service Personnel Only!)

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

If the CO₂ filter becomes clogged, replace with Forma stock #770801.

1) Disconnect the unit from the power supply.

2) Remove screws securing side service panel.

3) Remove and replace the filter.
6.6 A WORD ABOUT CO₂ TEST INSTRUMENTS

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

As previously noted, it is extremely important that any Forma automatic CO₂ incubator be zeroed to air (See Section 4.15). CO₂ TEST INSTRUMENTS SHOULD BE USED AS A SECONDARY CHECK OR TO CHECK CO₂ AT OPERATING LEVELS ONLY!

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

6.7 OVERVIEW OF THE FYRITE CO₂ ANALYZER

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

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

ANTIDOTES

EXTERNAL: FLOOD WITH WATER, THEN WASH WITH VINEGAR.

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

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

CALL PHYSICIAN

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6.8 FYRITE OPERATING PRECAUTIONS

1) **DO NOT invert the FYRITE when the plunger is depressed.**

2) **DO NOT hold the FYRITE near your face when the top plunger is depressed.**

3) **ALWAYS hold the FYRITE by the fins to prevent heat transfer from your hands.**

4) **ALWAYS moisten the filter in the sampling tube before taking a sample. Failure to do so will result in inaccurate readings.**

5) **For maximum accuracy, the FYRITE MUST be at ambient temperature. DO NOT store the FYRITE in a location subject to extreme temperatures (such as the trunk of a car or a windowsill).**

6) **Check the strength of the FYRITE fluid whenever the instrument is used. See Section 6.10 for instructions on checking the fluid strength.**

6.9 OPERATING THE FYRITE

1) **Hold the FYRITE upright and away from your face. Press the plunger momentarily to vent the tester.**

2) **Invert the FYRITE to drain the fluid into the top.**

3) **Turn the FYRITE upright, and allow the fluid to drain to the bottom.**

4) **Hold the FYRITE at eye level. Loosen the locknut at the rear of the scale. Slide the scale until the top of the fluid column lines up with the zero on the scale. Tighten the locknut.**

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

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

7) Invert the FYRITE, and allow all the liquid to drain to the top. Turn upright, and allow all the liquid to drain to the bottom. Repeat once.

8) Momentarily hold the FYRITE at a 45 degree angle to allow the fluid droplets to drain to bottom.

9) Hold the FYRITE upright. Allow the fluid a few seconds to stabilize. Determine the percent CO₂ from the level of the fluid column. A delay of 5 to 10 seconds in taking the reading may result in a slight error; a longer delay may result in a substantial error.

10) Repeat steps 6 through 10 until two consecutive readings agree.

11) Remove the FYRITE hose from the sample port to allow the chamber to breathe.

NOTE: When used correctly, the FYRITE is accurate to within +1/2% of actual CO₂ value. Incorrect sampling technique can cause an error of as much as 4%.

6.10 CHECKING THE FYRITE FLUID STRENGTH

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

Fluid strength can also be checked by testing a certified gas sample containing a known CO₂ concentration. Fresh FYRITE fluid should be good for approximately 350 samples.

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

CAUTION: IF REPLACEMENT OF THE FLUID IS NECESSARY, CAREFULLY FOLLOW THE DIRECTIONS ON THE PACKAGE. REMEMBER THAT THE FLUID IS POISONOUS AND CAUSTIC.
6.11 RAISING OR LOWERING THE FYRITE FLUID LEVEL

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

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

TO REMOVE FLUID: See your FYRITE manual.
SECTION 7 - SERVICE

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7.3 Replacing the CO₂ Sensor
7.4 Replacing the Triac
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7.8 Replacing the Circuit Breaker
7.9 Replacing the Power Switch
7.10 Replacing the Thermistors
7.11 Replacing the 0.3 Amp Fuse

CAUTION: SERVICING OF THE UNIT SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.
7.1 **CO₂ CONTROL CALIBRATION**

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

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

**TOOLS NEEDED:**

1) Calibration screwdriver (provided).
2) Circuit Board Extender Card.
3) FYRITE CO₂ Analyzer (See Section 6.9 for proper usage).

