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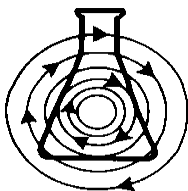
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Guide to Operations

Innova[®] CO-48 Personal Size CO₂ Incubator

MANUAL NO: M1300-0050
Revision A
June 1, 2004



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**CAUTION!**

This equipment *must* be operated as described in this manual. If operational guidelines are not followed, equipment damage and personal injury *can* occur. Please read the entire User's Guide before attempting to use this unit.

Do not use this equipment in a hazardous atmosphere or with hazardous materials for which the equipment was not designed.

New Brunswick Scientific Co., Inc. (NBS) is not responsible for any damage to this equipment that may result from the use of an accessory not manufactured by NBS.

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New Brunswick Scientific Co., Inc. reserves the right to change information in this document without notice. Updates to information in this document reflect our commitment to continuing product development and improvement.

Manual Conventions



NOTE:

Notes contain essential information that deserves special attention.



CAUTION!

Caution messages appear before procedures which, if caution is not observed, could result in damage to the equipment.



WARNING!

Warning messages alert you to specific procedures or practices which, if not followed correctly, could result in serious personal injury.

Bold

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1 INTRODUCTION

The Innova CO-48 CO₂ incubator is microprocessor controlled and designed to ensure accurate and reliable operation. The unit incorporates a large, back-lit LCD display, touch-sensitive keypad and sophisticated control system that allows for easy programming, control and monitoring of the chamber conditions. The display also provides for graphical viewing of system data, on-screen messaging and help files to simplify operation and maintenance.

A direct heating system, utilizing a thermal heating element, completely surrounds the incubator, providing an even temperature within the seamless chamber. The independently and directly heated outer door is designed to ensure an even distribution of heat, thereby eliminating condensation on the inner door. This system ensures a rapid, controlled return to optimum chamber conditions after a door opening while also preventing any overshoot. The incubator's direct heat system provides for optimal use of laboratory space by allowing the most efficient internal volume for the footprint of the instrument. A viewing window within the door allows for sample viewing without disturbing chamber conditions.

A solid-state infrared sensor is used to control the level of CO₂, providing excellent reliability and remaining unaffected by humidity. The CO₂ system has a programmable automatic zero system (AutoZero) to re-reference the sensor baseline to atmospheric CO₂ levels at regular intervals. A small pump supplies HEPA-filtered atmospheric gas to the sensor. The chamber atmosphere within the sensor is completely displaced, allowing the control system to automatically reference the sensor, after which the pump is switched off, allowing the chamber atmosphere to homogenize back into the sensor. This provides for accurate CO₂ control without disturbing the chamber environment.

A purpose-designed humidity control system allows a high uniform relative humidity and prevents undesirable condensation in other parts of the chamber. The manual control system allows limited adjustment over an approximate range of 95 - 97% RH.

The seamless 48-liter chamber and all internal components are manufactured from polished stainless steel. The shelves (which are non-tip), shelf racks and humidity tray are easily removed without tools for thorough cleaning and are capable of being sterilized. Air circulation is achieved without the use of a fan, eliminating ductwork (a potential source of contamination), simplifying cleaning, eliminating vibration, and reducing small sample evaporation within the chamber. The outer shell of the incubator is manufactured from zinc-plated stove enamelled steel to give a durable corrosion-resistant finish.

The incubator incorporates a two-level alarm system. The chamber-monitoring alarms are programmable and will alert you if temperature or CO₂ have not recovered within a preset time after the door has been opened. If it is not required, this system can be disarmed. The system alarms occur only if a system component problem has developed that requires user intervention to rectify. The incubator also incorporates an over-temperature safety system that operates independently from the main control system.

The incubator features multiple options that can be installed to simplify maintenance and provide superior control over experimental conditions. For example, high-temperature decontamination quickly and conveniently decontaminates the unit's chamber at 120°C, without the need to remove interior components or the CO₂ sensor. A humidity tray warning system warns the user before the humidity tray runs out of water, preventing dehydration of samples. Oxygen control (tri-gas) provides for conditions that require above- or below-ambient oxygen levels. These and other options and accessories provide for a uniquely flexible CO₂ incubator capable of meeting the most demanding requirements.

2 UNPACKING & INSTALLATION

2.1 Inspection of Boxes

After you have received your order from New Brunswick Scientific, inspect the boxes carefully for any damage that may have occurred during shipping. Report any damage to the carrier and to your local NBS Sales Order Department or distributor immediately.

2.2 Unpacking



WARNING!
At least two people are required for to safely lift your CO-48.

Disassemble the wooden shipping crate and remove the protective packing. Save the packing materials for possible future use, and be sure to save this User's Guide for instruction and reference.

To simplify lifting the incubator, leave it on the pallet. You must have at least one person *at either side* to safely lift the unit. *Supported by the base only*, remove the incubator by lifting it from the delivery pallet.

Locate and remove the parts stored in the Humidity Tray.

If any part of your order was damaged during shipping, is missing, or fails to operate, please fill out Customer Satisfaction Form 6300 (packed in the envelope with your warranty card) and return it by fax or mail. You can also call New Brunswick Scientific's or your distributor's service department.

Using your NBS packing list, verify that you have received the correct materials and that nothing is missing.

Table 1 on the following page outlines the accessory items that are supplied with your new incubator:

Table 1: Accessories Provided

Quantity	Item	Notes
3	Non-tip Shelves	Packed Separately
2	Wire Shelf Racks	Packed Separately
14	Silicone Rubber Suction Feet	Packed in Humidity Tray
1	Humidity Tray	Packed Separately
1	White porous CO ₂ Sensor Cover	Installed
1	Black Sensor Cover*	Installed
1	Power Cord	Packed in Humidity Tray
3 meters, 9.8 feet	PVC Tubing, ~1/4-inch or 6mm bore, with an inline CO ₂ HEPA-filter connected, ready for use	Packed in Humidity Tray
2	Hose Clips	Packed in Humidity Tray
1	AutoZero HEPA Filter	Packed in Humidity Tray
4	Adjustable Feet	Packed in Humidity Tray
4	Anti-slip Pads for adjustable feet	Packed in Humidity Tray
1	User Manual	Provided

* There is a holder at the rear of the unit to store the black sensor cover.

2.3 Utilities

In order to use the incubator, you will need:

Table 2: Utilities

Utility	Requirement
Electricity	100/120V, 50/60 Hz grounded electrical supply with minimum capacity of 6 amps (or 8 amps for High Temperature Decontamination Models)
	OR
	220/240V, 50 Hz grounded electrical supply with minimum capacity of 3 amps (or 5 amps for High Temperature Decontamination Models)
CO ₂ Gas	Cylinder with 100% CO ₂ vapor withdrawal, together with a two-stage regulator for pressure control to 5 psi or 0.35 bar

2.4 Location

The incubator is designed to operate at a chamber temperature of 1.0°C above ambient, and at an absolute minimum ambient temperature of 15°C if the unit is being used at 37°C. *Care should be taken to avoid placing the incubator in a position that may affect its performance, such as those listed below.*

DO NOT place the incubator:

- **Directly under, beside or within the air-flow of heating or air-conditioning ducts, or other drafts;**
- **Directly beside heat-generating equipment such as a heater, an autoclave or an oven;**
- **Near the exhaust of heat- or cold-generating equipment (like a –86°C freezer);**
- **Near a window exposed to direct, unshaded sunlight.**

Place the incubator in the working position, on a level surface capable of bearing its weight of approximately 70.5 lbs/32 kg (actual use weight will be heavier and will depend on the options installed and the material stored in the incubator).

