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REVCO

Ultima II and Elite II Laboratory CO_2 Incubators

Installation and Operation Manual

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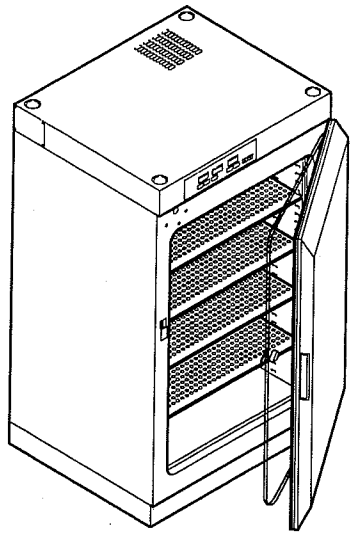
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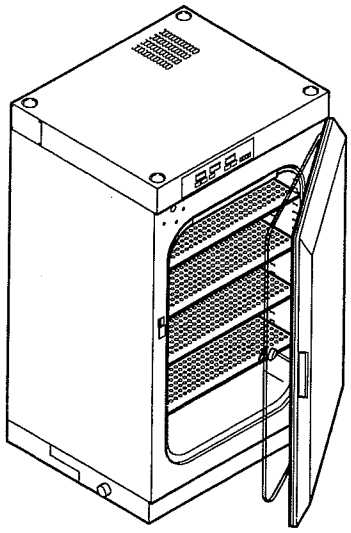
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1 Introduction



Welded Wall



Seamless Wall

Figure 1. Ultima II and Elite II Incubators

1.1 Features and Benefits

Revco Ultima™ II and Elite™ II incubators are designed to create a stable, reliable environment for cell culture applications. They operate at temperatures ranging from 5°C above ambient temperature to +40°C.

- Convenience Outlet. A receptacle rated at 115 VAC, 75 watts maximum, is located at the rear of the incubator. The outlet is ideal for electronic recorders or other small loads. Do not exceed the electrical capacity of this outlet.
- Alarms:
  - High and low level CO_2 and (on Ultima tri-gas models) O_2 setpoint alarms, adjustable to within ±1% of setpoint.
  - High and low temperature alarms settable by the user.
- Chamber Drain. All models are provided with a chamber drain valve at the bottom left of the cabinet.
- CO_2 tank switchover and Alarm.
- IntrLogic™ II microprocessor control system with large, easy-to-read display. On program request, software steps the user through initial installation and startup procedures.
- Keyed power/alarm switch provides setpoint security.
- Units stackable.
- An in-chamber HEPA filter is standard for Ultima models, optional for Elite models.
- The IncuSoft™ interface for RS485 data port communications is standard for Ultima models, optional for Elite models.

1.2 Requirements

- High quality two-stage, low pressure 30 psig pressure regulators are required for proper operation of the CO_2 and (if applicable) O_2 gas supplies, 15 psig at the incubator.
- CO_2 used in the incubator must be at least 99.9% pure.
- In-line gas supply filters must be used on the CO_2 supply and (on tri-gas units) the O_2 supply to prevent damage to the solenoid valve(s). One filter for each gas is supplied with the startup kit:
  - Type: Microbiological
  - Specification: 0.3 micron
  - Location: rear of unit
- Each chamber contains approximately 10 gallons of jacket water when filled. The water takes six to eight hours to heat from 20° to 37°C. This time must be allowed for the interior temperature to stabilize before any adjustments or permanent calibrations are made.

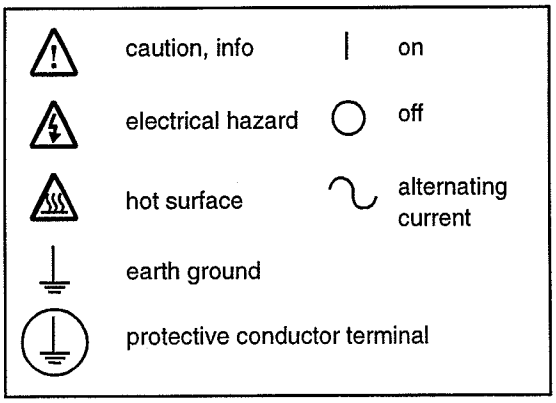
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2 Safety Precautions

In this manual and on labels attached to this product, the words WARNING and CAUTION mean the following:

- WARNING: a potentially hazardous situation which, if not avoided, could result in serious injury or death.
- CAUTION: a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or damage to the equipment.

The following symbols are used in caution, warning and informational labels attached to the incubator:



Before installing, using or maintaining this product, please be sure to read this manual and product warning labels carefully. Failure to follow these instructions may cause this product to malfunction, which could result in injury or damage.

Below are important safety precautions that apply to this product:

- Use this product only in the way described in the product literature and in this manual. Before using it, verify that this product is suitable for its intended use.
- Do not modify system components, especially the controller. Use OEM exact replacement equipment or parts. Before use, confirm that the product has not been altered in any way.
- Disconnect the unit from all power sources before cleaning, troubleshooting, or performing other maintenance on the product or its controls. To disconnect power supply to the incubator, unplug the supply cord at the back of the incubator. Note that turning the key switch on the front control panel to the Off position is not sufficient to disconnect power.

WARNING! The user is responsible for carrying out appropriate decontamination procedures when hazardous materials are spilled on or inside the incubator.

3 Operating Standards

The incubators described in this manual are classified for use as stationary equipment in a Pollution Degree 2 and Overvoltage Category II environment, according to the UL61010A-1 and IEC 664 standards.

These units are designed to operate under the following environmental conditions:

- Indoor use
- Altitude up to 2000m
- Maximum relative humidity 80% for temperatures up to 31°C
- Main supply voltage fluctuations not to exceed 10% of the nominal voltage.

4 Pre-Installation

4.1 Unpacking

At delivery, examine the exterior for physical damage while the carrier's representative is present. If exterior damage is present, carefully unpack and inspect the unit and all accessories for damage. If there is no exterior damage, unpack and inspect the equipment within five days of delivery. If you find any damage, keep the packing materials and immediately report the damage to the carrier. ***Do not return goods to the manufacturer without written authorization.*** When submitting a claim for shipping damage, request that the carrier inspect the shipping container and equipment.

4.1.1 Included Parts

The following items are packaged and shipped inside the incubator cabinet:

- Shelves and shelf brackets
- 3/16 in. (476 mm) ID clear tubing for the gas connection (a Y fitting is also supplied with dual-chamber units)
- Decontamination kit: 0.3 micron gas filter, replacement Blower Wheel, CO_2 Sensor gasket, and Injection Port Assembly gasket
- Tubing, funnel, and bottle of water conditioning crystals for filling the water jacket
- Humidity pan
- HEPA filter (if one comes with your unit)
- A thin, 1/2" open-end wrench to adjust leveling legs and relocate the outer door hinge
- Stacking brackets (for dual models)

4.2 Set-up

Remove shelves from the inside of the incubator and clean the incubator (refer to Section 8.1 on page 14). The shelves and brackets can be autoclaved at this time.

4.3 Location

Install the unit in a level area free from vibration with a minimum of three inches (7.6 cm) of space on the sides and rear and 12 inches (30.5 cm) at the top. The floor must be able to support 40 PSI (single chamber incubator) or 75 PSI (double chamber incubator).

Be sure to position the incubator so that the power cord can easily be reached to disconnect power. Do not position the equipment in direct sunlight or near any HVAC duct/diffusers. The ambient temperature range at the location must be 59 to 90°F (15 to 32°C).

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4.4 Gas Supplies

Verify that the incubator gas supplies are available near the installation area: CO_2 for all incubators, also O_2 and N_2 for tri-gas models. The required gas supply pressure is 15 PSI, controlled by a high-quality, two-stage regulator suitable for each connected input gas.

Do not connect the gas at this time.

4.5 Wiring

CAUTION! Connect the equipment to the correct power source. Be sure to operate the incubator at the voltage specified on the dataplate. Incorrect voltage can result in severe damage to the equipment.

WARNING! For personal safety and trouble-free operation, this unit must be properly grounded before it is used. Failure to ground the equipment may cause personal injury or damage to the equipment. Always conform to the National Electrical Code and local codes. Do not connect the unit to overloaded power lines.