**CALIBRATION PROCEDURE**

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

1.1. TURN POWER OFF TO CO₂ MODULE!

1.2 Remove the CO₂ Module, and insert the extender card into card guides. Push extender card in firmly. Plug CO₂ Module into the connector on the front of the extender card.

**CAUTION:** TAKE CARE TO PLUG-IN THE MODULE RIGHT SIDE UP, OTHERWISE DAMAGE WILL OCCUR TO THE CO₂ MODULE.

1.3 Turn OFF the CO₂ supply at the source.

1.4 Fill the humidity pan with sterile distilled water.

1.5 Turn unit on and allow the chamber temperature and humidity to stabilize. This will take a minimum of 8 hours if the temperature setpoint has been recently changed. Allow 3 days on initial start-up.

1.6 Turn the span pot counterclockwise 10 turns.
STEP 2: ADJUST THE ZERO POT

2.1 Using the small screwdriver mounted on the control panel, adjust the CO₂ control zero pot to read 00.0 on the digital display.

2.2 Wait 5 minutes, and repeat as necessary until the display is stable.

STEP 3: ADJUST THE SPAN POT

3.1 Turn ON the CO₂ at the supply.

3.2 Turn the CO₂ setpoint to the desired operating level. Allow the CO₂ to stabilize at the desired level on the readout and control (inject light will cycle) for a minimum of 15 minutes.

3.3 Using a FYRITE or other measuring device, check the CO₂ level in the chamber until two consecutive readings agree.

3.4 Turn the CO₂ setpoint to 0.0% to prevent CO₂ from being injected into the chamber during the adjustment.

3.5 Adjust the span pot so the digital display agrees with the FYRITE reading.

3.6 Turn the setpoint back to the desired operating level and allow the CO₂ to control and stabilize for a minimum of 15 minutes.

3.7 Check the CO₂ in the chamber with a FYRITE or similar device until two consecutive readings agree. If the digital display is within plus or minus 1.0% of the FYRITE reading, proceed to Step 4. If the reading is not within plus or minus 1.0%, repeat steps 3.4 through 3.7.

STEP 4: RE-CHECK THE ZERO ADJUSTMENT

4.1 Turn OFF the CO₂ at the supply.

4.2 Open both doors wide for 45 seconds. Close the doors, and allow a minimum of 30 minutes for the incubator to stabilize and assure a zero CO₂ condition in the chamber.
4.3 If the readout is greater than 00.4, repeat the door opening for 15 seconds, and again allow the incubator to stabilize for a minimum of 15 minutes. If the display is not less than the previous reading, consult the factory. If the display now reads 00.4 or less, re-adjust the zero pot so the display reads 00.0.

STEP 5: CHECK THE CO₂ AT THE DESIRED SETPOINT

5.1 Turn ON the CO₂ at the supply.

5.2 Turn the CO₂ setpoint to the desired level.

5.3 Allow the incubator to reach setpoint and control for a minimum of 30 minutes.

5.4 Check the CO₂ with a FYRITE or similar device until two consecutive readings agree. If the FYRITE and display are not within 1.0%, consult the factory.

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

7.2 37°C CONTROL RECALIBRATION

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

TO RECALIBRATE:

1) Make a note of how much the display varies from 37°C.

2) Locate the 37°C recalibration adjustment set screw between the 37°C slide switch and the temperature adjustment knob.

3) Using calibration screwdriver mounted on control panel, adjacent to the sample port, turn the calibration screw one turn clockwise for every half degree that the display is below 37°C. Turning the screw counterclockwise will lower the temperature.
4) Allow the temperature to stabilize, and check the display again. If it still varies significantly, repeat steps 1 through 3.

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

7.3 REPLACING THE CO₂ SENSOR

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove shelves, duct sheets, and blower channel from the chamber.

