

SureTherm™ CO₂ Incubators with *IncuView™ LCI*

OPERATING MANUAL



Benchmark™
Scientific



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1. GENERAL INFORMATION AND PRECAUTIONS

Safety Symbols:



1.1. Precautions related to the power cable

 Always allow at least 3 cm between the power cable and the back wall to prevent the back wall from causing pressure on the power cable.
Compliance

 Always use the electrical plug that was supplied with this instrument.
Compliance

 Never touch the power cord with wet hands. (This can result in electric shock.)
Prohibition

 Never use a damaged power cord or power outlet.
Prohibition

 In the event of smoke or a burning smell, immediately remove the power cord from the outlet.
Remove plug

1.2. Precaution for use

 Do not attempt to disassemble this instrument. If service is required, please contact your local representative.
No disassemble

 Never operate a flammable spray near this instrument. (This can result in a fire hazard.)
Prohibition

 Always use caution when using flammable substances such as benzene, alcohol and LP gas. (Failure to do so can result in a fire hazard.)
Prohibition

 Prevent foreign substances from contacting the door seal. (The inflow of outside air can negatively impact the temperature in chamber.)
Compliance

 Permissible ambient temperature range for transport: -10°C to 60°C.
Compliance



Compliance

ALWAYS ensure that the instrument is connected to an outlet with specifications that match those of the serial number label.

(Over-voltage or under-voltage can damage the product and result in poor performance.)



Compliance

When installing the instrument, always allow a distance of at least 30cm from the back wall. Install the unit in the way that the power plug is easily accessible and can be easily pulled in case of danger.



Compliance

Install the instrument on a flat and stable surface, free from vibration and in a well-ventilated location. (If the surface is not level, it can cause an excessive vibration of the product.)



Compliance

Excessive CO₂ can be harmful when in high concentrations.

Any excess amount of CO₂ should be properly ventilated or by connection to a suitable exhaust system.

2. FEATURES AND SPECIFICATIONS

2.1 Features

1. Excellent uniformity of both temperature and CO₂
2. Six Side direct heat for temperature uniformity and fast recovery
3. IR CO₂ sensor detects precise density of CO₂
4. Outer heated door prevents condensation on glass viewing door
5. Optional IncuView LCI for viewing of cells in real time
6. Natural Humidification by water tray