The incubators described in this manual are rated either for supply voltage 115/120 VAC, single-phase, 60Hz, 6 amps, or for supply voltage 230 VAC, single-phase, 50Hz, 3 amps. Be sure to check your dataplate for correct information.

Always connect the unit to a dedicated (separate) circuit. Do not exceed the electrical and temperature ratings printed on the dataplate located near the upper hinge of the unit. Electrical codes require fuse or circuit breaker protection for branch circuit conductors. Use time delay fuses for #12 AWG circuits.

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5 Initial Start-Up Procedures

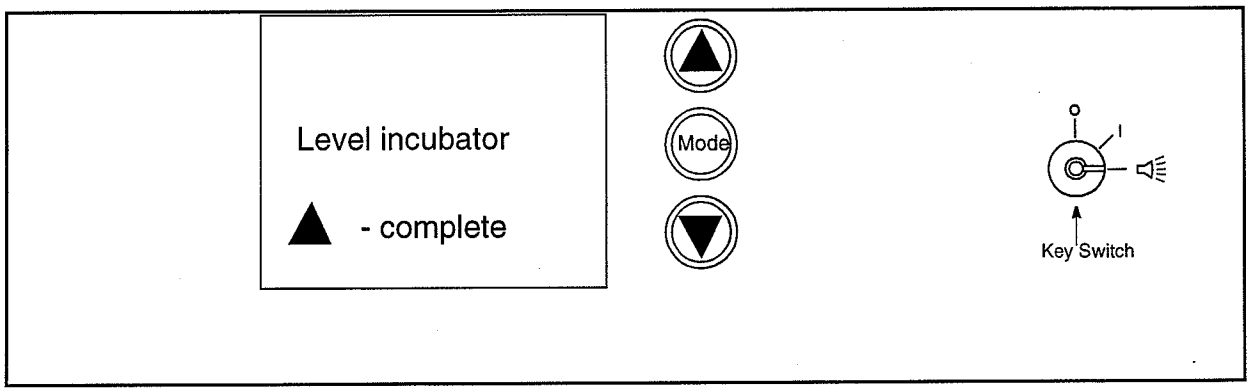


Figure 2. Control Panel: First Start-Up Prompt

IMPORTANT NOTE: *When setting up your incubator for the first time, be sure to follow the control instructions on the sticker provided on the control panel, and in Section 5.3 below.*

5.1 Start-Up Prompts

When you first start up your incubator, the control display will go through several prompts that will guide you through the entire set-up process, from leveling the incubator to adjusting the operating parameters.

During normal operation, the control panel display looks like Figure 8 on page 8. The next chapter explains all the control functions available during normal operation. On initial start-up, however, you will see a series of prompts similar to the one shown above. This chapter explains the start-up prompts and the procedures they ask you to follow.

5.2 Installation Tools

Tools you will need to complete installation are:

- A sharp knife or scissors suitable for cutting plastic tubing
- A bubble level, at least 9 in. (23 cm) long, for leveling the incubator
- A thin, 1/2 in. (1.25 cm) open-end wrench (provided with your incubator) to adjust the leveling feet

5.3 Power and Key Switch

Turn the key switch (shown in the figure above) to the "1" position.

The Revco logo will then roll across the display.

While the logo is displayed, *press and* ***hold the Increase button (Δ) until the logo disappears to initiate the special start-up prompts.*** The first prompt is the one shown above: if you see a temperature display instead, you haven't pressed the Increase button long enough — turn the key switch back to "0" and try again.

5.4 Level and Position

The first prompt asks you to level the incubator. ***It is very important to level the unit both left to right and front to back.***

1. Place a bubble level across the top of the incubator (side to side).
2. Use the thin, 1/2 in.(1.25 cm) open-end wrench to adjust the leveling feet located at the base of the incubator.
3. Repeat steps 1 and 2, this time placing the bubble level on top of the incubator front to back.
4. Slide the incubator into place.

After the water jacket is filled, the incubator must be re-leveled left to right and front to back.

When the incubator is level, press Δ to advance to the next prompt.

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Marilyn Barry

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Update for "Battery Low" Alarm

The Display Message of "Battery Low" indicates the Control System has tested and determined the Alarm Battery should be replaced.

The function of this Alarm Battery is to operate ONLY the Display and Alarm System during a Power Loss while the Key is in the **On** or **Alarm** positions. This Battery System will not power the Heaters, Fan Motor or Gas Control Systems.

Only qualified Technicians should replace this Battery. Replacement Instructions and the Battery are available from Thermo Scientific.

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REVERSING THE OUTER DOOR

For the customer's convenience, the incubator is designed so that the inner and outer door hinges can be moved to the other side of the cabinet. This procedure addresses reversing the outer door.

Turn the Power switch to "Off" and unplug the power cord from the wall outlet.

9. Remove the Phillips screws that secure the door heater harness and harness strain relief to the bottom surface of the door. Unplug the harness from the door.

10. Remove the kickplate mounting screws from the lower front and remove the kickplate. Rotate the kickplate and attached harness so that the harness is on the left side. Reinstall all kickplate mounting screws.

11. Remove the two retaining screws on the back of the control housing, and slide the control housing cover rearward approx. 6" to expose the upper hinge mounting bolts.

12. Block up the door so that it cannot fall when the hinges are removed.

13. Use a 5/16" wrench and remove the two mounting bolts which secure the upper hinge to the cabinet; remove the door and repeat for the lower hinge.

14. Remove the metal plate covering the door heater harness connection on the top of the door, and transfer it to the bottom of the door.

15. Remove the four white plastic plugs from the cabinet screw holes on the left side and insert them in the holes on the right side where the mounting bolts were previously installed.

16. Maintaining the front-to-back orientation of the door, rotate the door so that the hinges are on the left. The bottom of the door now becomes the top.

17. Attach the lower hinge using the previously removed mounting bolts and position the door on the lower hinge. Attach the upper hinge using previously removed mounting bolts.

18. Reconnect the harness to the bottom of the door and reinstall the Phillips screws in the plug and harness strain relief.

19. Test operation of the door and confirm gasket seal. Readjust hinges to achieve gasket seal if necessary.

20. Slide the control housing cover back into place and install the retaining screws.

21. Connect power and turn the key switch to the On position; resume normal operation.

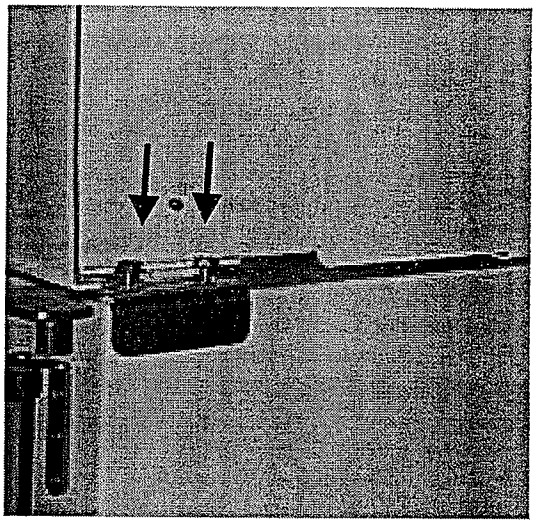


Figure 4.
Upper Hinge, Outer Door

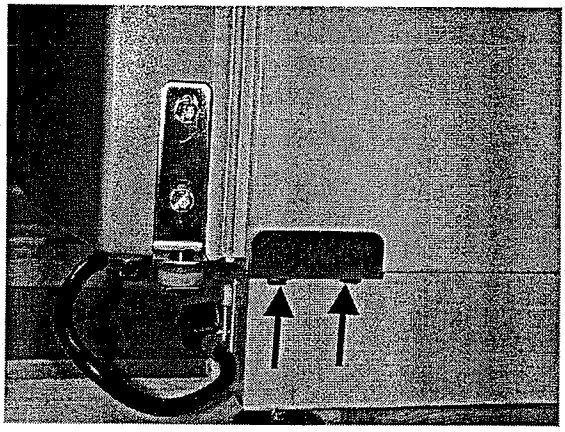


Figure 5.
Lower Hinge, Outer Door

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Instructions for reversing the doors from standard right hand swing to left hand swing on CO2 Incubators.
Part Number 312098H01

REVERSING THE INNER DOOR

1. For the customer's convenience, the Cybernetic incubator is designed so that the inner and outer door hinges can be moved to the other side of the cabinet. This procedure addresses reversing the inner (glass) door.