The incubator is not designed to be directly stackable. A second incubator may be safely stacked on top of another identical incubator by using the custom-designed stacking stand available as an accessory for the Innova CO-48. It is not possible to put any other type of incubator or heavy apparatus on top, as the top cover and stacking stand were not designed to support any other device.

2.5 Installing the Feet

To ensure adequate airflow for correct operation of the relative humidity control system the incubator feet *must* be installed. *More than one person is required* to perform this operation.

To insert the adjustable feet:

1. If they are not already installed, install the locking nuts onto each of the four feet provided.
2. Beginning with the front pair: tilt the incubator toward the back, and screw the feet in, to the required depth.
3. Tilt the incubator forward to install the rear pair of feet.
4. Put an anti-slip pad (provided) on each foot.

2.6 Setting Up

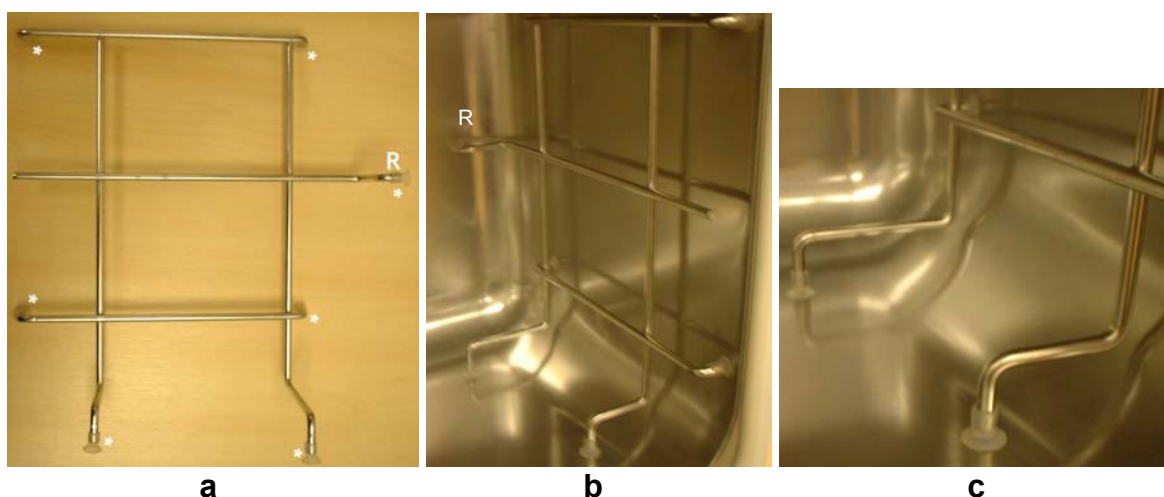
Install the power cord:

1. Insert the power cord into its receptacle on the back on the unit.
2. Press the cord firmly into its socket.

Install the shelf racks and shelves, and level the incubator:

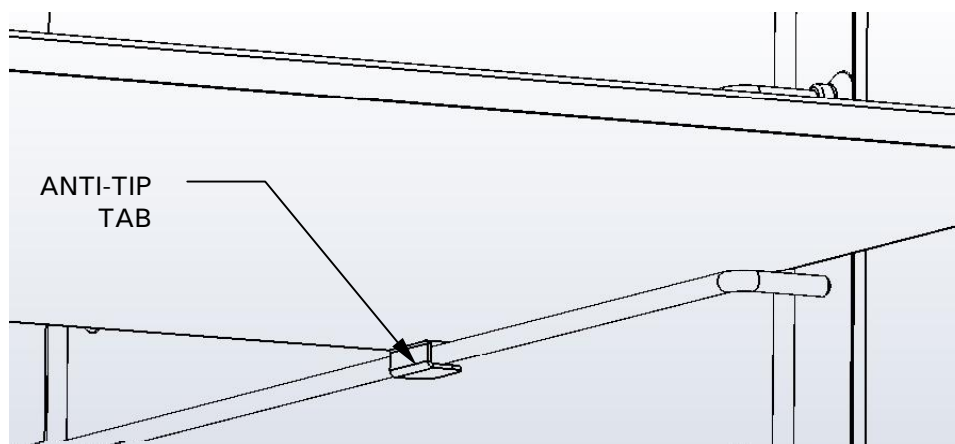
1. Each wire shelf rack has silicone suction cups that hold the rack in place. Install the silicone suction cups onto the wire rack supports (7 per rack, each marked with an asterisk in *Figure 1a* below).
2. Note that there are lefthand and righthand racks. The suction cup marked **R** (“Rear”) goes to the rear of the chamber as shown in *Figure 1b* below. The suction cups will adhere to the chamber walls even if they are dry; but if you feel it is necessary, you can dampen them with distilled water to increase adhesion.
3. Ensure the shelf racks are installed squarely in the chamber so the shelves will sit on a level plane (see *Figure 1c* below).

Figure 1: Installing Shelf Racks



4. Install the three shelves, making sure that each shelf’s anti-tip tab is properly inserted onto each of the wire shelf rack guides (see *Figure 2* below).

Figure 2: Installing Shelves

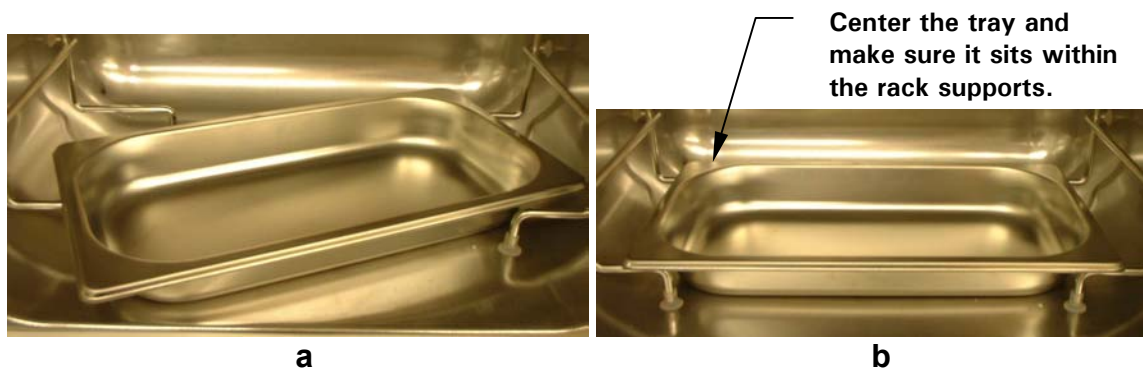


5. Level the incubator by adjusting the feet. Place a small level on the second shelf of the incubator. Adjust the leveling feet until the incubator is level and stable. Lock the leveling legs in place by tightening the locking nuts on each leg.

