Air-Jacketed,
NU-5100E/G DH Automatic CO_2 Incubator

OPERATING INSTRUCTIONS

March, 2007
Revision 2
(Series 2 & Higher)

OM0151

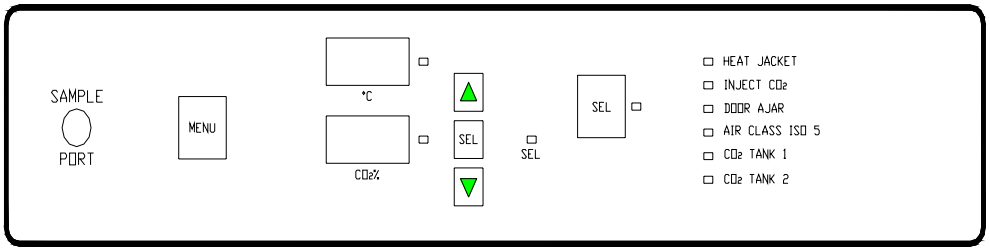
Introduction

The NuAire NU-5100 DH Automatic CO_2 Direct Incubator has been designed to provide a reliable controlled in vitro environment for optimum tissue cell culture growth. The following operating instructions are a condensed version of the operation and maintenance manual. For more in depth detail of the Incubator operation, please refer to the operation and maintenance manual.

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1.0 Control Panel & Indicators



■ HEAT JACKET	Indicates Main Heater ON
■ INJECT CO_2	Indicates Injection of CO_2
■ DOOR AJAR	Inner Glass Door Open
■ AIR CLASS ISO 5	Chamber Air Class
■ CO_2 Tank 1	Indicates CO_2 Tank in Use
■ CO_2 Tank 2	Indicates CO_2 Tank in use (Option)
■ ALARM	Fault Occurrence
[RUN/SETUP]	Mode Switch key
[SEL]	Select Key Allows Selection of Parameters on Display
↑/ ↓	UP/DOWN Keys Allow Entry of Parameter Data into Microcomputer
MENU	Gives Access to the Test & Options Menus also the Master Reset Function.

2.0 NU-5100 DH Start-Up

After your NU-5100 DH Incubator has been unpacked, positioned, and leveled, proceed with the following check list.

1. Check for standard items packed with unit (per chamber*).
   - (3) Stainless steel shelves*
   - (6) Stainless steel shelf brackets*
   - (1) Full size water pan with supports*
   - (1) Gas tube with filter
   - (1) Electrical Cord 2 Meter
   - (1) Operation & Maintenance Manual
   - (1) Operating Instructions
2. Install shelves and water pan. Connect Incubator to an appropriate grounded power source via the back panel power cord. Use a dedicated laboratory circuit for the power supply. A SURGE PROTECTOR IS STRONGLY RECOMMENDED to avoid power-related faults.
3. Turn on Incubator via the on/off switch on the pack panel, press RUN/SETUP key on front panel to SETUP.
4. Attach CO_2 gas supply to the CO_2 inlet on the Incubator pack panel. Use a TWO-STAGE REGULATOR and set the output pressure to approximately 20 PSI.
5. Enter temperature and CO_2 percent setpoints (see section 4.0).
6. Once parameter setpoints are entered, press RUN/SETUP key to RUN and let Incubator stabilize for 24 hours. The CO_2 percent will indicate "delay" until the Incubator reaches within 5.0°C of setpoint temperature.

3.0 Setpoint Parameter Entry

Chamber Temperature

- Press mode switch to setup. Hold for 3 seconds.
- Press [SEL] to indicate green LED next to chamber temperature display.
- Press ↑ or ↓ to indicate desired temperature.
- Press mode switch back to run.

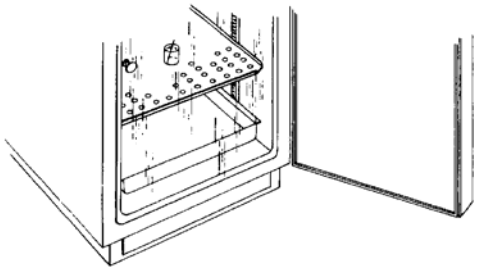
CO_2 Percent

- Press mode switch to setup.
- Press [SEL] to indicate green LED next to CO_2 percent display.
- Press ↑or ↓ to indicate desired CO_2 percent.
- Press mode switch back to run.

4.0 Chamber Temperature Calibration

The NU-5100 DH TEMPERATURE CALIBRATION MUST BE PERFORMED WITHIN 1°C OF THE PLANNED OPERATING TEMPERATURE. Normally, 37.0°C is the most common setpoint. To initiate the procedure, turn on the NU-5100 DH via the power switch on the back panel. Press mode switch to setup default temperature. Setpoint is 37.0°C; use the ↑↓ arrows to change if desired. Press mode switch back to run and let stabilize for 8 to 12 hours. Use an independent instrument to check and calibrate the temperature.