2. With the unit turned off and the power cord unplugged from the wall outlet, use a Phillips screwdriver and remove the three mounting screws which secure the top hinge to the cabinet (Figure 1). Make sure that the glass door is supported as the top hinge is removed. Set the glass door aside and remove the lower hinge (Figure 2). Do not remove the brackets attached to the glass door.

3. Remove the eight white plastic plugs from the cabinet face. Mount the previously top-right mounted hinge in the bottom-left position using the previously removed mounting screws.

4. Maintaining the front-to-back orientation of the glass door, rotate the glass door so that the hinges are on the left.

5. Reposition the glass door on the lower hinge bracket and attach the upper hinge using the previously removed mounting screws.

6. Remove the two latch mounting screws (Figure 3) and reposition the latch on the right side using previously removed mounting screws. Install the white plugs in the holes where the hinge and latch mounting screws were previously installed.

7. Test operation of the door and latch.

8. Connect power and turn the key switch to the On position; resume normal operation.

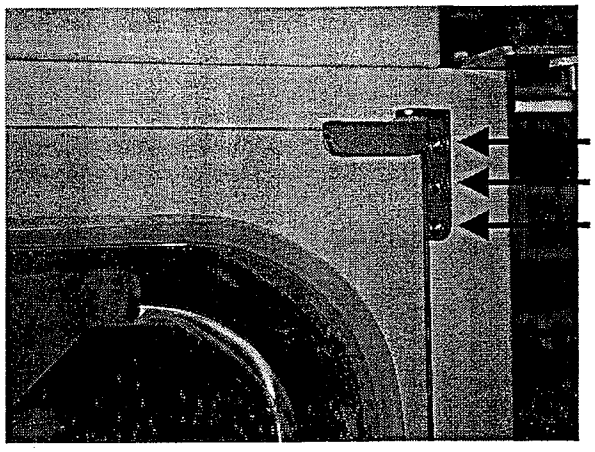


Figure 1.
Upper Hinge, Inner Door

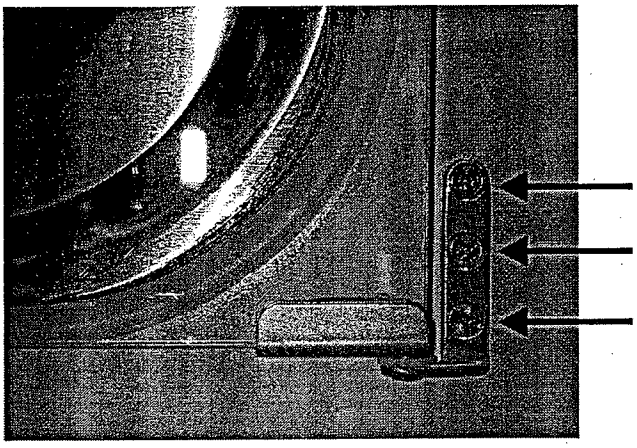


Figure 2.
Lower Hinge, Inner Door

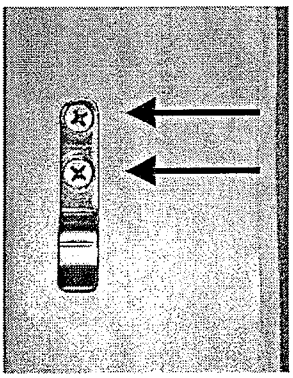


Figure 3.
Glass Door Latch

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5.5 Shelving, HEPA Filter

The next prompt asks you to install the shelves and the HEPA filter.

5.5.1 Shelves

The incubator shelves are fully adjustable. First install the side support walls and top duct. Then determine the location you want for each shelf and install the shelf brackets (refer to Figure 3).

1. Place the base pan with the hole for the humidity pan facing the front of the cabinet.
2. Place a shelf support wall on top of the base on the left side, with the indicator hole toward the front bottom of the unit. The curve of the support wall aligns with the curve of the chamber.
3. Install the top air duct, making sure that the circular hole is to the right directly under the HEPA filter fan.
4. Lean the right support wall against the right side of the chamber and slide it up carefully into vertical position under the top duct. The three parts should lock firmly into place. Do not install the HEPA filter (Section 5.5.2) until the shelf assembly is complete.
5. Position a shelf bracket in the slots on the wall, with the back flange facing up and the side flange facing down. Then pop the shelf bracket up into the slots.
6. Install another shelf bracket in the same location on the opposite wall of the incubator.
7. Slide a shelf into the clips.

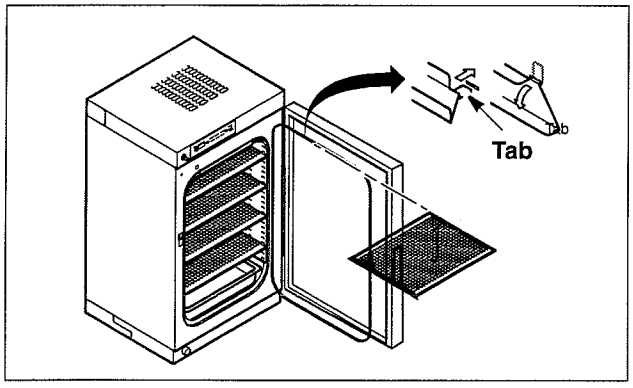


Figure 3. Shelving Detail

5.5.2 HEPA Filter

You can use a HEPA filter to remove airborne particulates from the chamber environment. The filter provided is 99.97% efficient with a 0.3 micron rating. It should normally be replaced every 6 months, more often if the chamber environment has a relatively high concentration of particulates.

To install the filter, place it in the hole in the top duct and twist, as shown in Figure 4.

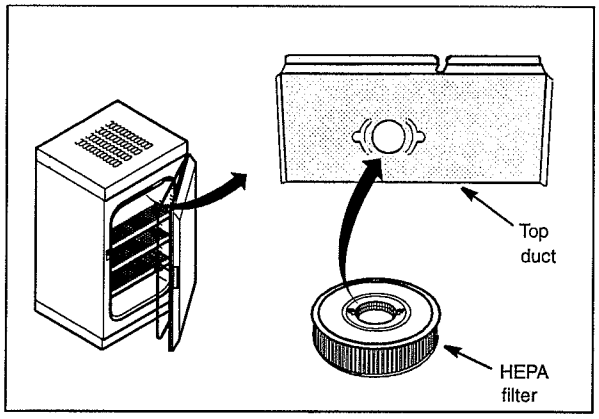


Figure 4. HEPA Filter

When the shelves and filter are in place, press Δ to advance to the next prompt

5.6 Water Jacket Fill

The next prompt asks you to fill the water jacket. Since water level is monitored automatically by the incubator control program, you will not see this prompt if the water level sensor detects that the jacket is already full.

Before starting to fill the water jacket, have a water source or 10 gallons of water available near the incubator. Also, make sure that the drain valve (located on the lower left side of the unit) is closed.

For double (stacked) units, *always* fill the bottom unit first.

WARNING! Over-filling the water jacket may result in damage to electronic components and can become hazardous. Avoid filling beyond the weep hole located near the upper left corner of the glass door.

The fill port is located on the front of the unit behind the upper left corner of the inner glass door. It is labeled FILL. To fill the water jacket, complete the following steps:

1. Locate the plastic bottle of water conditioning crystals, funnel, and length of 3/8 inch tubing supplied with the incubator.
2. Connect one end of the 3/8 inch tubing to the funnel.