Install the humidity tray:

1. Install the humidity tray in its location beneath the lowest shelf rack position: insert the tray diagonally (*see Figure 3a*), then turn the tray 45° as shown, until you can set it in position, resting on the chamber floor, with its front and rear edges resting just above the shelf rack supports (*see Figure 3b*).

Figure 3: Installing/Removing the Humidity Tray



Connect the CO₂ gas supply:

1. Connect the unit to the CO₂ supply using the ~1/4-inch or 6mm plastic tubing (with installed HEPA filter) by attaching the tubing from the two-stage regulator (or in-line regulator) to the matching CO₂ inlet on the rear of the incubator.
2. Use the tubing clips provided to eliminate CO₂ leaks.

Install the HEPA AutoZero filter:

1. Press the AutoZero HEPA filter gently into the white plastic filter socket at the top of the rear panel of the incubator (*see Figure 4 on the following page*).

Figure 4: AutoZero HEPA Filter & Fitting



3 OPERATION

3.1 Control Panel

The control panel consists of an LCD display, five function keys & four direction keys (see Figure 5):

Figure 5: Control Panel



The illustration above shows the screen in normal operation, and this is how the screen should look when you switch the incubator on.

The purpose of each Function Key is identified at the bottom of the display (above each key); the function may change from screen to screen.

The cluster of four arrowed Direction Keys will move the cursor around the screen and adjust values.

The **HELP** file contains most of the information in this User Manual, together with more detailed troubleshooting information.

3.2 Preparing for Operation

1. Remove the black protective cover from the CO₂ sensor (located on the back surface of the internal chamber), and store it for use when you clean the incubator. There is a storage holder for the cover on the back on the unit.
2. Ensure that the white porous sensor cover remains in place.
3. Using the power cord provided, connect the incubator to a grounded power supply.

4. Switch the incubator ON using the on/off switch at the rear of the cabinet. The display will illuminate immediately.
5. Turn on the CO₂ gas supply with the pressure regulator set to 5 psi or 0.35 bar.

**NOTE:**

Be certain to check for leaks in the CO₂ connections to avoid depleting your CO₂ gas supply. This can be accomplished using a solution of soapy water applied to each fitting and checking for bubbles. If any bubbles are noted, readjust the fitting.

6. The chamber setpoints are pre-programmed at 37.0°C and 5% CO₂. Leave the incubator on until the programmed chamber temperature and CO₂ concentration has been reached (*please see NOTE below*).

**NOTE:**

The incubator's CO₂ valve is disabled until the incubator reaches the temperature setpoint. After reaching the temperature setpoint, the CO₂ valve is activated, allowing the unit to reach the CO₂ setpoint. If power is interrupted to the incubator long enough for the temperature to drop below setpoint, the CO₂ valve will be deactivated until setpoint is again achieved. (*This serves to avoid spurious CO₂ readings while the incubator is reaching its temperature setpoint*)

7. Leave the incubator running for at least two hours (preferably overnight) to allow conditions to stabilize.

3.3 Using the Humidity Tray & Humidity Control

If humidification is required, the humidity tray should be filled with 0.5 liters of warm (~ 37.0°C) distilled water at this time.

For cell culture work, we recommend the use of copper sulphate (or a recognized biocide) in the humidity tray. Tests have shown that, in addition to inhibiting bacterial growth in the tray, this can reduce contamination on the chamber walls. Add one small teaspoonful (~0.11 oz or 3.2 g) of copper sulphate each time you fill the tray with fresh water.

For IVF and other sensitive work, we do **not** recommend the use of any biocide in the humidity tray. To reduce the possibility of contamination, every 10 to 14 days, empty the tray, clean it with a solution of 70% isopropyl alcohol and 30% distilled water, and then refill it with 0.5 liters of warm distilled water.

To remove the humidity tray, turn it 45° to clear the shelf rack supports (*see Figure 3a*).

**CAUTION!**

Never leave water in the humidity tray while the incubator is switched off, or when a high temperature decontamination cycle is initiated, to avoid possible damage to the CO₂ sensor.

The humidity level within the chamber can be manually adjusted from ~95% to ~97%. The controller to adjust the humidity level is found on the lower, front right side of the instrument. The black adjustment knob can be rotated clockwise for standard (~95%) humidity levels, and counter-clockwise to increase the humidity level.

**NOTE:**

The humidity tray should always be left in place, even if the incubator is not being humidified.

3.4 Programming

3.4.1 Temperature and CO₂ Level

To set the desired operating temperature and CO₂ level:

1. Press the **PROG** function key (*see Figure 5, left-most menu button*):
2. In the **PROG** screen that appears, press the desired function key, **TEMP** or **CO₂**, then use the ◀ & ▶ direction keys to adjust the value.

**NOTE:**

If the incubator is supplied with the option of oxygen control, the setpoint for the oxygen level can be selected and changed like the temperature and CO₂ setpoints.

3. When the desired setpoint is displayed, press the **ENTER** function key.
4. If you have made adjustments, allow the incubator to stabilize at the setpoints before continuing. (See important **NOTE** on the following page.)

**NOTE:**

If a temperature $>1^{\circ}\text{C}$ below the actual chamber temperature is set, the independent over-temperature system will activate. This is indicated by a warning message on the display. When the chamber cools down, normal operation will resume. Programming a higher temperature can also deactivate the warning.

3.4.2 User Access Code

A **USER ACCESS CODE** is programmable, if required. The User Access Code allows you to restrict access to the **PROG**, **USER**, and **ALARM** screens (where settings can be changed) to authorized persons only.

To set the User Access Code:

1. In the **PROG** screen (accessed by pressing the **PROG** function key), the user access code will be displayed as a series of four asterisks.
2. Use the left and right direction keys to move to each code position, and the up and down direction keys to select a number from 0 to 9.
3. Once the number is selected, press the **ENTER** function key to save the code.
4. After returning to the main screen, programming access will require the code to make any further programming changes.

To cancel the access code:

1. In the **PROG** screen, enter the current access code.
2. Now program **0000** as the new access code.
3. Press the **ENTER** function key to save the change.
4. The code is now cancelled and programming is no longer restricted.

**NOTE:**

If the access code has been misplaced, you will be unable to make changes to your incubator's settings. Contact customer service or your service representative for instructions on how to regain access to your incubator.

3.5 Referencing CO₂ Sensor with AutoZero

Prior to using the incubator, you should manually perform a CO₂ AutoZero (see Section 3.6.3 for an explanation of this feature):

1. Perform a CO₂ AutoZero by pressing the **USER** function key (see Figure 5), selecting the **PROGRAMMABLE CO2 AUTOZERO**, and pressing the **START** key.
2. The unit will display a countdown as the AutoZero is running.
3. When the countdown is complete, the unit is ready to use.



NOTE:

It may be necessary to open the door momentarily if, after performing an AutoZero, the CO₂ level is too high.

3.6 USER Settings

In the **USER** screen (see Figure 6), you can adjust the features called out on the screen.

There are other **USER** options that may be displayed on this screen if they are installed on your incubator. See Section 7.1 for a list of options.

Figure 6: USER SETTINGS Screen



This section explains each of the **USER** screen features.