Below is a description of calibration with a glass thermometer as one example for temperature calibration. At the beginning of this procedure, set a mercury glass thermometer in a glass beaker filled with water resting on a shelf in the middle of the NU-5100 DH chamber. Do not place the glass beaker on the bottom of the chamber because it will result in a slightly higher temperature reading due to the heater located on the chamber bottom. Placing the thermometer in glass beaker on the middle shelf will give the most accurate results for calibration. The chamber should be humidified to avoid false low readings due to evaporation of water from the flask. An accurate digital thermometer with a type K thermal couple could also be used.



When the unit has stabilized at the operating temperature, perform the following calibration procedure.

- Allow Incubator to stabilize at its given temperature setpoint in run mode.
- In run mode press "SEL" to indicate LED next to temperature display.
- Press and hold ↑ key for three seconds.
- Determine actual temperature within chamber by reading temperature measurement instrument.
- Press ↑ or ↓ key to indicate same temperature as the actual temperature being measured in the chamber.
- Press "SEL" to set current value and exit calibration.

The chamber temperature calibration is complete. Let unit stabilize for 8 to 12 hours. If the chamber temperature (actual thermometer) still does not match the display, perform the above procedure again. In some cases it might be necessary to calibrate several times to achieve a stable condition due to ambient conditions of temperature and humidity within the laboratory.

5.0 Door and Perimeter Temperature Calibration

The NU-5100 DH inner glass door and outer shell perimeter temperature calibration is best accomplished by running the Incubator 24 hours with the water pan in place and perform the following calibration sequence, if required. Open the Incubator door and look for general condensation. Some condensation on the glass door can be desirable as an indication of adequate humidity in the chamber. Typically, a trace of condensation in the corners of the glass door indicates a properly calibrated door heater. The perimeter heater controls the heater located on the outer shell next to the glass door. Typically, no condensation should form on the inner chamber next to the glass door. However, if calibration is required, simply perform the procedure as stated below. The door and perimeter heater operates as a duty cycle percentage ON/OFF (0 is off, 100 is Full ON). Default settings are 18% for the door and perimeter 24%.

The following steps should be taken for setting these duty cycle percentages:

- Allow Incubator to stabilize at its given temperature and humidity level in run mode.
- Press "SEL" to indicate LED next to temperature display.
- Press and hold ↑ and ↓ keys simultaneously for three seconds. Temperature display alternates between either "dor" or "PEr" and the duty cycle percentage.
- Press ↑ or ↓ key to desired "dor" or "PEr" duty cycle percentage (press RUN/SETUP key to change from "dor" to "PEr" and back again).
- Press "SEL" to set current value and exit calibration.

5.1 Automatic Door and Perimeter heater duty cycle automatic control

The door and perimeter duty cycles are automatically reduced when the room temperature in the lab increases enough to allow the contribution from these heaters to over heat the chamber. For example if the door and perimeter duty cycles are set up when the room temperature is 22ºC and the room temperature is allowed to increase to 27º. Less heat is required to keep the chamber at set-point. If the chamber starts to overheat, the duty cycles will be reduced at a rate of 1% per minute starting when the chamber temperature is 0.2ºC above set-point. The duty cycles will continue to be reduced until the chamber temperature returns to set-point. These duty cycles are continuously monitored and will be increased slowly again, as long as the chamber temperature does not go over the set-point. If the room ambient reduces back to 22ºC the door and perimeter duty cycles will actually be returned to their original settings.

NOTE: If it is known that the lab room temperature where the Incubator is installed will vary significantly. (For example, the heater or air conditioning is shut off after work hours or there is no air conditioning and the room temperature has large temperature swings.) The door and perimeter duty cycles should be set in the lower temperature expected in the lab. Then the door and perimeter heaters will automatically be adjusted to avoid over temperature conditions in the chamber when the room temperature rises. In this case the chamber should be monitored for condensation regularly. If the chamber walls and ceiling start to get excessive condensation the door and perimeter heater duty cycle settings will need to be reduced. Do not adjust the duty cycle settings by more than 5% at a time.

6.0 CO_2 Sensor Description

THERMAL CONDUCTIVITY CO_2 SENSOR

This incubator is equipped with a thermal conductivity sensor to measure and control the CO2 percentage level in the chamber (commonly referred to as a “TC” sensor). The thermal conductivity of the incubator chamber‘s atmosphere is affected by the percentage of CO2 present, the chamber temperature and the absolute humidity in the chamber. To monitor the chamber CO2 % accurately the temperature and the absolute humidity must be held constant. This way the only change in the thermal conductivity would be a change in the CO2 percentage in the chamber.

Changing the chamber temperature set point or any changes in the humidity level can require a new zero & span calibration of the TC sensor.