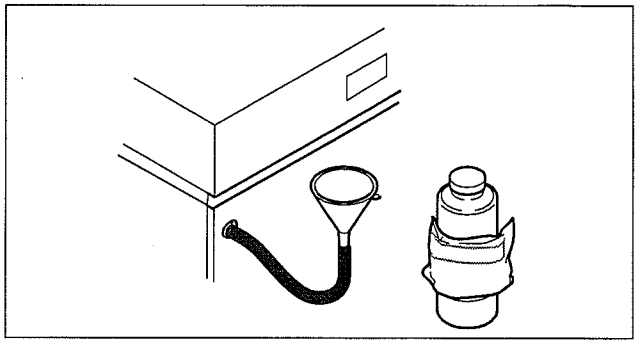


Figure 5. Water Jacket Fill

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3. Fill the plastic bottle of water conditioning crystals with warm water, replace the cap, and shake the bottle until all the crystals are dissolved.

Note: *It is important that you use the entire bottle of crystals to treat the water in the water jacket. If all of the crystals are not dissolved on the first try, pour off and keep shaking the bottle until all the crystals are dissolved*

4. Open the outer door of the incubator and remove the fill port cap located in the upper left corner (labeled FILL).
5. Slide the tubing to the fill fitting as shown in Figure 5.
6. Carefully pour all of the conditioning crystal solution into the funnel.
7. Using *cool* tap water, continue to fill the water jacket (approximately 10 gallons).
   - ***Always use cool tap water to fill the water jacket.*** If you use hot water to fill the water jacket, temperature correlation will be impossible for days.
   - ***Do not use deionized water to fill the water jacket.***
   - If the water jacket is too full, water will come out of the weep hole. If that happens, remove any excess water from the water jacket, using the drain valve at the bottom of the incubator (refer to Section 8.3 on page 14.)
8. Replace the fill port cap.
9. Close both incubator doors; when the water jacket is full, the program automatically advances to the next prompt.

5.7 Re-level Incubator

Level the incubator left to right and front to back (refer to Section 5.4 on page 4). press Δ to advance to the next prompt.

5.8 Set Up CO_2 Supply

This step will be skipped if internal devices already detect adequate input pressure.

CO_2 gas connection(s) are located at the rear of the unit.

Note: *The required gas supply pressure is 15 PSI. Make sure the supply is available in the installation area.*

To install the CO_2 connections, complete the following steps:

1. Be sure that you have the right size tubing (3/16 in. interior diameter).
2. Cut a small length (approximately 6 in.) from the supplied roll of 3/16 in. ID tubing.
3. Pull the cap off the gas connection port at the rear of the incubator and attach one end of the tubing to the gas connection port.
4. Connect the opposite end of the tubing to a high-quality input gas filter (0.3 micron supplied). Note that the side of the filter marked "IN" faces the incoming gas connection, *not* the back of the incubator (refer to Figure 6).
5. Use the remaining 3/16 in. ID tubing to connect the input gas to the gas filter. Keep the tubing length as short as possible to minimize the pressure drop.

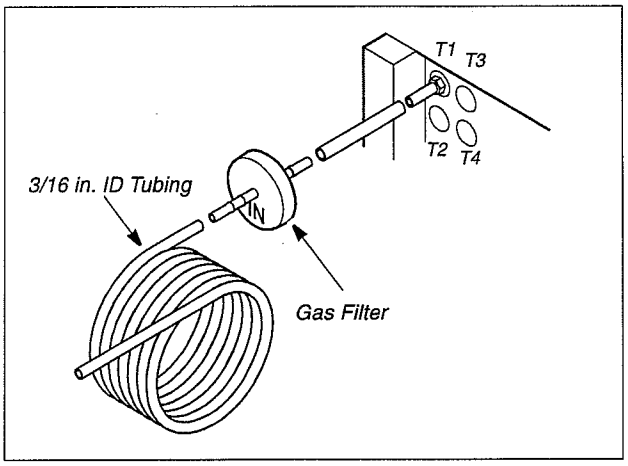


Figure 6. Gas Connections

6. Repeat steps 1-5 for the second gas connection. Note that stacked units require separate gas connections.

5.9 Set Up O_2 or N_2 Supply (Tri-Gas Units Only)

For tri-gas units, the gas you hook up at T3 and T4 depends on whether the ambient oxygen level is above or below the desired O_2 setpoint.

If the O_2 (oxygen) setpoint is ***greater than*** ambient, hook up O_2 supplies (enhancement mode).

If the O_2 setpoint is ***less than*** ambient, hook up N_2 (nitrogen) supplies (depletion mode).

In both case, hook up the gas connections in a similar way to the CO_2 connections described in Section 5.8. Use connections T3 and T4 as shown in Figure 6. The right connections to use will be shown in the display prompts.

WARNING! Never use oil to lubricate fittings used for O_2 connections. Oil easily combusts in the presence of high concentrations of oxygen.

When the gas supplies are properly connected and the supply is turned on, the display will automatically advance to the next prompt.

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5.10 Humidity Pan

Do not install the humidity pan during this special start-up procedure.

1. After you have entered the appropriate operating parameters and completed the initial start-up procedure, wait approximately eight hours for the cabinet temperature to stabilize.
2. Fill the humidity pan with cold water and place it in the bottom of the chamber (refer to Figure 7 on page 7); then press ▲. to continue.

Note: *To retard microorganism growth, you can use 0.25 ml of Roccal II or the equivalent (1:15,000 ratio) in the humidity pan. Do not use the water conditioning crystals. Test the Roccal II for effects on cell growth prior to applying to the humidity pan.*

3. After installing the humidity pan, wait another four hours for stabilization. Your incubator will then be ready to operate.

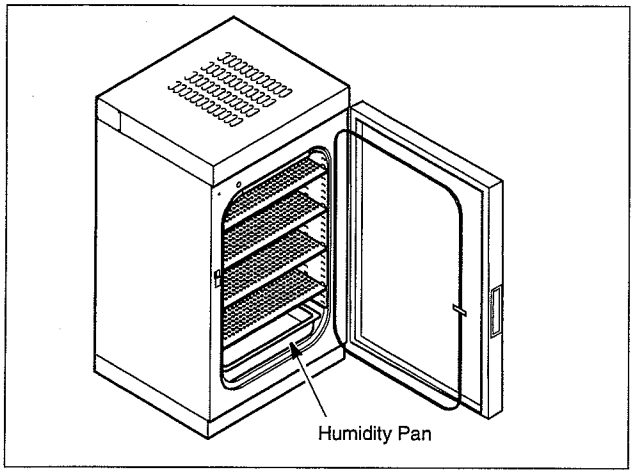


Figure 7. Humidity Pan

5.11 Setpoint Parameters

Once you have completed the previous installation steps, you will then be prompted to accept or adjust the values of several operating parameters. In each case, press the Increase or Decrease buttons to change a displayed value, press Mode when the displayed value is the one you want. The modifiable value is always the one that is flashing.

If you do not adjust a displayed parameter and 60 seconds elapse, the software will register the existing default value and move to the next parameter.

If you want to operate with all the factory-set defaults, press Mode repeatedly until you come to the end of the prompts.

The adjustable parameters are:

- Temperature (default 37°C)
- Warm alarm (default 40°C; cannot deviate from the temperature setpoint by less than 0.3°C)
- Cold alarm (default 34°C; cannot deviate from the temperature setpoint by less than 0.3°C)
- CO_2 setpoint (default 5%)
- High CO_2 alarm (default 6%; cannot deviate from the CO_2 setpoint by less than 1%)
- Low CO_2 alarm (default 4%; cannot deviate from the CO_2 setpoint by less than 1%)
- O_2 setpoint (tri-gas models only; default is typical atmospheric, 20.9%)
- High O_2 alarm (tri-gas models only; default 23.9%; cannot deviate from the O_2 setpoint by less than 1%)
- Low O_2 alarm (tri-gas models only; default 17.9%; cannot deviate from the O_2 setpoint by less than 1%)
- HEPA filter change reminder (in months, 1, 2, or 3)

When you have finished adjusting the parameters, the screen will return the normal display (shown on the next page). An additional message will indicate that the stabilization period has begun (normally 11 to 12 hours).

During this initial stabilization period, leave the door closed.

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6 Key Switch and Control Operation

6.1 Key Switch

To operate the incubator with alarms activated, be sure to turn the key switch all the way to the rightmost position (as shown in the figure below). To avoid nuisance alarms, work with the key switch in the "1" position during the set-up procedures described in Section 5.