3.6.1 DATE/TIME ADJUST

The date and time are factory-set and will only require adjustment if you are in a different time zone, or when you change your clocks to Daylight Saving Time and back again to Standard time. You may also select the style of display for the date.

A battery back-up system ensures that the correct time/date setting is never lost.

3.6.2 AUDIO VOLUME ADJUST

The audible volume can be adjusted to your own preferences.

3.6.3 PROGRAMMABLE CO₂ AUTOZERO

When you select this feature, the **PROGRAM CO₂ AUTOZERO** screen (*see Figure 7 below*) allows you to program the AutoZero frequency and time, or run the AutoZero function manually.

The AutoZero System automatically re-references the CO₂ Sensor to atmospheric CO₂ in the following way:

1. A pump activates for two minutes, pumping HEPA-filtered atmosphere at 0.3 liters/minute into the sensor's measuring chamber. This displaces the chamber atmosphere completely from the sensor.

Figure 7: PROGRAM CO₂ AUTOZERO Screen

```

PROGRAM CO2 AUTOZERO
SET AUTOZERO FREQUENCY      DAILY ◀
SET PREFERRED TIME FOR A/Z   07:00
NEXT A/Z WILL BE 12/04/2002 AT 07:00
LAST A/Z WAS 11/04/2002 AT 15:18
RESULT WAS OK
PRESS ZERO KEY TO CARRY OUT A/Z NOW.
◀ ▶ MOUFS CURSOR ◀ ▶ ADJUSTS VALUE
[START] [ ] [ENTER] [EXIT] [ ]

```

 **NOTE:**

This procedure does not affect the internal chamber environment. It will not affect your cell culture as the procedure is being performed.

2. At the end of the countdown, the control system adjusts the AutoZero Factor to reference the sensor to 0.05% CO₂, which is the approximate atmospheric level.
3. The pump switches off and the chamber atmosphere diffuses back into the sensor's measuring chamber. This takes three minutes, after which the normal CO₂ control system takes over.
4. The result of the AutoZero (listed as **A/Z** on some screens) is sent to the **DATALOGGER ALARM EVENTS** screen so that a record of the results will be kept.

The frequency of AutoZeroing can be set in steps between once a day and once every 28 days, which is the default setting. If not required, it can be disabled (see Section 3.6.6).

The default time setting is 7:00 am. This can be altered to suit your requirements. We do recommend that you only change the time setting shortly before you start to use the incubator.

If the AutoZero function is to be run manually, simply press the **START** function key, within the **PROGRAM CO₂ AUTOZERO** window.



NOTE:

The AutoZero will only occur if the temperature is at setpoint. If the temperature is not at setpoint, the system will postpone AutoZero until the setpoint is achieved.

3.6.4 DATALOGGER

See Section 3.7 for detailed information.

3.6.5 POWER FREQUENCY

You can adjust the power frequency to either 50 or 60Hz to match the local electrical supply.

3.6.6 DISABLE

This feature allows you to inform the control system to ignore certain sensors if their function is not required. The standard item on this menu is the **CO₂ PRESSURE SWITCH**. Additional **DISABLE** options appear on this screen according to the options installed on your incubator. See Section 7.1 for available options.

To disable a feature, scroll to **OFF** using the ◀ & ▶ direction keys, then press the **ENTER** function key.

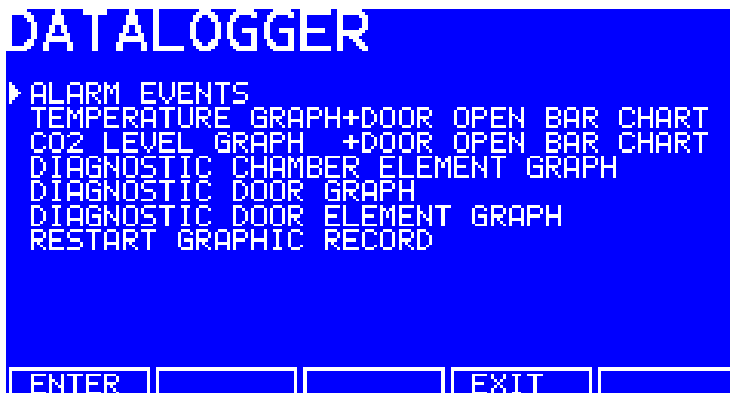
3.6.7 DECONTAMINATION (Model Option)

If the incubator is supplied with the High Temperature Decontamination option, the menu item **DECONTAMINATION** will be displayed. This feature activates the decontamination cycle of the incubator. The decontamination cycle heats the inner chamber to 120°C, holds that temperature for 4 hours, then cools the chamber to the selected temperature setpoint. All of the interior components (with the exception of certain sensors) can be left in place during the cycle to ensure that everything within the chamber is decontaminated prior to resumption of activity. For a full explanation of this feature, see section 10.1.

3.7 DATALOGGER Screen

The **DATALOGGER** Screen displays the following information:

Figure 8: DATALOGGER Screen



This section explains these features.

3.7.1 ALARM EVENTS

The following alarm events are recorded in the order in which they occurred, with the most recent event displayed at the top.

- Power ON / OFF
- Chamber Temperature High / Low (programmed value)
- CO₂ Level High / Low (programmed value)
- CO₂ Supply Failure
- All System Alarms
- CO₂ AutoZero (A/Z) Adjustments
- CO₂ Auto Gain (A/G) Adjustments

- Oxygen and Relative Humidity (R/H) Alarms (where these options are installed)

The capacity is 99 events, after which the earliest event is overwritten and a later event is added.

The date and time of each event are also recorded as shown in Figure 9 below.

Figure 9: ALARM EVENTS Screen

ALARM EVENTS							
PROG	RH	A/R	1.000	TO	1.000	11:27	12/04
PROG	O2	A/R	1.000	TO	1.000	11:27	12/04
PROG	CO2	A/G	0.338	TO	0.338	11:27	12/04
PROG	CO2	A/Z	1.566	TO	1.566	11:27	12/04
HUMIDITY WATER LOW						11:27	12/04
CO2 SUPPLY (CHECK)						11:27	12/04
RH LOW		0.0				11:27	12/04
O2 LOW		0.0		PROG:	19.0	11:27	12/04
CO2 LOW		0.0		PROG:	5.0	11:27	12/04
TEMP HIGH		37.5		PROG:	37.0	11:27	12/04
POWER ON						11:27	12/04
POWER OFF						11:27	12/04
							EXIT

To scroll the screen back, press the ▼ direction key. Press ▲ to go back to the first screen.