3) Locate CO₂ sensor in the center of the incubator ceiling, and remove wing nuts. The sensor will drop down.

4) There is a clip that connects sensor wiring to incubator wiring. To open the clip, pull out slightly on the clip tab to release sensor.

5) Remove the O-ring, and place it on the new sensor.

6) Clip the new CO₂ sensor onto the incubator wiring, and return sensor to original opening. Be sure to tighten wing nuts securely so the O ring seals properly.

7) After the sensor has been replaced, recalibrate the CO₂ controller according to instructions in Section 7.1.

7.4 REPLACING THE TRIAC

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove the screws securing the right side access panel. Remove panel and set aside.

3) Remove two mounting screws that secure triac.

4) Carefully disconnect wires to triac, and make note of their configuration to insure proper connection to new triac.
5) Remove triac from unit. Note thermal compound between base of triac and back of control panel housing. If necessary, reapply more thermal compound before installing new triac.

6) Install the new triac by reversing the above procedure. Be sure to install wiring in same configuration as old triac.

7.5 REPLACING THE CO₂ SOLENOID

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove the screws securing the right side access panel. Remove panel and set aside.

3) Locate CO₂ solenoid in the upper rear of the control panel, and disconnect tygon tubing attached to it. Note how tubing is installed so that it can be attached to new solenoid in same way.

4) Remove the screws that hold the solenoid in place.

5) Disconnect wiring to solenoid, making note of its configuration.

6) Remove solenoid, and replace with new solenoid, by reversing above procedure. Be sure to connect wiring and tubing as noted during removal of old solenoid. Note the flow direction marked on solenoid.

7.6 REPLACING THE TEMPERATURE CONTROL

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove the screws securing the right side access panel. Remove panel and set aside.

3) Remove temp control knob by loosening two Allen head screws recessed in knob.

4) Remove nut on shaft, then remove nut on back of panel behind control knob.

5) Remove wiring to temp control, and make note of its configuration.

6) Remove control, and replace it with new control by reversing above procedure.
NOTE: It may be necessary to "pry-loose" the defective control since it is secured with sticky tape. When installing the new control remove cover from the tape and align carefully into place.

7.7 REPLACING PILOT LIGHTS

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove the screws securing the right side access panel. Remove panel and set aside.


4) Insert the new pilot light from front, and install new retaining clip.

5) Rewire pilot light in same configuration as old light.

7.8 REPLACING THE CIRCUIT BREAKER

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove the screws securing the right side access panel. Remove panel and set aside.

3) Remove nut securing circuit breaker to control panel.

4) Remove the wiring, and note its configuration.

5) Install new circuit breaker by reversing above procedure.
7.9 REPLACING THE THERMISTOR

1) Turn the power switch "OFF" and disconnect the unit from the power supply.

2) Remove the screws securing the top access panel. Remove panel and set aside.

3) Locate thermistors by lifting insulation in the front left-hand corner top of the incubator. Remove silastic around defective thermistor cable.

4) Pull the defective thermistor out of the probe sheath.

5) Cut wires to defective thermistor, making note of their configuration.

6) Attach new thermistor by use of electrical in-line connectors.

7) Install new thermistor by reversing above procedure. Take care not to damage the probe tip, make sure that the probe is fully inserted into the sheath. Also RESEAL around cable with silastic or similar material.

7.10 REPLACING THE 0.3 AMP FUSE

The 3/10 amp fuse is located directly above the line cord, and is labeled.

1) Disconnect all power to the incubator.

2) Remove the screws securing the side access panel. Remove panel and set aside.

3) Use a fuse puller, a small screwdriver, pry to lift one end of fuse from clip. Grasp fuse and remove from holder. Discard fuse.

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

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

NOTE: 3/10 Amp fuses have very fine elements. Continuity test fuse before installation to be sure element is intact.
5) Reinstall the right side access panel.