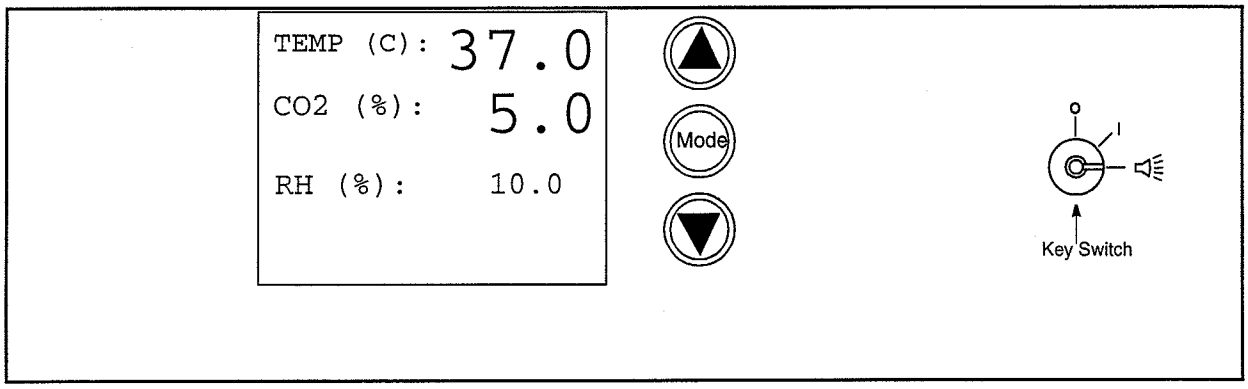


Figure 8. Control Panel, with RH display

6.2 Control Panel Features

The control panel is located on the top of your incubator.

Before loading and using your incubator, be sure to take some time to review the control panel functions.

The main display, during normal operation, shows: cabinet temperature in degrees Celsius, as measured by the sensor inside the cabinet; and percentage levels of carbon dioxide (CO_2) and relative humidity. When one or more of these fields flashes during normal operation, an alarm or error condition is indicated. Note that alarm conditions are displayed only when the key switch is turned to the alarm position.

When you are in programming mode (described in detail in Table 2) the main display changes to show the setpoint you are viewing and related alarm setpoints. For example:

```
Set Temp SETPOINT:

37.0C 40.2C 33.8C
```

Here the first value displayed is temperature setpoint; the next two values are the warm alarm and cold alarm setpoints. The flashing value is the one you can change using the increase and decrease buttons.

The Increase (Δ) and Decrease (∇) pushbuttons are used to change setpoint values in programming mode and for various display functions.

The Mode pushbutton is used: to silence an audible alarm; to enter programming and service modes; and in combination with the other buttons for various display functions.

For full descriptions of display, programming, and service functions, refer to Tables 1, 2, and 3.

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6.3 Display Functions

Table 1. Control Panel Display Functions

Function	Meaning	Sequence	Display
Normal operation	Default display while incubator is running	—	Display shows cabinet temperature, CO2, Relative Humidity, O2.
Cold excursion	Show coldest cabinet temperature since last startup or reset	Press ∇	Display shows cold excursion while button is pressed.
Warm excursion	Show warmest cabinet temperature since last startup or reset	Press Δ	Display shows warm excursion while button is pressed.
Mode	Silence audible alarm	Press Mode	Display shows current values, alarm or error field continues to flash.
Reset	Return to default display after excursion or alarm condition	Press Δ and ∇ simultaneously	Excursion values are reset; display shows current values. Display flashes twice
Water temperature	Show water temperature as measured by sensor in water jacket	Press ∇ and Mode simultaneously	Display shows water temperature.

6.4 Setpoint and Alarm Programming Functions

To enter programming mode, press Mode, and hold until the display indicates that you are changing to program mode. Pressing Mode repeatedly scrolls through the available functions. Whichever parameter you are currently changing, the display will automatically return to normal operating mode 30 seconds after the last key entry. You can also exit programming mode by scrolling through all available functions and parameters using the Mode button.

Table 2. Setpoint and Alarm Programming Functions

Function	Programming Sequence
Adjust temperature setpoint	Enter programming mode by pressing Mode and holding for 5 seconds. On release, the current temperature setpoint value flashes in the display; use ∇ and Δ to adjust it.
Adjust warm alarm setpoint	Press Mode again. The current warm alarm setpoint value then flashes in the display; use ∇ and Δ to adjust it. There is a minimum deviation of 0.3º C between each alarm setpoint and the temperature setpoint.
Adjust cold alarm setpoint	Press Mode again. The current cold alarm setpoint value then flashes in the display; use ∇ and Δ to adjust it. There is a minimum deviation of 0.3º C between each alarm setpoint and the temperature setpoint.
Adjust CO_2 setpoint	Press Mode again. The display changes to display CO_2 setpoint and high and low CO_2 alarm setpoints, with the operating CO_2 setpoint flashing. Use ∇ and Δ to adjust it. There is a minimum deviation of 1% between each alarm setpoint and the operating CO_2 setpoint.
Adjust CO_2 high alarm setpoint	Press Mode again. The current high CO_2 alarm setpoint then flashes; Use ∇ and Δ to adjust it. There is a minimum deviation of 1% between each alarm setpoint and the operating CO_2 setpoint.
Adjust CO_2 low alarm setpoint	Press Mode again. The current high CO_2 low setpoint then flashes; Use ∇ and Δ to adjust it. There is a minimum deviation of 1% between each alarm setpoint and the operating CO_2 setpoint.
Adjust O_2 setpoint (tri-gas only)	Press Mode again. The display changes to display O_2 setpoint and high and low O_2 alarm setpoints, with the operating O_2 setpoint flashing. Use ∇ and Δ to adjust it. There is a minimum deviation of 1% between each alarm setpoint and the operating O_2 setpoint.
Adjust O_2 high alarm setpoint (tri-gas only)	Press Mode again. The current high O_2 alarm setpoint then flashes; Use ∇ and Δ to adjust it. There is a minimum deviation of 1% between each alarm setpoint and the operating O_2 setpoint.
Adjust O_2 low alarm setpoint (tri-gas only)	Press Mode again. The current high O_2 low setpoint then flashes; Use ∇ and Δ to adjust it. There is a minimum deviation of 1% between each alarm setpoint and the operating O_2 setpoint.
Set Temp offset	Press Mode again. The display changes to display temperature offset (for calibration purposes). Use ∇ and Δ to adjust it.
Set CO_2 offset	Press Mode again. The display changes to display CO_2 offset (for calibration purposes). Use ∇ and Δ to adjust it.

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6.5 Service Mode Parameters

From programming mode, you can enter service mode by pressing Mode and holding for 5 seconds.Pressing Mode repeatedly scrolls through the available functions. For any modifiable parameter you can use ∇ and Δ to adjust the value. The display automatically returns to normal operating mode 30 seconds after the last key entry or after scrolling through all available functions and parameters.

Table 3. Service Parameters

Parameter	Notes
Network Adr	Network address (for RS485 applications). Default 238.
SN	Serial number.
Check Sum	Checksum to identify firmware version
Ambient Temp	Ambient temperature in ºC, as measured by a sensor in back of the cabinet.
Water Templ	Water jacket temperature in ºC.
Temp Offset	For temperature setpoint calibration; default 0ºC.
CO_2 Offset	For CO_2 setpoint calibration; default 0%.
O_2 Calibration	For O_2 setpoint calibration; default 0.

In service mode, data and bar graphs are also displayed showing power usage, for diagnostic purposes.

6.6 Restore Function

When the incubator is first powered up, you can restore all factory-set program parameter defaults as follows:

Function	Sequence	Notes
Restore program defaults	Press Δ and ∇ simultaneously, hold for five seconds	Restores original (factory-set) values of all program parameters; clears excursion values. This is useful for tracking recent excursions (for example, minimum and maximum operating temperatures within a one-day period).

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6.7 Alarm Summary

This section describes the alarm functions in detail.