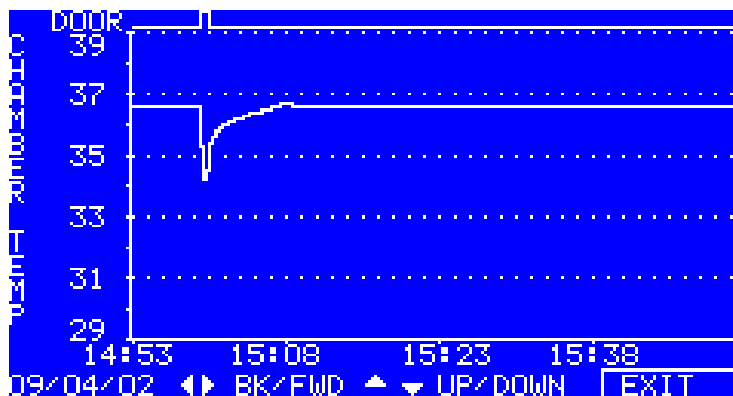
3.7.2 TEMPERATURE GRAPH + DOOR OPEN BAR CHART

When you select this from the **DATALOGGER** screen, the Door Open bar chart is shown at the top of the screen to associate it with a temperature disturbance (*note the correlation in Figure 10 below*). A temperature reading is recorded every 18 seconds while the temperature is outside the specification of $\pm 0.1^{\circ}\text{C}$ and each reading is shown as a single pixel.

When the temperature has settled within specification, the recording is compressed to one pixel representing **ten** 18-second readings (as long as the temperature remains in specification). This allows up to ten hours of readings to be displayed on one screen. When the temperature moves outside specification, for instance if the door is opened, the graph reverts to individual 18-second readings until temperature is within specification again.

When the data is compressed or decompressed, a *light dotted line* is displayed vertically on the screen to signify that the time axis is changing from 15-minute to 2½-hour increments or vice versa. A *heavy dotted line* is displayed when the unit is switched on.

Figure 10: TEMPERATURE GRAPH + DOOR OPEN BAR CHART Screen



Compressing data allows memory space to be maximized. Once the memory space has been filled, the earliest events are overwritten as they are replaced by the latest recording. Graphical recording can be extended, however, to a number of years if your incubator is equipped with an RS-232 port, by connecting the port to a PC loaded with *InnovaLog* Software (see Section 7.2).

3.7.3 CO₂ GRAPH + DOOR OPEN BAR CHART

These graphs record in a way similar to the Chamber Temperature graphs. The specification for CO₂ is $\pm 0.1\%$.



NOTE:

Both CO₂ and Temperature graphs share the same time axis. If the time axis changes to accommodate data in one graph, it will also change in the other.

3.7.4 DIAGNOSTIC CHAMBER ELEMENT GRAPH

This graph records chamber element temperature over time to assist troubleshooting.

3.7.5 DIAGNOSTIC DOOR GRAPH

This graph records the door's inner surface temperature over time to assist troubleshooting.

3.7.6 DIAGNOSTIC DOOR ELEMENT GRAPH

This graph records door element temperature over time to assist troubleshooting.

3.7.7 RESTART GRAPHIC RECORD

This feature removes the current graph and begins a new one. The data cannot be recovered once it is deleted.

3.8 CHAMBER ALARMS Menu Screen

The **CHAMBER ALARMS** programming screen (see Figure 11 below) allows the various alarm options to be selected and modified. Press the ▲ or ▼ direction key to move around the options and the ◀ or ▶ direction key to adjust values. The temperature and CO₂ High and Low Alarm setpoints automatically adjust to within ± 0.5 of the temperature and CO₂ setpoints. The alarm setpoints can also be manually adjusted.

Figure 11: CHAMBER ALARMS Programming Screen



To arm the Chamber Alarms after a selectable delay:

1. Choose the option **ARM ALARMS WHEN AT SETPOINT:**
2. Select **NO** for both **TEMP** and **CO2** (as shown in Figure 11 above)
3. Choose the option **DELAY IN ARMING AFTER DOOR OPEN:** and select the desired delay (15 minutes in the sample screen above) to allow for temperature and CO₂ recovery after the door has been opened.

Alternatively, the alarm system can be set to rearm only after the original temperature and CO₂ setpoints have been achieved:

1. Choose the option **ARM ALARMS WHEN AT SETPOINT:**
2. Select **YES** for both **TEMP** and **CO2**.

3. When **YES** is selected for this function, the **DELAY IN ARMING AFTER DOOR OPEN** is ignored.

A **DOOR OPEN ALARM**: can be adjusted, choosing from seven preset durations (45 seconds in Figure 11) to warn of an improperly closed door.

The **AUDIBLE** and **VISUAL** alarms can be adjusted from **OFF** to **ON** (which means the alarm will be on continuously until it is acknowledged) in seven preset time increments.

In the **OFF** position, any Chamber Alarms that occur will be displayed on the screen without flashing and with the audible alarm inhibited.

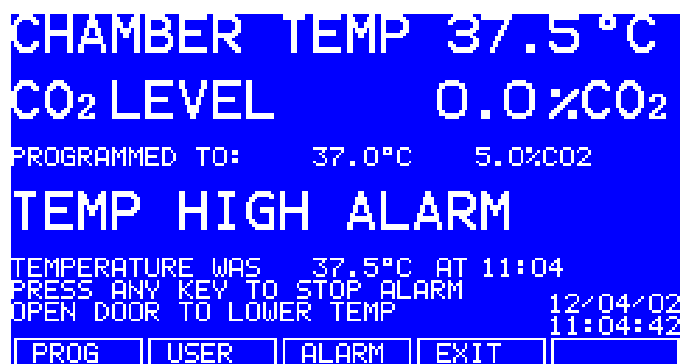
Section 3.8.1, *Chamber Alarm System Function*, and Figure 13 explain in detail how the Chamber Alarms operate.

3.8.1 Chamber Alarm System Function

When the incubator is switched ON, or after the temperature and CO₂ levels have been reprogrammed, the Alarm System is inactive until the setpoint values (± 0.1) are achieved, after which the Alarm System is armed. As setpoint is achieved, the CO₂ and temperature alarms are individually armed.

If temperature and/or CO₂ levels deviate more than the programmed setpoints, the display flashes, the audible alarm sounds and a message appears on the screen. You can acknowledge the alarm by pressing any key.