2.2 Additional Features available in H3565-180HD and H3565-180HDO2 models

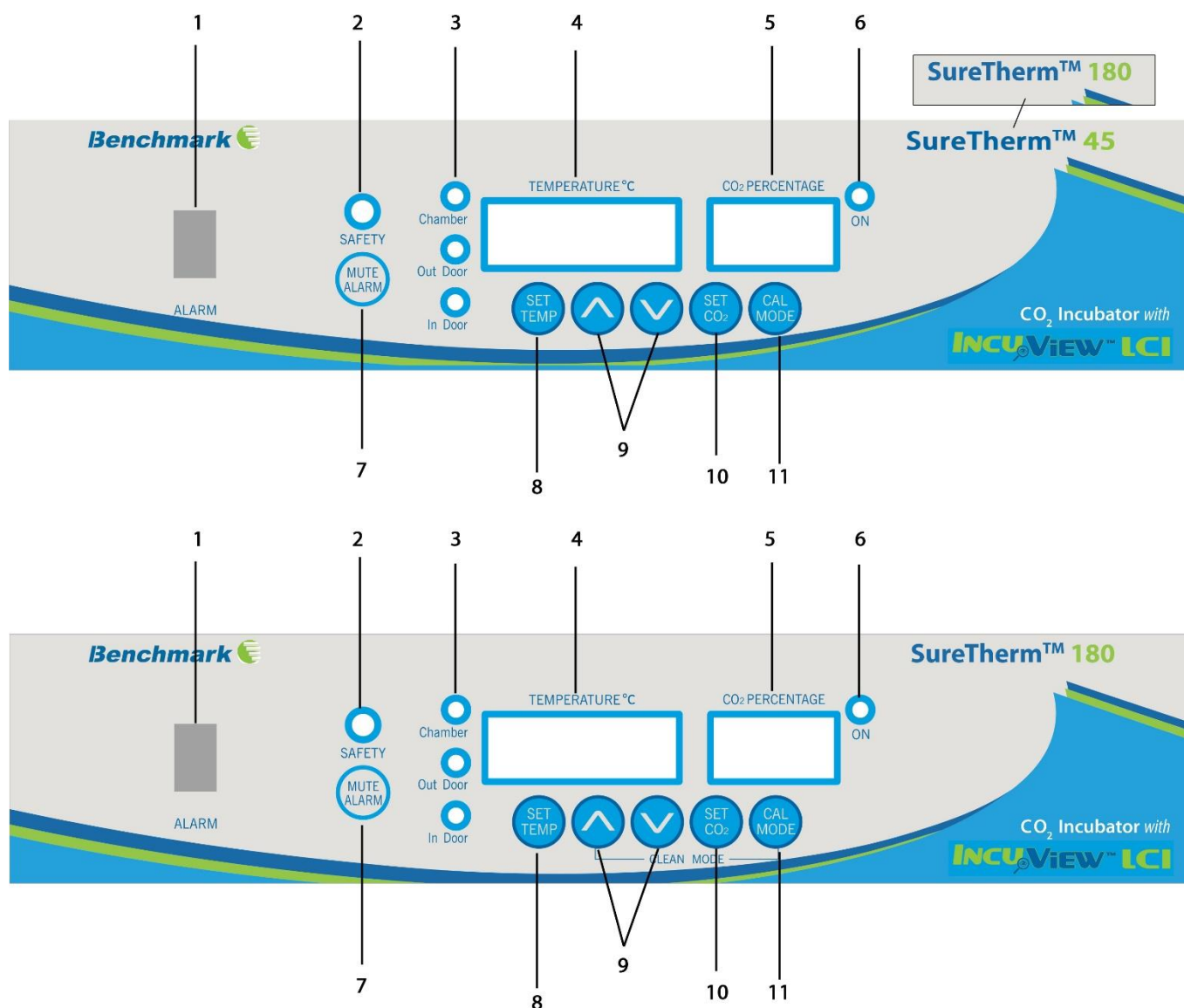
1. Hot air decontamination system with dry heat, 125°C
2. Six divided inner doors for "ST-180 PLUS" (HDO2 model only)
3. Oxygen percentage control (HDO2 model only)

2.3 Specification

Items	ST-45 (H3565-45)	ST-180, ST-180HD and ST-180HDO2 (H3565-180 / 180HD / 180HDO2)
Temperature Range	Ambient +5°C to 60°C *	
Temp. Accuracy	±0.1°C at 37°C	
Controller	Microprocessor On Off Control	
Humidity	Standard Model - 70% ~ 85% at 37°C with water tray *H3565-180HDO2: 95%	
CO ₂		
Range	0% to 20%	
Accuracy	±0.1% at 5% at 37°C setting	
CO ₂ Increment	0.1%	
CO ₂ Sensor	IR CO ₂ Sensor	
Outer door	Silicon Magnet Packing Door	
Inner door	Tempered Glass Door Six Divided Inner Door for ST-180HDO2 model only	
Jacket type	Dry wall type (6 sides direct heating type)	
Chamber material	STAINLESS STEEL 304	
Decontamination	125°C (ST-180HD and ST-180HDO2 models only)	
Oxygen Control	0.5 to 20% (ST-180HDO2 only)	
Weight	35Kg	78Kg
Capacity / Shelf	45Liter / 2 shelves	180Liter / 3 shelves
Chamber dimension	335(W) x 361(D) x 392(H)mm	473(W) x 528(D) x 710(H)mm
Overall dimension	420(W) x 465(D) x 553(H)mm	560(W) x 665(D) x 945(H)mm
Power	110/220V, 50/60Hz (AC 230V : 300W , AC 115V : 300W)	110/220V, 50/60Hz (AC 230V : 320W , AC 115V : 420W)