Some important general notes:

- Alarms are activated only when the key switch is turned to the alarm position.
- Audible alarms may be silenced at any time by pressing MODE; in that case a full ringback (not a chirp) will occur in 15 minutes. When audible alarms are no active, the ringback condition will clear automatically. Note, however, that has-been alarms can still be active.
- 'Has-been' alarms (indicating past alarm conditions) may be cleared by pressing Δ and ∇ simultaneously. Be careful, however, because this action also clears temperature excursions: you may want to view excursions before clearing has-been displays.

The following table describes all alarm functions. Not all alarms are available on all units: for example, O_2 alarms are only relevant to tri-gas units.

Table 4. Incubator Alarm Functions

Alarm	Visual	Audible	Remote	Has-been	Hysteresis	Notes
Temperature Warm	x	x	x	x	0.2º C	
Temperature Cold	x	x	x	x	0.2º C	
CO_2 High	x	x	x	x	0.0%	
CO_2 Low	x	x	x	x	0.0%	Visual alarm is immediate but audible, remote, and has-been are delayed 15 minutes
O_2 High	x	x	x	x	0.0%	
O_2 Low	x	x	x	x	0.0%	Visual alarm is immediate but audible, remote, and has-been are delayed 15 minutes
RH High	x	x	x	x	0.0%	
RH Low	x	x	x	x	0.0%	Visual alarm is immediate but audible, remote, and has-been are delayed 30 minutes
Ambient Warm	x					
Ambient Cold	x					
Power Fail	x	x	x	x		If the key switch is not in the alarm position, the display will still be dimmed for backup battery conservation.
Add Water	x	x	x			Checked every 2 seconds and displayed every 4 seconds
HEPA Reminder	x					Will display for 18 hours, then clear automatically
Battery Low	x					Checked every 4th, 12th and 20th hour
Door Open	x	x	x			If the door is open for 3 minutes, mute will be interrupted
Tank 1 CO_2 Main	x	x	x			Audible and remote alarms active only when both tanks are empty, else visual only
Tank 2 CO_2 Backup	x	x	x			
Tank 3 O_2/N_2 Main	x	x	x			
Tank 4 O_2/N_2 Backup	x	x	x			

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6.8 Calibration (Optional)

6.8.1 CO_2 Measurement and Calibration

This method uses an instrument, such as the Fyrite, to read the actual CO_2% in the chamber. The display can be changed to agree with the measured reading. The factory standard method, using traceable gas standards, assures an accuracy of ±0.2%. The Fyrite instrument obtains ±0.5% accuracy.

To use the Fyrite for CO_2 concentration measurement, complete the following steps:

1. Wait at least 15 minutes after the CO_2 level arrives at setpoint before attempting any concentration measurement.
2. Make sure that the wick in the Fyrite sample tube is moist and make sure that the tubing is in good condition (no cracks or cuts).
3. Hold the Fyrite upright and away from your face. Depress the plunger valve briefly to vent the Fyrite and release the valve.

⚠ **WARNING!** Never depress the plunger valve when the Fyrite is in the inverted position. Doing so causes fluid, which is corrosive and contains poisonous elements, to spill. Refer to the MSDS sheet contained in the Fyrite instruction packet for additional information.

4. Invert the Fyrite, holding it at a slight angle to drain the fluid into the top reservoir.
5. Turn the Fyrite up to a 45 degree angle momentarily to allow fluid droplet drainage into the bottom reservoir.
6. Hold the Fyrite completely upright and away from your face. Depress the plunger valve briefly and release the valve.
7. Loosen the locknut at the rear of the scale. Slide the scale until the top of the fluid column lines up with zero on the scale. Tighten the locknut.

Note: *When setting zero, hold the Fyrite vertically and level with your eyes while sighting across the scale to the top of the fluid column. Use this same procedure for adjusting zero and reading percent CO_2.*

8. Remove the plug from the grommet in the glass door, and insert the open end of the tube through the opening in the grommet.
9. Holding the Fyrite in the upright position, place the sampling rubber connector tip over the plunger valve on the Fyrite. Purge the sample line by squeezing the aspirator bulb twice, then depress the plunger valve firmly with the connector tip. Squeeze and release the aspirator bulb *18* times. During the 18th squeeze and with bulb held deflated, release the connector tip and the plunger valve.

Note: *Always hold the Fyrite by the fins only to prevent warming of the Fyrite fluid during analysis.*

10. Invert the Fyrite until the fluid drains into the top reservoir, then turn the Fyrite upright to drain the fluid into the bottom reservoir. Repeat this step once.
11. Briefly hold the Fyrite at a 45 degree angle to allow the fluid to drain into the bottom reservoir.
12. Hold the Fyrite completely upright and immediately read the CO_2 percent on the scale at the point corresponding to the top of the fluid column.
13. Wait a few minutes, then repeat the entire procedure (steps 3 through 12) once to confirm the reading.

To offset the CO_2 % level, refer to the Service Parameters section (Section 6.5 on page 10).

6.8.2 Temperature Correlation

The factory standard method of temperature calibration uses instruments with an accuracy of ±0.1°C or better. To place an offset on the displayed reading to match any other calibrated temperature measuring instrument:

To offset the temperature, refer to the Service Parameters section (Section 6.5 on page 10).

6.9 Remote Alarm Connection

Terminal strips for remote alarms are located on the back of the control housing. The contacts are not powered from internal circuits. These terminals provide normally open or normally closed contacts for switching remotely powered alarms.

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7 Control Systems Theory

7.1 Temperature Control System

Laboratory CO_2 Incubators have a "jacket" between the incubator chamber and the exterior wall of the unit. In water-jacketed incubators, the jacket is filled with water.

Interior chamber temperature control is maintained by two sensors. One sensor is located in the jacket and the other sensor is located in the chamber air. Both sensors constantly signal the electronic circuitry. The chamber air provides a reference point while the jacket is being controlled. This circuitry recognizes that jacket temperature is very slow to react to any change in either ambient or chamber temperature but the chamber temperature can change very rapidly due to door opening.

For example:

The chamber inner door is opened. The chamber air sensor immediately signals a large drop in temperature but the control recognizes that, unless there is a corresponding (smaller) drop in jacket temperature, there is no need to increase the heat. The system does nothing until sufficient time passes to measure how fast the chamber air temperature is rising to meet the jacket temperature after the door is closed. Heat is applied to the jacket in short bursts. The rate of heat application changes as the circuit monitors the two sensors. This control scheme is extremely accurate and stable, with the ability to control within ±0.2°C of the setpoint.

7.2 Overtemperature Monitoring System

This system is activated anytime the chamber air sensor detects a temperature above the overtemperature setpoint, which should be set no closer than 0.3°C above the chamber temperature. When the system is activated, the jacket heater is turned off and both audio and visual alarms are activated. Control is now effectively switched to the overtemperature monitoring system. The overtemperature sensor is the chamber air sensor which also provides the signal for the digital display on the control panel.

7.3 Door Heat System

Heating the inner surface of the outer door with a low wattage, large area heater provides enough radiant heat to the glass door to control condensation. The micro-processor control operates the door heater.

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8 Maintenance

8.1 Cleaning

The incubator can be easily cleaned and disinfected in about 30 minutes.

Be sure to use an appropriate disinfectant solution: Roccal II; its Lysol equivalent, 5 milliliters per liter; or O-Syl in a one percent solution. ***You should always dilute disinfectants with sterile, distilled water.***

⚠ **CAUTION! Before using any cleaning or decontamination method except for those recommended in this manual, contact Technical Service to verify that you will not damage the equipment.**

⚠ **CAUTION! Do not use strong alkaline or caustic agents, which can cause corrosion, rust and pitting of stainless steel surfaces. Stainless steel is corrosion-resistant but not corrosion-proof.**

⚠ **CAUTION! Do not use sodium hypochlorite solutions such as Purex and Clorox. These can also cause corrosion and pitting of stainless steel.**

⚠ **CAUTION! Do not use steel wool pads such as Brillo; they deposit carbon particles in the chamber.**

When cleaning stainless steel, use the mildest cleaning procedure that will do the job effectively. To avoid marring the surface, always rub in the direction of the finish polish lines.

Do not use aromatic solvents to clean the cabinet interior: residues could cause contamination of the cabinet environment.