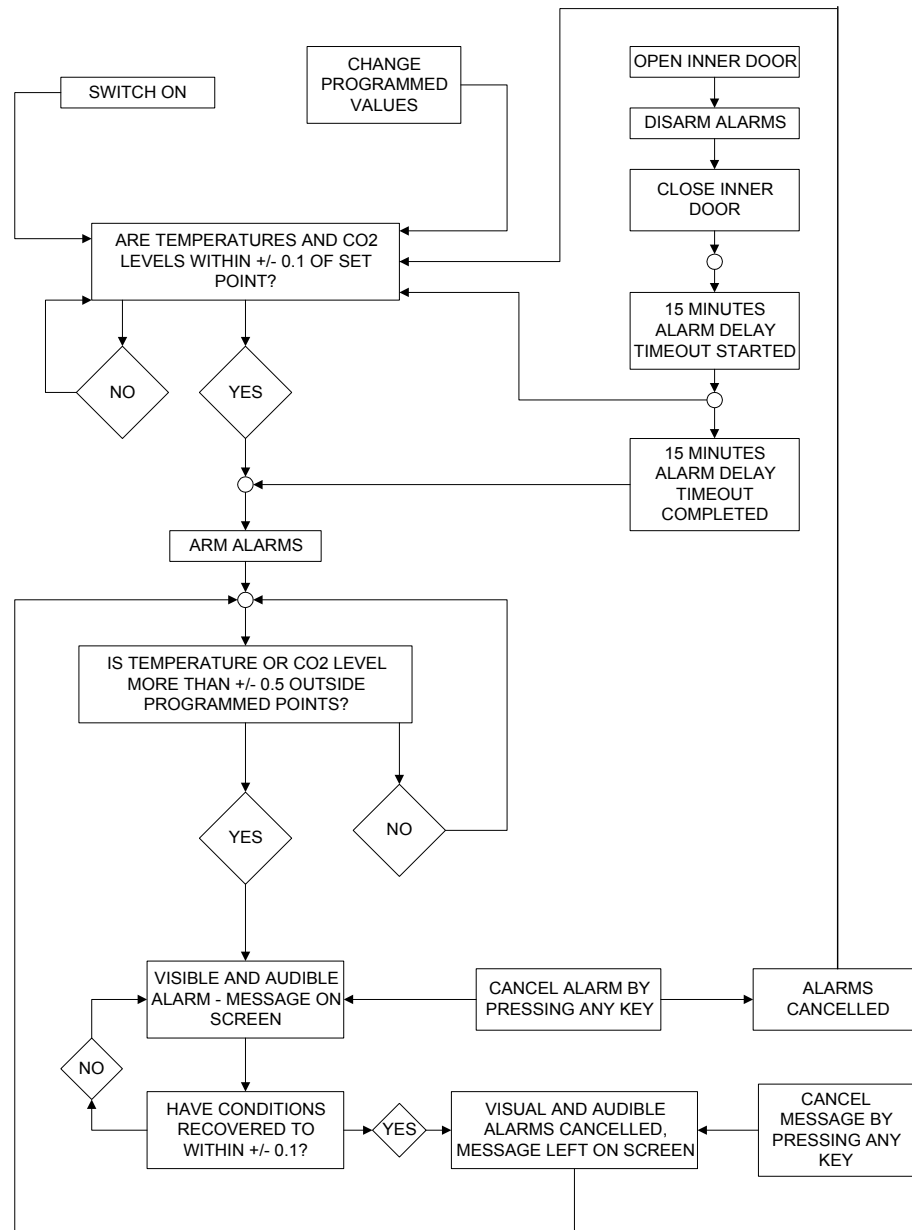
Figure 12: CHAMBER ALARM Message



After setpoints have been achieved for the first time, when the inner door is opened, the Alarm System is disabled; on closing the door, if selected, a **programmable alarm delay** starts:

- If chamber conditions recover within the programmed alarm delay time, the Alarm System is immediately re-armed. After the delay, the Alarm System is armed and if the temperature and CO₂ are outside the Alarm High & Low settings, the alarm will be activated.
- If an alarm occurs and the chamber subsequently recovers, the alarm stops and the system is re-armed. Details of the Alarm Event are stored in the Datalogger.

Figure 13: Chamber Alarm System Flow Chart



If the CO₂ valve is opened and no pressure is detected, an alarm occurs and a warning message appears on the screen, alerting you to **CHECK CO₂ SUPPLY**:

Figure 14: CHAMBER ALARM to Check CO₂ Supply

```

CHAMBER TEMP 37.5°C
CO2 LEVEL      0.0 %CO2
PROGRAMMED TO: 37.0°C  5.0%CO2
CHECK CO2 SUPPLY
CO2 SUPPLY FAILURE - CHECK
PRESSURE SETTING 0.35BAR/5PSI
PRESS USER AND DISABLE TO CANCEL
PRESSURE SWITCH IF NOT REQUIRED 12/04/02
11:14:03
[PROG] [USER] [ALARM] [EXIT]

```

As you can see in *Figure 14 above*, instructions are provided in the **ALARM** screen to deal with the situation that triggered the alarm.

3.9 Diagnostic Menu Screen

The diagnostics screen (*Figure 15 below*) contains technical information regarding the status of many of the system components. This screen is mainly for technical service use, and can be used to troubleshoot the incubator systems before service is scheduled. This information allows technical support to optimize the service support required and to shorten service time.

Figure 15: DIAGNOSTICS Screen

```

DIAGNOSTICS BA3011011604
CO2 PRESSURE SWITCH DETECTED
HUMIDITY SWITCH DRY
DOOR SWITCH CLOSED
CHAMBER TEMP 37.03 CHAMBER ELMT 37.00
DOOR TEMP 34.43 DOOR ELMT 39.18 ●
CO2 ZERO FACT 1.014 CO2 GAIN FACT 1.000
CO2 AMPL 8650 CO2 READING 11.000
CO2 VALVE OFF N2 VALVE OFF O2 VALVE OFF
O2 READING 0.00 O2 TIMER 0
O2 REF FACTOR 1.000 O2 OFFSET 1001
TEMP STAGE 5 CO2 STAGE 0 5
[ENG] [ ] [ ] [EXIT] [ ]

```

3.10 HELP MENU Screen

The **HELP MENU** screen (*Figure 16 below*) provides user selectable categories of abbreviated information found in the user manual. All the major systems are covered in the help menu, including help for installing the unit. If the user manual is misplaced, information about the CO₂ incubator and its functions can always be found on-screen.

Figure 16: HELP MENU Screen



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4 ROUTINE MAINTENANCE

4.1 General Notes

To ensure that chamber conditions remain as stable as possible, minimize the length of time that the door is open. The magnetic door catches are specifically designed to make door opening and closing as easy as possible. When you open the door, wipe off any small drops of condensate that may have formed on the inner seal. This will avoid a build-up of condensation.

If you are using the humidity tray for humidification, be sure to follow the indications provided in *Section 3.3*.

4.2 Daily Checks

1. Check that the temperature and CO₂ levels are reading within specification.
2. Check the reserve pressure in the CO₂ cylinder (normally 725 psi or 50 bar when full). The design of the incubator ensures very low consumption of CO₂: during normal working conditions, a typical large cylinder should last approximately 12 months (frequent door openings will deplete the supply more rapidly, however). If there is a significant drop at the cylinder pressure of 725 psi or 50 bar, it means that the cylinder is almost empty and should be replaced. Making certain that there are no leaks at any of the connections will ensure a greater lifetime to the CO₂ supply and will help avoid accidentally running out of CO₂.
3. Check the **DATALOGGER** screen for any alarms or events that may have occurred overnight.

4.3 Monthly Check

Remember that we recommend routine replacement of the water in the humidity tray, and that you clean the tray at the same time.

1. If you are not changing the humidity tray water and cleaning the humidity tray regularly, you should at least fill the humidity tray once a month. Do not, however, exceed the maximum volume of 0.5 liters. Use warm water (~37.0°C) to ensure a rapid return to optimum chamber conditions. After adding water, check that the humidity tray is centered between the shelf rack supports.

2. If required, you can take a sample of the gas inside the chamber using the CO₂ sample port, and check it using a CO₂ gas analyzer. The CO₂ sample port is located at the top of the rear panel.

If you conduct a sampling, please do the following:

- Turn off the CO₂ gas by re-programming the setpoint for CO₂ to 0.0% to prevent CO₂ from being injected into the chamber and giving a false reading.
- Use a flow rate that is ≤ 0.5 liters/minute to take a sample.
- Keep the door closed to minimize heat loss.
- Remember to reset the CO₂ setpoint to the desired level after sampling.