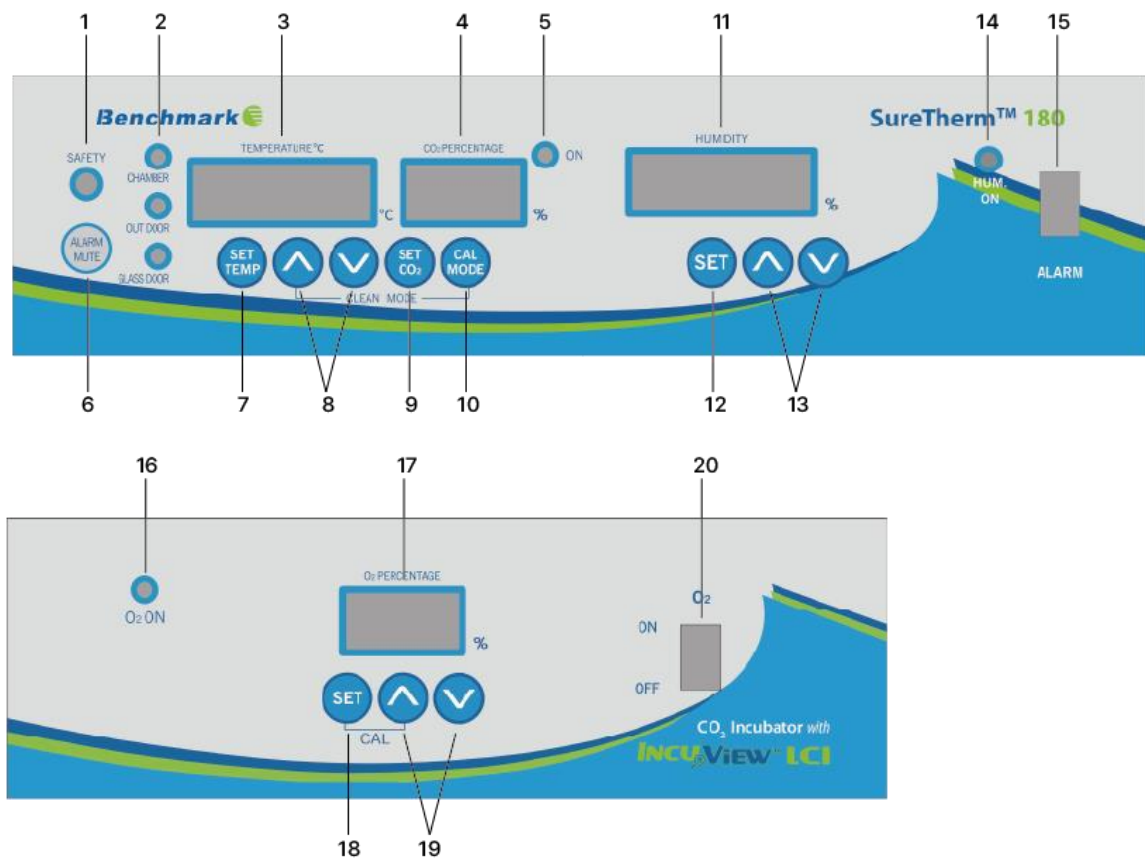
*The minimum temperature specification may vary depending on the room temperature.

3. CONTROL PANEL



(H3565-180 & H3565-180HD)

1. Alarm On/Off Switch
2. SAFETY Activation Indicator: If the over-temperature safety is activated, this LED will be ON
3. Heating Signal: Shows the status of each heating at the 3 sensor locations
(Glass door = heater around glass door)
4. Temperature Display LED Window
5. CO₂ % Display Window
6. CO₂ Supply Status Pilot Lamp: Pilot lamp ON means inflow of gas
7. Alarm Mute Button: When pressed, provides 10 minutes audible alarm delay
8. Temperature Setting Button
9. Temp/CO₂ Adjustment Buttons
10. CO₂ Setting Button
11. Calibration Mode Button