6) Connect power to incubator. Turn "POWER" switch to "ON" and check operation of controls.
SECTION 8 - SPECIFICATIONS

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8.13 Performance Data
SECTION 8 - SPECIFICATIONS

Models 3546/3548

8.1 CAPACITY

Chamber Capacity: 5.7 Cubic Feet 0.16 Cubic Meters
Water Jacket Volume: 12.9 Gallons 49 Liters
Humidity Reservoir Capacity: 1.46 Gallons 5.5 Liters
Humidity Pan Capacity: 6.375 Liters

8.2 WEIGHT

Net Weight Without Water: Approx. 180 lbs.
Approx. 81.6 kgs.
Net Weight With Water: Approx. 267.5 lbs.
Approx. 121.3 kgs.
Shipping Weight (Motor): 270 lbs. Nominal
122 kg Nominal

8.3 DIMENSIONS

Exterior: 31.2" W x 36.1" H x 23.8" F-B
79.2 cm W x 91.7 cm H x 60.4 cm F-B
Interior: 26.8" H x 18.6" W x 18.8" D
68.0 cm H x 47.2 cm W x 47.7 cm D

8.4 CONSTRUCTION

Exterior: 18 Ga. Cold Rolled Steel
Interior: 20 Ga. Stainless Steel Type 304 2-B Finish
Insulation: 1-1/2" Fiberglass
Inner Door Gasket: Silicone
Outer Door Gasket: 4 Sided Molded Magnetic Vinyl
Finish: Powder Coated
Bristol Gray & Windsor Blue Trim
8.5 SHELVES
Capacity: 22 (5 Provided)
Dimensions: 17.75" W x 17.75" D
        45.2 cm W x 45.2 cm D
Construction: 18 Ga. Electropolished Stainless Steel
        Type 304
Usable Shelf Area (per shelf): 2.2 Square Feet
Usable Shelf Area (maximum): 48.4 Square Feet
Flatness: +/- 0.032" Off Horizontal Plane
Clearance: Adjustable on 1" Centers

8.6 ALARM/MONITOR MODULE
Sensor: Thermistor
Control Sensitivity: +/- 0.1 Degree C
Readout: LCD
Setpoint: Digital W/Screwdriver Adjust
Readability: 0.1 Degree C
Accuracy: +/- 0.2 Degrees C
Alarm Setability: 0.1 Degree C

8.7 CO₂ MODULE
Sensor: Matched Thermistors
Controller: Thermal Conductivity
Sensitivity: +/- 0.1% CO₂
Readout: LCD
Setpoint: Digital with Screwdriver Adjust
Readability: 0.1% CO₂
Accuracy: 0.1% CO₂
Alarm Differential & Delay: +/- 1% (nominal) for longer
than approx. 4 minutes.
Supply Voltage: +/- 15V

8.8 TEMPERATURE CONTROL
Sensor: Thermistor
Controller Type: Proportional, Zero-Switching
Range: 0 to 60 Degrees C
Sensitivity: +/- 0.05 Degrees C

8.9 HEATERS
Chamber: 260 Watts
Door: 5 Watt Continuous, 120 Watt Cycled
Top: 6 Watts
8.10 BLOWER

CFM: 7.5
Wheel Material: Polypropylene
Motor: 1/200 HP, 3000 RPM, 2 Pole
Externally Mounted, Internally Removable

8.11 FITTINGS

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

8.12 ELECTRICAL CHARACTERISTICS

Main: 90-130 VAC, 50/60 Hz, 4 FLA
Circuit Breaker: 5 Amps
Power Switch: 2 Pole

MODEL 3548:
Main: 180-260 VAC, 50/60 Hz, 1.9 FLA
Circuit Breaker: 5 Amps
Power Switch: 2 Pole

8.13 PERFORMANCE DATA

Temperature
Range: 5 Degrees C above ambient to 60 Degrees C
Control Tolerance: +/-0.02 Degrees C at 37 Degrees C in 72 Degrees F ambient