To clean and disinfect your incubator:

1. Remove the shelves, support walls and pans.
2. Clean all interior surfaces with the disinfectant solution using a clean sponge.
3. Rinse the interior surfaces at least twice with sterile distilled water.
4. Clean the inner door gasket thoroughly.
5. Clean the inside of the glass door with the disinfectant solution, then rinse twice with sterile distilled water.
6. Clean the shelves, support walls and pans with disinfectant and rinse thoroughly with sterile distilled water.
7. Wipe down all disinfected surfaces with an alcohol solution.

⚠ **CAUTION! Alcohol is volatile and flammable. Use only in a well-ventilated area removed from open flames and other heat sources. Allow sufficient time for fumes to dissipate before using cleaned components.**

8.2 CO_2 Filter Replacement

To replace the CO_2 Filter:

1. Turn the main power switch to OFF.
2. Turn the gas supply (or supplies) to OFF.
3. Remove the tubing from both ends of the gas filter.
4. Note the flow direction on the filter. The side marked IN points to the gas supply. Install the new filter onto the tubing connected to the incubator and the tubing connected to the gas supply (refer to Section 4.4 on page 3 and Figure 6 on page 6).
5. Turn the gas supply (or supplies) to ON.
6. Turn the main power switch to ON.

8.3 Draining the Water Jacket

A drain valve is located on the bottom left side of the unit. To drain the water jacket:

1. Turn the main power switch to OFF.
2. Run a flexible plastic drain line to the nearest floor drain or a large container.

Note: *The jacket holds approximately 10 gallons of water. Make sure that the floor drain or container can accommodate that amount of water.*

⚠ **CAUTION! Water will rush out of the incubator rapidly. Make sure that one end of the drain line is located in a floor drain or large container before connecting the other end of the drain line to the drain fitting.**

3. Attach the drain line to the water drain fitting on the lower front of the incubator; this allows the jacket to drain.
4. Open the valve.

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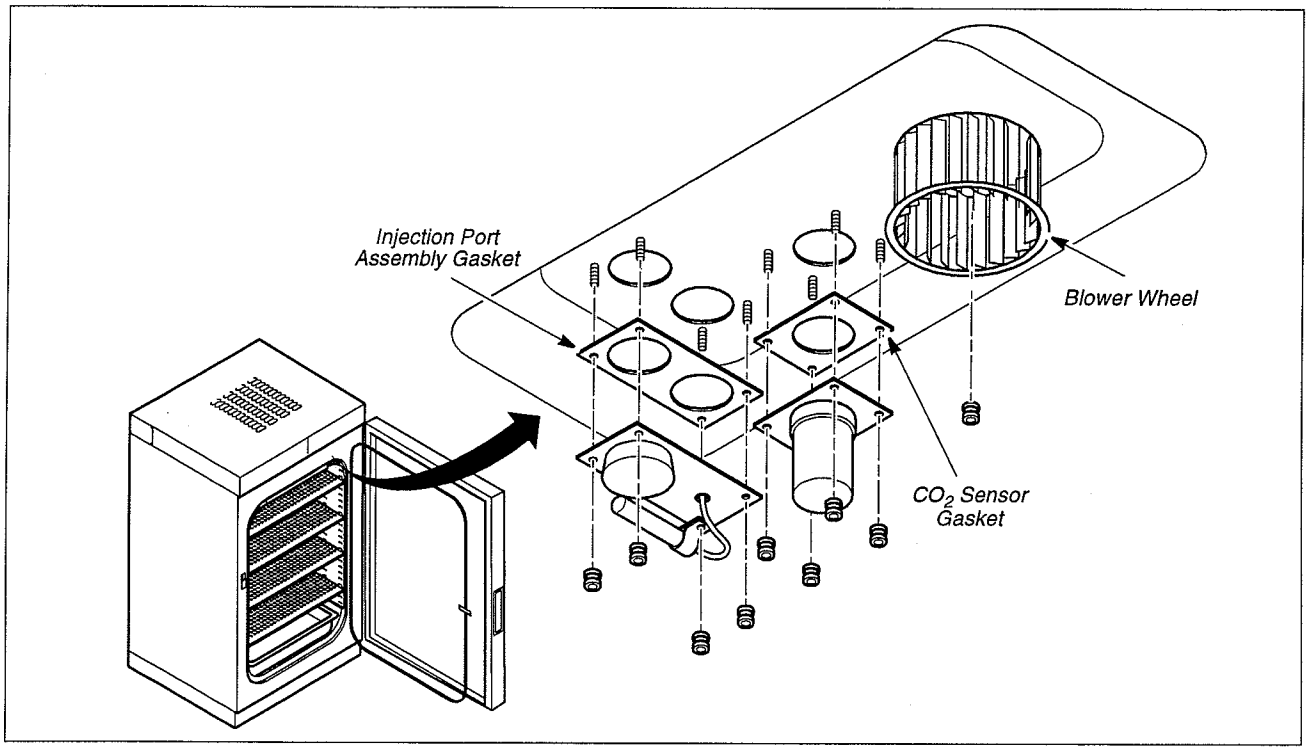


Figure 9. Top Duct Components

8.4 Decontamination Kit

The decontamination kit provided with your incubator includes:

- a replacement blower wheel
- a CO_2 Sensor gasket
- and Injection Port Assembly gaskets.

To install replacement components (shown in Figure 9):

1. Turn off the main power supply by unplugging the service cord.
2. Turn the gas supply (or supplies) to OFF.
3. Remove the shelves and shelf brackets.
4. Tilt one duct wall toward the center of the incubator until it disengages from the top duct.

⚠ **CAUTION!** The top duct will drop down when the side wall is disengaged.

5. Remove the duct wall, the top duct, and the other duct wall.
6. Remove the blower wheel by carefully pulling firmly in a downward direction until the wheel slides off the motor shaft.
7. .Replace the blower wheel with the one provided in the decontamination kit. Make sure that the blower wheel spins freely and does not come into contact with the motor mounting screws.
8. Carefully remove the thumbnuts from the sensor and injection plates, allowing to hang freely from the ceiling of the incubator. Remove one plate at a time.
9. Carefully disconnect the wiring connectors or tubing from the plates.
10. Remove and discard the gaskets and replace them with the ones provided in the decontamination kit.
11. Replace the plates.
12. Reinstall the shelves and shelf supports.
13. Turn the main power switch to ON.

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8.5 Fuses

The fuses used in this incubator are located on the power supply board and should only be replaced by a qualified technician.

The F1 and F2 fuses are Type "T", rated at 120V/6A or 230VAC/3A.

The F3 and F4 fuses are Type "T", rated at 120V/500mA or 230VAC/300mA.

Refer to the Replacement Parts List on page 19 for service part numbers.

8.6 Door Seal Check

To check the door seal, complete the following steps:

1. Open the inner glass door.
2. Insert a strip of paper (a couple of inches wide) between the door gasket and the cabinet flange and close the door.
3. Slowly pull the paper strip from the outside. You should feel some resistance.
4. Repeat this test at 4 inch (10 cm) intervals around the door. If the door does not seal properly, call your Technical Service representative: the gasket needs to be adjusted or replaced.

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9 Troubleshooting

WARNING! Troubleshooting procedures involve working with high voltages which can cause injury or death. Troubleshooting should only be performed by trained personnel.