(H3565-180HDO2)

1. SAFETY Activation Indicator: If the over-temperature safety is activated, this LED will be ON.
2. Heating Signal: Shows the status of each heating at the 3 sensor locations (Glass door = heater around glass door)
3. Temperature Display LED Window
4. CO₂ % Display Window
5. CO₂ Supply Status Pilot Lamp: Pilot lamp ON means inflow of gas
6. Alarm Mute Button: When pressed, provides 10 minutes audible alarm delay
7. Temperature Setting Button
8. Temp/CO₂ Adjustment Buttons
9. CO₂ Setting Button
10. Calibration Mode Button
11. Humidity display: Current Humidity value display
12. Humidity Setting Button
13. Humidity Adjustment Buttons
14. Humidity Status Pilot Lamp: Pilot Lamp ON means humidifier operation
15. Alarm On/Off Switch
16. Oxygen Status Pilot Lamp: Pilot lamp ON means inflow of Oxygen
17. Oxygen Display: Current Oxygen value display
18. Oxygen Setting Button
19. Oxygen Adjustment Buttons
20. Oxygen Input ON/Off Switch

4. INSTALLATION

Before beginning the installation, always:

Inspect the packaging for damage. When the instrument is received, please inspect the item carefully to check for any potential transit damage. In the event of damage, always report the damage to the shipping carrier and your local representative immediately.

Included in the package:

1. Stainless Steel Perforated shelf - 2 Pcs in ST-45 / 3Pcs in ST-180 models
2. Power Cord - 1 Pcs
3. Stainless Steel Water Container for humidity - 1Pc
4. CO₂ Gas Tubing with in-line CO₂ Gas filter - 1Pc
5. Operating Manual - 1Pcs

Above parts are packed inside incubator. When received, open the door of incubator and remove all parts to check confirm receipt.

Cleaning before use

Before conducting cell culture in this mini incubator, it is recommended to clean entire chamber, shelves and water container by using soft cloth with at least 70% Ethanol mixed with 30% distilled water.

Installation Procedure:

4.1 Place the incubator at the desired location

Always avoid placing the incubator in:

- An area near equipment generating heat or cold air
- Direct sunlight
- An uneven surface or table.
- A place with heavy vibration
- A place with little air ventilation space behind the incubator.

4.2 Place the shelves and water container in the incubator at the desired height levels. If preferred, place the stainless-steel water container at bottom of chamber toward the back of incubator (in order to get it to be close to circulation fan). This increases the humidity.



Compliance

Distilled water is recommended in order to avoid contamination and corrosion.

If possible, use warm (~37°C) distilled water for immediate humidification.

4.3. Connect the CO₂ Gas supply

The Gas tubes provided are 6 mm (diameter) tubes. Insert the edge of the tube to gas inlet port and connect it to a gas regulator which should be installed on the gas cylinder. Or, install to the gas line in your lab.

- Turn on the gas supply with the pressure set to 1 Bar (or 14.5 Psi)

NOTE: To confirm that there are no leaks in the CO₂ connections, a “bubble check” is recommended. Apply soapy water to each fitting and check if any bubbles are generated. If so, readjust the fitting.

4.4. Connect the power cord

- Plug the power cord into the power inlet on the back side of the incubator.
- Plug the power plug into an outlet of the appropriate voltage.

5. CO₂ INCUBATOR OPERATION

5.1 Power switch

Turn on the power switch. The digital LED will display current temperature and CO₂% in the chamber.

5.2 Setting temperature

- [Press the "SET TEMP" key](#), then, the LED screen will flash and display current programmed temperature.
- [Set up the desired temperature by pressing UP \(▲\) or DOWN \(▼\).](#)
- [Press "SET TEMP" key](#) after adjustment. The "SAVE" message is shown on the display.



NOTE: Always press the "SET TEMP" key after adjusting to the desired value. Otherwise, the value will not be saved.