Some TC CO_2 sensors go through an aging period including but not limited to new installations. Calibration should be checked on a weekly basis and a control calibration should be performed if necessary.

NOTE: THE ZERO/SPAN SENSOR CALIBRATION IS PERFORMED AT THE FACTORY. IF THE TEMPERATURE SET POINT REMAINS AT THE DEFAULT OF 37 DEG. THIS CALIBRATION IS NOT NECESSARY FOR A NEW INSTALLATION.

7.0 CO_2 Control Calibration

CO_2 Control Calibration can be performed anytime the measurement of an independent measurement of the chamber CO_2 level doesn't correlate to the front panel display. However, this calibration SHOULD NOT BE PERFORMED MORE THAN ONCE PER WEEK.

When unit has stabilized at the operational temperature, the chamber humidity level and CO_2 percentage, take a measurement with an independent instrument and, if necessary, perform the following: NOTE: The inner door should have been closed for more than an hour.

- In run mode - green LED above mode key is on & not blinking.
- Press "SEL" to indicate LED next to CO_2 percent display.
- Press and hold ↑key, CO_2 display alternates between “ADJ” and the CO_2 percentage.
- Press both ↓ and ↑keys simultaneously, (clears all previous offsets).
- Take an independent measurement of the chamber CO_2 percentage (compare the display CO_2 to the independent measurement then offset the display using the following procedure.
- Press ↓ or ↑ key to indicate same CO_2 percentage as the independent measurement.
- Press "SEL" to set current value and exit calibration.

8.0 CO_2 Sensor Calibration (Zero/Span)

This procedure should be performed only when the Temperature set point is changed, or if the humidity level changes in the chamber or if the sensor is replaced.

- Make sure unit is in Run mode, the green LED above the mode key should be on and not blinking.
- Press the "SEL" key to indicate the green LED next to the CO_2 display.
- Push the ↓ until "dor" appears in the CO_2 display then open the inner and outer doors: When "dor" stops flashing in the display after 90 seconds close the doors. The display will continue to blink the value that the sensor detects.
- Leave the incubator set for at least 3 hours and as long as over night (for higher temperature set points) to allow the temperature and chamber humidity to stabilize fully.
- When the chamber conditions are fully stable Press both ↓ and ↑keys simultaneously to start the span injection. The display then zeros out and the span injection automatically starts "InJ shows in the CO_2 display
- After the injection is complete "DLY" shows in the CO_2 display to allow time for the CO_2 to mix in the chamber
- When mixing is complete "SPn" shows in the display indicating that it is time to take an independent measurement of the CO_2 in the chamber.
- Press ↓ or ↑ key to indicate same CO_2 percentage in the display as the independent measurement just taken.
- Press and hold the run/setup button unit the mode changes to setup then changes back to run there by recording and completing the calibration.

NOTE: If the "SEL" button is pressed at any time the calibration it is aborted and must be rerun.

- Let the chamber stabilize and perform a Control Calibration if needed (see section **9.4.1)**.

9.0 Maintaining Your NU-5100 DH

NU-5100 DH Chamber

The chamber maintenance is up to the discretion of the owner and the extent of cleanliness and sterility desired. The shelves and bracket supports are all removable and autoclavable. The interior should be wiped down with an appropriate disinfectant such as 70% ISOPROPYL ALCOHOL or equivalent. **DO NOT USE ANY CHLORINATED OR HALOGEN MATERIALS IN THE CHAMBER. SUCH MATERIAL IS HARMFUL TO THE POLISHED STAINLESS STEEL.** *The humidity pan should also be sterilized and the water changed regularly to assure sterility. A small amount of copper sulfate may be added to the humidity pan to inhibit bacterial growth.*

P/N X-980385 (50 mm Disk, Uni-directional In-Line, Dry)*

CO_2 Supply Filter

The CO_2 Supply Filter should be replaced every fifth empty CO_2 tank or when the filter is visibly discolored (yellow-brown). Note direction of flow (IN is labeled on one side of filter) when replacing filter.

P/N A-980899-03 (Radial HEPA Filter)

Chamber HEPA Filter

The chamber HEPA filter should be replaced approximately every two years to assure optimum performance. A visual check should be performed periodically and during CO_2 sensor calibration to assure filter integrity. A visual check would include, removing the plenum top and observing the HEPA filter interior and exterior for heavy discoloration (yellow-brown) or filter change. To replace, remove the knurled nuts holding it to the top of the chamber.

9.1 Chemical Decontamination of the Incubator Chamber

To chemically decontaminate NuAire Incubators, users may use the traditional formaldehyde, Vapor Phased Hydrogen Peroxide, or Chlorine Dioxide. All three of the chemicals are compatible to all parts within NuAire Incubators.