We recommend that you perform a CO₂ AutoZero prior to sampling (*see Section 3.5*).

3. We also recommend that you AutoZero the CO₂ system at least once every 28 days to ensure that CO₂ level is correct.

5 CLEANING & DISINFECTING

5.1 Cleaning

1. Routinely clean the exterior of the incubator by wiping it over with a soft cloth, moistened with soapy water.
2. Rinse the soap from the cloth in clean water, and wipe the exterior surfaces again.

5.2 Disinfecting

The recommended disinfecting agent for use with the incubator is a solution of 70% isopropanol (isopropyl alcohol) and 30% distilled water. Be sure to follow appropriate safety regulations while you are using this solution:



WARNING!

- **As a routine precaution, wear protective gloves.**
- **Be sure to adequately ventilate the work area as you are disinfecting, to avoid the formation of potentially explosive alcohol vapors.**
- **Protect all electrical connections from contact with the alcohol solution.**

To best protect yourself, your incubator and your work area, follow these instructions:

1. Program 0.0% CO₂ and switch off the incubator. Unplug the unit from the power supply.
2. Dampen a clean cloth with the alcohol solution and wipe down all external surfaces, taking care to keep the alcohol solution from coming into contact with any electrical outlets or assemblies.
3. Remove all of the shelves, the humidity tray, the shelf racks and the inner door seal.
4. Place the black protective cover over the CO₂ sensor. Also protect any additional sensors, such as Oxygen or Humidity, with the cover(s) supplied.

**CAUTION!**

It is very important to ensure that no liquid is spilled onto the white porous CO₂ sensor cover at the rear of the chamber. Failure to use the protective cover(s) could result in damage to the sensor(s) and may affect your warranty.

5. You can clean the humidity tray by rinsing it in sterile water, wiping it down with the alcohol solution, and then rinsing it with sterile water.
6. Wipe down the inside of the chamber with the alcohol solution, and leave it to dry completely.

**CAUTION!**

Never use any of the following substances to clean the stainless steel, or damage will result: Sodium Azide, Aqua Regia, Iodine, Ferric Chloride or Sulphuric Acid.

7. Wipe the internal components of the chamber twice with the alcohol solution. Wipe off excess liquid and leave it to dry completely.
8. Reassemble the inner door seal, the shelf racks and the shelves, before switching the incubator on. Wipe the inner door seal with the alcohol solution, rinse and leave to dry.
9. Ensure the protective cover(s) are removed from the sensor(s) and replaced in the holder for safekeeping (protective covers must also be removed from any additional sensors installed, such as Oxygen or Humidity).
10. Refill the humidity tray (*as explained in Section 3.3*). When you reinstall it, ensure that the humidity tray is centered between the shelf rack supports.
11. Leave the incubator on for at least two hours (preferably overnight) to allow conditions to stabilize.
12. When the incubator has stabilized, carry out an AutoZero and reprogram the desired CO₂ level. It may be necessary to open the glass door briefly if, after performing an AutoZero, the CO₂ level is too high.

5.3 High Temperature Decontamination

If your incubator is supplied with the option of high temperature decontamination, follow the guidelines outlined in the appendix section for correctly and safely operating this option.

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6 SPECIFICATIONS

Table 3: Specifications

Innova CO-48 Incubator Specifications	
Temperature Management	<ul style="list-style-type: none"> ▪ Digital programming via microprocessor control on 0.1°C increments. Measurement of chamber and door temperature via 4 RT* matched thermistors (sensitivity 0.01°C) ▪ Adjustable independent control of door heater ▪ “Out of Limits” temperature protection system independent of microprocessor control.
Range	1°C above ambient temperature to 50°C
Control	± 0.1°C
Stability	± 0.1°C
Uniformity	± 0.2°C
CO₂ Control	Solid-state infrared CO ₂ sensor operating independent of humidity. Programmable, fully automatic zeroing function.
Range:	0.2 - 20%
Control:	± 0.1%
Stability:	± 0.2%
Uniformity:	± 0.1%
Recovery Rate:	Better than 1.5% minute
Gas Connections:	~1/4-inch or 6mm tubing
Required Gas Pressure:	5 psi / 0.35 bar
Relative Humidity	Removable stainless steel humidity tray
Reservoir Capacity:	0.5 liters
Humidity Control: <i>manual</i>	Normal: 95% at 37°C High: 97% at 37°C
Shelves	Polished stainless steel, non-perforated (standard).
Usable Area:	875cm ² per shelf
Number of Shelves:	3 standard ; with Multiple Position Option, up to 6 shelves
Alarm Systems	Two-level alarm system giving programmable audio/visual warnings with options for remote communication. Level 1 signals system failures, level 2 is programmable and monitors chamber conditions.
Dimensions	Seamless interior with removable door seal
Chamber (HxWxD):	401 x 401 x 308mm or 15.8 x 15.8 x 12.1 inches
Chamber Volume:	48 liters or 1.7 cu ft
External (HxWxD):	645 x 484 x 470mm or 25.4 x 19.1 x 18.5 inches
External, Crated (HxWxD):	860 x 610 x 585mm or 33.9 x 24.0 x 23.0 inches (Including pallet)
Weight	Crated: 50 kg/110.2 lbs Uncrated: 32kg/70.5 lbs (with standard features)

*RT = Resistance Temperature curve

...continued...

Innova CO-48 Incubator Specifications	
Grounded Electrical Supply	
Voltage:	100-120V 50/60Hz or 220-240V 50/60Hz
Power:	<ul style="list-style-type: none">▪ 500 watts, Standard models▪ 700 watts, High Temperature Decontamination models
Energy to maintain 37°C:	< 0.1kwh
Storage Temperature	10 - 50°C

7 OPTIONS & ACCESSORIES

7.1 Options

Some option combinations are not possible; others may incur extra cost. Please inquire before ordering.

Option	NBS Part Number	Retrofittable in Field?
O ₂ Control, 1-19%	P0628-5250	No
O ₂ Control, 1-95%	P0628-5260	No
High Temperature Decontamination	Model Type	No
Humidity Measurement & Display	P0628-5280	No
Humidity Tray Warning System	P0628-5290	No
Access Port, 10mm Ø	P0628-5300	No
RS-232 Port	P0628-5310	Yes
Centronics Printer Port	P0628-5320	Yes
Split Inner Door	P0628-5330	No
Alarm Relay Contacts	P0628-5340	Yes
Internal Power Receptacle	P0628-5350	No

7.2 Available Accessories

Accessory	NBS Part Number
CO ₂ Bottle Automatic Change-Over Unit	P0628-5000
CO ₂ Two Stage Regulator	P0628-5010
CO ₂ Supply Line Filters, HEPA	P0628-5020
In-Line Pressure Regulator	P0628-5030
CO ₂ Gas Analyzer Kit	P0628-5040
10 Spare CO ₂ Gas Analyzer Tubes	P0628-5050
Air Zero Filters, HEPA (supplied in pairs)	P0628-5060
Non - Perforated Shelves	P0628-5070
Perforated Shelves	P0628-5080
Floor Stand & Stacking Frame, for double stacking	P0628-5090
Multi-position Shelf Racks (Max 6 positions)	P0628-5100
<i>InnovaLog</i> PC-based data-collection Software (requires RS232)	P0628-5360