Table 5. Troubleshooting Procedures

Symptom	Solution
General	
No display on control panel.	No power: • The service cord is loose in the outlet. • Check the outlet for power. • Check the circuit breaker in the power panel. Make sure the circuit serving the incubator is a dedicated circuit. Reset the circuit breaker. • Check that the main power switch on the incubator is turned on.
Water leaking from the cabinet.	Water jacket is overfilled: • Visually check the water level. • Drain some water from the water jacket.
Temperature display disagrees with setpoint.	• Check the jacket water level. The water must be up to the fill port. • Allow sufficient time for stabilization. . • Make sure door was not recently opened. If door was opened, allow stabilization time. • Make sure power did not fail recently. If power failed, allow stabilization time after power is restored.
High temperature alarm flashes.	• Check the incubator location. • Do not open the door more frequently than at five minute intervals. Set the operating temperature setpoint at least 5°C above the maximum ambient temperature.
Oxidation forming on interior surfaces.	• Do not wipe surfaces with a Clorox solution greater than 10%. • Always wipe surfaces with a mild detergent and water to remove Clorox residue. • Never use a Brillo pad on interior surfaces. Use a non-metallic pad (e.g., Scotch-brite). • Corrosive culture medias can cause oxidation.
Add-Water indicator is illuminated and alarm is sounding.	• Do not fill the incubator with de-ionized water. Use tap or distilled water. • Check the floor for evidence of a leak. • Make sure the incubator is level. . • Check that water is visible at the weep hole. If not, add water
Condensation	
Humidity is too low.	• Close the glass door for at least 30 minutes. • Make sure that the humidity pan is stainless steel, has at least 150 square inches of water surface area, and more than one inch of water depth. • Check the water level in the humidity pan. . • Check the jacket water level. • Make sure the glass door seals properly. Use the outer door seal procedure to check the inner door seal
Too much condensation on glass door.	• Outer door gasket is not sealing properly or is damaged. • Make sure that the humidity pan cover is in place.
Condensation on inside of outer door.	• Door seal is not tight.
Condensation on interior walls/ceiling.	• Check the water level. • Make sure the incubator is level. • Check the incubator location. • Make sure the glass door seals properly. Use the outer door seal procedure to check the inner door seal. • Make sure that the humidity pan cover is in place.
Temperature Control	
Temperature display is drifting.	• Check the incubator location.
Inside temperature is not equal to the display temperature.	• Verify the calibration procedure. • Check the incubator location.
Temperature not controlling at setpoint.	• Close the doors for a minimum of 30 to 40 minutes. • Check the setpoint..
Temperature is over-shooting during the day.	• Do not open the door more frequently than at five minute intervals. • Check the incubator location.

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Symptom	Solution
CO_2 Gas Control	
CO_2 display indicates more than 0.2 above setpoint.	• Check the setpoint. • .Check the incubator location.
CO_2 display indicates more than 0.2 below setpoint.	• Check the setpoint. • Check the CO_2 gas supply. • Replace the gas input filter. • Check the gas tubing for dirt and replace if necessary.
CO_2 recovery takes too long.	• Make sure a gas supply filter is installed. • Replace the gas input filter. . • Check the gas tubing for dirt and replace if necessary.
CO_2 display is drifting.	• Close the glass door for at least ten minutes. • Check the CO_2 gas supply.
CO_2 concentration measurement does not equal the display.	• Check the setpoint. • Verify Fyrite analyzer operation.
CO_2 concentration (as measured by a gas analyzer) is less than the setpoint.	• The gas pressure regulator is set too low. • The door seal is not tight. • The gas setpoint is incorrect. • CO_2 concentration measured too soon after door closing. • Make sure power did not fail recently. If power failed, allow stabilization time after power is restored.
CO_2 concentration (as measured by a gas analyzer) is greater than the setpoint.	• The gas percentage is incorrectly set. • The CO_2 injection solenoid is stuck open.
CO_2 setpoint and display agree. Fyrite analyzer reads lower.	• Fyrite not zeroed. Check the Fyrite Operation manual • Wool filter in Fyrite is dry. • Fluid in Fyrite needs to be changed. • Chamber absolute humidity has decreased.
CO_2 setpoint and display agree. Fyrite analyzer reads higher.	• Fyrite not zeroed. • Chamber absolute humidity has increased. • CO_2 control is incorrectly zeroed.
CO_2 alarm and light are activated. Can be silenced.	• CO_2 level has deviated more than one percent from setpoint. • CO_2 supply has been interrupted.
Digital CO_2 display and Fyrite read more than one percent different from setpoint. CO_2 alarm is not activated.	• Defective alarm. • Defective alarm circuit. • Defective CO_2 sensor or control.
Digital CO_2 display and Fyrite read 0% CO_2. Setpoint is okay. CO_2 alarm and light are activated. CO_2 inject light is on.	• Loss of CO_2 supply. • Defective CO_2 solenoid. • Blocked CO_2 inline filter.
Digital CO_2 display locks up. Shows some random number or a decimal point.	• Defective display board. • Defective output to display board. • Faulty interconnect wiring.
Digital CO_2 display will not go to zero no matter how long the inner door is left open.	• Defective CO_2 sensor. • Defective CO_2 control.
Display flickers badly or counts up or down three or four tenths of a percent.	• Defective display board. • Excessive RFI or EMI near cabinet.
CO_2 setpoint cannot be changed.	• Defective setpoint potentiometer. • Defective CO_2 control. • Defective CO_2 sensor.
Unit cannot be zeroed.	• Defective CO_2 zero potentiometer. • Defective CO_2 sensor.
CO_2 overshoots badly.	• Defective air circulator. • CO_2 control defective. • CO_2 inlet pressure is too high. • CO_2 solenoid valve is stuck.
CO_2 recovers extremely slowly.	• Plugged orifice in CO_2 solenoid valve. • Inline CO_2 filter is partially blocked. • Leak around the sensor gasket. • Leak around the port cover gasket. • CO_2 inlet pressure is too low. • Blockage in the CO_2 injection line.

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Symptom	Solution
Actual CO_2 is higher than the setpoint and display. Re-zeroing helps, but the symptom returns.	• Defective CO_2 sensor. • Incorrect calibration of CO_2 control.
CO_2 alarm sounds while CO_2 level is controlling at setpoint.	• Excessive EFI or EMI near cabinet. • Faulty grounding circuit. • Defective CO_2 control.
CO_2 setpoint changes by itself.	• Defective setpoint potentiometer. • Defective CO_2 control. • EMI or RFI.

10 Replacement Parts

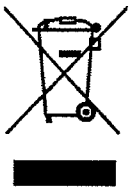
Part Number	Description	UM	Quantity
21487H01	Motor, Fan 110/120V 50/60Hz	ea	1
33862G02	Valve, Inject Assembly	ea	1
305819H01	Gasket, Outer Door, 3.3 cu.ft. models	ea	1
305597H01	Gasket, Outer Door, 5.8 cu.ft. models	ea	1
311921H02	Glass, Inner Door, 3.3 cu.ft. models	ea	1
311921H01	Glass, Inner Door, 5.8 cu.ft. models	ea	1
29323H01	Gasket, Inject/Sensor Plate	ea	1
305673H01	Hinge, Glass Door	ea	1
311789G03	Outer Door Assembly, 3.3 cu.ft. models (120V)	ea	1
311789G04	Outer Door Assembly, 5.8 cu.ft. models (230V)	ea	1
305172H01	Board, Display	ea	1
302268H01	Board, Power	ea	1
31727G01	Rust Inhibitor Water Conditioner	ea	1
39588G01	Gas Sensor Assembly	ea	1
302079H01	RTD Sensor with Cable - Water jacket	ea	1
302079H02	RTD Sensor with Cable - Display	ea	1
38747H01	Foot, Leveling	ea	4
311923H01	Latch Assembly, Glass Door	ea	1
305860H02	Heater, Door 120V 25W 50Hz/60Hz, 3.3 cu.ft. model	ea	1
305860H01	Heater, Door 120V 25W 50Hz/60Hz, 5.8 cu.ft. model	ea	1
86832H01	Wheel, Blower #250X125C181C1	ea	1
86836H01	Gasket, Sensor CO_2 Inc	ea	1
86961H01	Receptacle, Snap-in 125V Eagle #49BK	ea	1
87333H01	3/16 in. ID and 5/16 in. OD Clear Tubing	ft	as req'd
88653H01	Washer, Lock Ext Tooth #6 SS	ea	1
88673H03	Gasket, Continuous Inner Door	ft	8
303308H01	Fuse, Type T, 230V@3A, power board F1	ea	1
303308H02	Fuse, Type T, 120V@6A, power board F2	ea	1
309327H01	Fuse, Type T, 230V@300mA, power board F3	ea	1
309327H02	Fuse, Type T, 120V@500mA, power board F4	ea	1
60678H03	Battery, 12V sealed lead acid	ea	1

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Deutschland



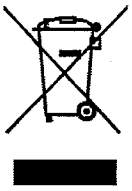
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