5.3 Setting CO₂

- [Press "SET CO₂" key](#). Then, the LED screen will begin flashing.
- [Input the desired value of CO₂ density](#) by adjusting UP (▲) or DOWN (▼) key
- [Press "SET CO₂" key again](#) after inputting the value. "SAVE" is shown up on LED screen as below.



NOTE: Always press the "SET CO₂" key after adjusting to the desired value. Otherwise, the value will not be saved.

5.4 Calibration for temperature and CO₂

In the event of a discrepancy, please follow the below procedure for adjusting the calibration.



Caution

Measure CO₂ density and Temperature after incubator is stabilized.

(Allow 2 hours for stabilization after the desired setting has been reached.)

Please note that a very low deviation range such as $\pm 0.1 \sim 0.3\%$ could be difficult to correct precisely by this calibration.

No.	DISPLAY	FUNCTION
1		Chamber Temperature
2		Door Heater Temperature
3		Glass Door Heater Temperature
4		CO ₂ Calibration
5		Heating control
6		CO ₂ gas control valve control

7		To apply a new value
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a. Press and hold “CAL MODE” for 10 seconds. Then, LED will be flickering as below.



Channel 1 is for adjusting the calibration of the main chamber temperature.

Press UP (▲) by the difference measured from the set value and the value measured by precision thermometer or thermocouple. OR

Press DOWN (▼) by the difference measured from the set value and the value measured by precision thermometer or thermocouple

Ex.) If measured temperature is 38°C and Display shows 37°C, then press up 1°C.

NOTE:

* Temperature Calibration range is $\pm 5^{\circ}\text{C}$

* To proceed to next calibration channel, press “CAL/SET” button. After 5th channel, the LED is back to temperature display.

b. Second Calibration Setting: Outer Door Temperature



Caution

The purpose of this heater is to prevent water condensation from forming on the glass door, caused by a large temperature difference between chamber and outside air. If water is condensing on the front door, we recommend adjusting this channel.

NOTE:

Other than water condensing on the glass door, the calibration of channel 2 and 3 would not be recommended.

c. Third Calibration Setting: Door Frame



Caution

The purpose of this heater is to prevent water condensation from forming on the glass door, caused by a large temperature difference between chamber and outside air. This setting should be adjusted if making a change to setting 2 has not resulted in preventing this condensation.

d. Fourth Calibration Setting: CO₂ density calibration



Channel 4 is for adjusting the CO₂ density.

Press UP (▲) by the difference measured from the set value and the value measured by precision analyzer.

Press DOWN (▼) by the difference measured from the set value and the value measured by precision analyzer.

Ex) If the measured CO₂ value is 5% and Display shows 4%, then press up to set to 1%.

e. Fifth Calibration Setting: Heating control



NOTE:

Channel 5 is to set heating control point and is designed to prevent a significant temperature overshoot. This mode is preprogrammed in the factory and should NOT be adjusted by the user.

f. Sixth Calibration Setting: CO₂ gas supply control



NOTE:

Channel 6 is to set the values associated with the CO₂ release solenoid. This mode is preprogrammed in the factory and should NOT be adjusted by the user.



5.5 Alarm

Three(3) minutes after the temperature and the CO₂ density have reached the desired setting, all alarm systems are activated. (If the temperature or CO does not reach the set point, the alarm system will not be activated.)

If the user would like to disable these alarms, the alarm can be set to the "OFF" position.

Alarm Activation

Temperature: $\pm 1^{\circ}\text{C}$ from set point for 8 ~ 9 minutes

CO₂: $\pm 1\%$ from set point for 8 ~ 9 minutes

Door Open: 1 minute after door opening

- Pressing the alarm mute button on the control panel will stop the alarm from activating.
If the alarm was stopped by mute button, the alarm will be re-activated after 10 minutes. (for CO₂ & Temp.)
For door open, the alarm will be re-activated every 1 minute.

5.6 Temperature Thermostat

In the event of a malfunction, this thermostat knob is designed to prevent the heater from overheating.

- Always set the safety knob to a HIGHER value than the set temperature.
- The safety knob has a fairly wide deviation
- The safety knob is designed to prevent the heater from overheating when the temperature control is malfunctioning.