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8 DRAWINGS & TABLES

8.1 List of Drawings

Following is a key to the illustrations in this manual:

Figure	Description	Page
1	Installing Shelf Racks	18
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3	Installing/Removing the Humidity Tray	19
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8.2 List of Tables

Following is a key to the tables in this manual:

Table	Description	Page
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2	Utilities	16
3	Specifications	43
4a	Decon Failure Codes & Descriptions	51
4b	Decon Failure Code Explanations	51

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9 APPENDIX A: HIGH TEMPERATURE DECONTAMINATION OPTION

The High Temperature Decontamination option is designed to heat the internal chamber to 120°C, maintain that temperature for 4 hours, and then allow the chamber to cool down to 37°C or the programmed temperature (if different from 37°C) when normal control takes over. The cycle is designed to decontaminate all internal surfaces and components with the exception of the Oxygen control sensor where supplied.

9.1 Using High Temperature Decontamination

1. The incubator should be cleaned, decontaminated chemically and dried thoroughly before starting the cycle (follow the instructions for Cleaning in Section 5).
2. The black protective cover must be removed before starting a cycle (the white porous cover can remain in place). The shelves, shelf racks, humidity tray and silicone rubber suction cups should all be in place during the cycle. If the Humidity Tray Warning Option is fitted, ensure the sensor is placed on the bottom shelf prior to starting the cycle. This is to protect the sensor from the direct heat at the bottom of the incubator. The incubator **MUST** be clean and dry, and the humidity tray **MUST** be empty, clean and dry, to continue. If it is not, permanent damage can occur to the incubator that may void your warranty.
3. To start the cycle, press the **USER** menu button, select **DECONTAMINATION** and press **START**. The incubator will then prompt: **IS CHAMBER CLEAN & DRY?** Answer **YES** if it is clean and dry. The cycle will start automatically. If the incubator is fitted with a Humidity Tray Warning System, the incubator will ask two more questions: (1) **IS HUMIDITY SENSOR ON LOWER SHELF?** Answer **YES** to continue; (2) **IS CABLE OFF BASE?** Answer **YES** to begin the cycle. If the incubator is fitted with Oxygen Control, the incubator will also prompt: **IS O₂ SENSOR REMOVED?** Ensure the O₂ sensor has been removed and answer **YES** to begin the cycle. Refer to Section 9.2 for the O₂ sensor removal/reinstallation procedure.
4. To cancel the cycle, press **CANCEL**. The incubator will cool down to the programmed level where normal control takes over.

See important **NOTE** on the following page.

**NOTE:**

In the unlikely event of a scheduled AutoZero beginning just prior to a decontamination cycle, the AutoZero will abort until the cycle is complete. A user initiated AutoZero will also abort but will not resume after completion of the decontamination cycle.

- If the incubator door is opened during a decontamination cycle, the process will continue as normal but will cause a failure message if the temperature falls as a result during the heating phase and especially during the decontamination phase.

**WARNING!**

The door should **NOT** be opened during the cycle due to the hazardous high temperatures involved. Serious burns could occur if the door is opened during the cycle.

**NOTE:**

The chamber walls and CO₂ sensor all achieve temperatures of between 120 - 150°C, particularly in areas that are inaccessible to chemical decontamination. Certain areas of the glass door and inner door seal surface temperatures will be somewhat lower than 120°C.

- After completion of the process, one of the following status messages will be displayed.

If the cycle:

- was completed successfully, **DECONTAMINATION COMPLETED OK** is shown.
- was cancelled by the user, **DECONTAMINATION WAS ABORTED** is shown.
- failed for any reason, **DECONTAMINATION FAILED [CODE DECON: XX]**. The codes are shown in Table 4a on the following page, and described in Table 4b. If this happens, please note the failure code and contact your service representative for advice.

Table 4a: Decon Failure Codes & Descriptions

Failure Code	Failure Code Description (see Table 4b below)
01	Z
02	W
03	W, Z
04	X
05	X, Z
06	W, X
07	W, X, Z
08	Y
09	Y, Z
0A	W, Y
0B	W, Y, Z
0C	X, Y
0D	X, Y, Z
0E	W, X, Y
0F	W, X, Y, Z

Table 4b: Decon Failure Code Explanations

Failure Code Description	Explanation
W	Temperature drop during warm-up period: indicates the temperature fell more than 2°C during the heating phase over a 60-second period.
X	Temperature drop during 4-hour period: indicates the temperature fell below 118.0°C during the decontamination phase.
Y	Temperature increase during cool-down phase: indicates the temperature rose by more than 2°C during the cooling phase over a 60-second period.
Z	Cancel key pressed.

 **NOTE:**

If the incubator power is cycled OFF then ON during a decontamination cycle due to a power outage, the incubator will power up as normal. This condition will be indicated by the absence of a completed decontamination status message (DECONTAMINATION COMPLETED OK). If the chamber temperature is above the setpoint or the element temperature is greater than a factory-preset control point, cool-down will be entered until these conditions are satisfied.

**NOTE:**

It is recommended that for the first few decontamination cycles, the AutoZero function be run following each decontamination cycle.

9.2 High Temperature Decontamination Option with Oxygen Control

The Oxygen Sensor is an electro-chemical device that will be destroyed by the high temperature used to decontaminate the incubator if left in place. For this reason, the Oxygen Sensor *must* be removed from the incubator prior to a High Temperature Decontamination Cycle. The sensor can be accessed from the rear panel of the incubator.

Detailed removal and installation instructions are provided in Sections 9.2.1 and 9.2.2 below.

**CAUTION!**

The incubator should be positioned to allow access to the back of the unit for removal of the Oxygen Sensor prior to starting a High Temperature Decontamination cycle.

9.2.1 Oxygen Sensor Removal

Prior to beginning a decontamination cycle, remove the Oxygen Sensor as follows:

1. Remove the black plastic plug that covers the Oxygen Sensor located on the back of the unit.
2. Disconnect the sensor cable by unplugging the electrical connector (grasp the white connector body, *not* the wire leads).
3. Unscrew the Oxygen Sensor by turning it counter-clockwise. If the sensor is difficult to remove, the unthreaded end of the black plastic blanking plug can be used as a removal tool. Never use excessive force or metal tools.
4. Store the sensor in a clean, safe place until the decontamination cycle is over.
5. The unit is now ready to perform a decontamination cycle.

9.2.2 Oxygen Sensor Replacement

When the cool-down period of the decontamination cycle has finished, reinstall the Oxygen Sensor as follows:

1. Using the blanking plug as a tool, reinstall the Oxygen Sensor by turning it clockwise.

**NOTE:**

The O₂ sensor only needs to be finger tight. Do not over-tighten, as this will distort the Oxygen Sensor and cause it to malfunction.

2. Reconnect the sensor cable by plugging in the connector (grasp the white connector body, *not* the wire leads).
3. Replace the black plastic plug that covers the Oxygen Sensor to reduce heat loss.

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