CO₂
Range: 0 to 20%
Control Tolerance: Better than +/- 0.1%
Consumption @ 5% CO₂: 1.7 Liters/Hr. + 7.2 Liters/15 Sec.
Door Opening

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

1) ELECTROPOLISHED STAINLESS STEEL SHELF

The perforated shelf is square for easy installation. 22 shelf capacity. Catalog # 224140

2) TISSUE CULTURE SHELVES

These 11" x 16" stainless steel shelves for culture dishes are designed for stacking to increase incubator storage space. Minimum order of 6 shelves. Catalog # 500171

3) FYRITE CO₂ ANALYZER KIT

For checking chamber CO₂ (0-20%) level in the chamber. Connects to the gas sample port on the control panel. Kit comes complete with aspirator, sampling tube, and carrying case. Catalog # 220012

4) EXTRA FYRITE FLUID

For replacing Fyrite tester fluid. Three bottles per carton. Catalog # 220051

5) DIGITAL THERMOMETER

Hand-held, the size of a pocket calculator, it features clear liquid crystal readout of temperature from -99.9 to +99.9 degrees C. Ideal for general laboratory use. Catalog # 853227

6) TWO STAGE PRESSURE REGULATOR

Controls CO₂ cylinder gas pressure. First stage reduces tank pressure to pre-set intermediate level. Second stage reduces pressure to recommended incubator inlet pressure. Permits stable CO₂ flow on high or low demand through the entire cylinder supply. Catalog # 965010

7) CO₂ GAS GUARD

For use with automatic CO₂ incubators only. Protects dual tank CO₂ supply by automatically switching to another tank when one supply is exhausted. Audible alarm warns of tank depletion; reset button silences the alarm. Manual tank switch-over included. Model # 3030.
8) REPLACEMENT CO₂ FILTER

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

9) DISINFECTION KIT

   Includes parts needed for improved disinfection of the incubator. Includes disposable blower wheel, O ring for the CO₂ sensor, and motor mounting gasket.
   Catalog # 190247

10) LABORATORY DISINFECTANT

   ColdSpore™ Concentrate (4 bottles) Catalog# 130043
   ColdSpore™ (spray bottles) Catalog# 130045

11) HUMIDITY PAN

   This humidity pan is made of stamped (seam-free) 304 stainless steel and will hold 6.375 quarts (6 liters) of water. Cleaning and decontamination is very easy due to the coved corners and seamless construction. Catalog # 237001

12) HYGROMETER

   For measuring chamber humidity. This instrument has a 4" dial and a range of 0 to 100% rh. Catalog # 155010

13) GLASS THERMOMETER

   For independently measuring chamber temperature. Range from 0 to 100 degrees C. Catalog # 285722
### SECTION 10 - PARTS LIST

PARTS LIST

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<thead>
<tr>
<th>STOCK #</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>770001</td>
<td>CO₂ Disposable Filter</td>
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<tr>
<td>250085</td>
<td>CO₂ Solenoid 12VDC, 3W</td>
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<tr>
<td>300164</td>
<td>Overtemp Relay</td>
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<tr>
<td>431142</td>
<td>Gasket, Magnetic</td>
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<td>400296</td>
<td>Silicon Feather Gasket</td>
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<td>230094</td>
<td>Fuse .3A (Slow-Blow Type)</td>
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<td>#312 Green Pilot Light</td>
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<tr>
<td>280006</td>
<td>#312 Amber Pilot Light</td>
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<td>Clip, Mounting, Pilot Light</td>
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<td>25A Triac</td>
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<td>100071</td>
<td>Blower Wheel</td>
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<td>227175</td>
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<td>Alarm/Monitor Module</td>
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<td>231142</td>
<td>CO₂ Control Module</td>
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<tr>
<td>231047</td>
<td>Temperature Control</td>
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<tr>
<td>290027</td>
<td>1K, Thermistor Cable</td>
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