NOTE: As stated previously, the chamber and components can also be wiped down with a 70% solution of Isopropyl Alcohol for cleaning and decontamination.

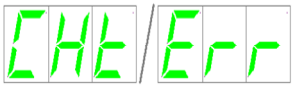
10.0 Error Indicators & Troubleshooting Guide

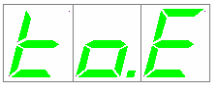
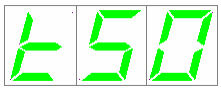
Step 1 NOTE ALL ERROR INDICATORS. When the incubator is running, any and all red or yellow LEDs indicate an error. Pressing any key will silence the audible alarm for 15 minutes.

Step 2 CLEAR ERROR INDICATORS. Error indicators can be cleared by pressing the mode key to Setup and back to Run.

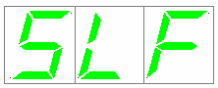
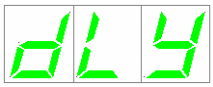
Step 3 MONITOR RE-OCCURRENCE OF ERROR INDICATORS. If re-occurrence of the error indicator is immediate or daily, use guide below to correct the situation.

Error Indicator Troubleshooting Guide

DISPLAYED ERROR CODE	CODE DESCRIPTION	CHECKS & CORRECTIONS
Temperature System		
	-Temperature over setpoint Normal mode and Decon cycle	1. Check temperature sensor calibration. 2. Faulty TRIAC, replace control board.
	-Temperature time out error during normal running and in Decon cycle	1. Check temperature sensor calibration 2. Replace fuse 3. Faulty TRIAC, replace control board 4. Faulty chamber heater contact NuAire Technical Service. 5. Door/Perimeter heater needs to be increased with a high temperature set-point in a low ambient temperature
	-Sensor signal limit is exceeded	1. Not plugged into control board properly 2. Sensor faulty, replace

CO_2 System		
	- CO2 over setpoint	1. Check injection solenoid for leaking valve 2. Check sensor and disk filter for condensation 3. Perform CO2 sensor calibration
	-CO2 time out error	1. Check CO2 gas supply - inline gas filters, CO2 gas tank pressure, CO2 sensor function 2. Check/replace CO2 gas supply tanks 3. Check for leaks in chamber - inner door gasket, chamber blower fan shaft seal
	- CO2 tank switch occurrence	1. Press RUN/SETUP key to “SETUP” and back to RUN to reset alarm

Memory Chip Fault		
	- Corrupted memory data read at start-up	1. Turn Incubator off and back on. 2. If CrC message persists, push “NUAIRE” button to reset. All systems will require recalibration 3. Continuation of 2, refer to Section 9. If CrC still persists, call NuAire Technical Service.
	- Set up information read failure	1. Turn Incubator off then on again. If error indicator continues, replace main control board. If error indicator is cleared, recalibrate Incubator temperature and CO2 control.
	- Data write to EEProm chip failure	1. Occurs when the checksum read of manually or automatically input data fails at the time of the input. Input data will be active in volatile memory but will be lost if power to the Incubator is interrupted. Contact NuAire Technical Service to replace control board.

General Indicators		
DOOR AJAR LED	- Inner glass door is not closed or magnetic switch needs a position adjustment	1. Close and latch inner glass door. 2. Adjust switch position to align it with the disk magnet on the glass door hinge by loosening acorn nut on the cable clip. 3. Check door switch, if faulty, replace.
	- Self diagnostic move	1. Indicates Incubator is performing self diagnostic task - Calibration can be performed when task is completed.
	- When performing on off set calibration DLY shows in display and the value will not change	1. Indicates the Incubator is busy with an automatic function like an air injection. Then display can be changed when the function is complete. This usually takes a few seconds CO2 control is in delay for one of the following reasons: A. Power interruption just occurred. Will resume CO2 within 1-minute. B. Chamber temperature is not within 2.0°C of Setpoint. Cannot bypass. 2. Shows for 1 minute in CO2 display after a menu exit.

BLINKING DISPLAY	- Interruption of power	1. Press any key to stop blinking displays.
CONDENSATION EXCESSIVE (Humidity pan in place)	- Glass door, gasket or front wall of chamber wet.	1. Increase door and front perimeter heater duty cycles. See section 9 for detailed instructions.
	- Back wall bottom and top walls	1. Decrease door and front perimeter heater duty cycle. See section 9 for detailed instructions.
Note: Depending on the room ambient that the Incubator is operating, the operator may have to readjust the door and perimeter heater duty cycle are too high and likewise if the door and perimeter heater duty cycles are too low the glass door and front wall of the chamber will show excessive condensation.		
EXCESS VIBRATION		Remove top plenum and ensure that blower wheel is not rubbing on anything.

For further assistance, call NuAire Customer Service at 1-800-328-3352 or (763) 553-1270 USA.