This is the safety device for preventing temperature from rising caused by any circumstances. Set the temperature at 5°C higher than operating temperature or desired point.

- If the "SAFETY" LED on the front panel is illuminated, this switch has been activated and is limiting the temperature.



Appendix I (Hot Air Decontamination)

The Benchmark CO₂ Incubators (Plus models) feature a decontamination program that heats the chamber to 125°C. The decontamination process (signified by “CLEAn” on the temperature display) takes approximately 8 hours in total (including heating and cool down time). Following the 8-hour cycle, the display returns to the values of the most recent program. At this time, the incubator is now ready for use.

Before operating Hot Air Decontamination, ensure the following:

- * **Removal of CO₂ Sensor is not** required as the sensor is out of reach to high heat.
- * Remove the cells, cell container and any heat-sensitive material from the chamber before the decontamination.
- * Remove any humidifier and filter parts. Water container and its cover can remain in hot chamber but, it should be dried before hot air decontamination.
- * Clean the inside of the chamber and make sure the chamber is dried thoroughly.
- * Temperature and CO₂ will reset to last setting value automatically after the 8-hour program.
- * **DO NOT** place cables inside the chamber on the bottom of chamber. Put it on the shelf like below.



※CAUTION:

DO NOT start the decontamination cycle with the optional microscope in the chamber. The temperature will damage the microscope. **ALWAYS** remove the microscope shelf prior to running this cycle.

During and After Hot Air Decontamination, ensure the followings:

- * **Do not open the door** when temperature display indicates **CLEAn** message like below.



- * Always be careful for the injury from hot air.
- * Be sure to check the temperature through its display before opening the door.
- * Do not turn off the incubator when decontamination is ongoing and the incubator is hot. Someone may open the door without recognition of the hot temperature in the incubator.

Note:

- * Humidity display(for ST-180HDO2) keeps showing the humidity during hot air sterilization. To stop its control, set the humidity at zero or much lower than present humidity.
- * To cancel the hot air decontamination cycle, just turn the main power off then back on. But, **DO NOT OPEN THE DOOR** until low temperature (lower than 50°C) is displayed. Keep incubator on after cancelling the decontamination program so people recognize the temperature inside the chamber.

STERILIZATION CYCLE (Total 8 Hours Program)

Cycle: 3 hours sterilization and 5 hours for cooling down

Phase 1: Heat up from 37°C to 125°C (It can take about 2 hours.)

Phase 2: 125°C Hot Air for about 1 hour

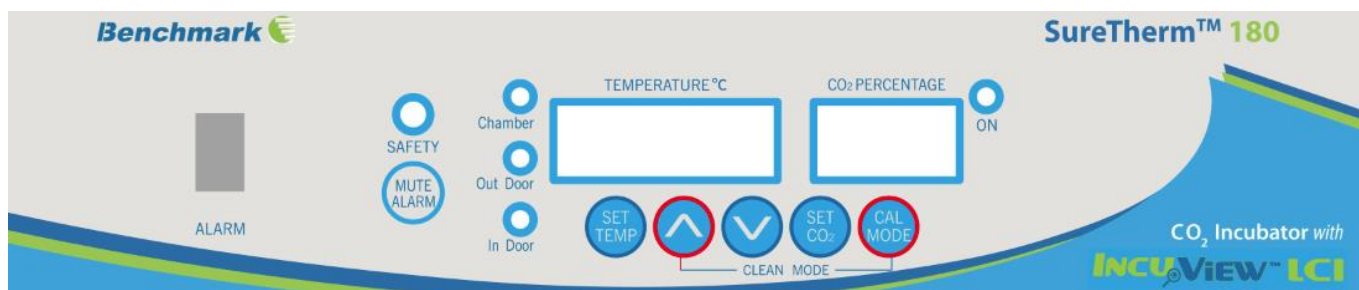
Phase 3: Cooling down for 5 hours

After above 8 hours decontamination program, both temperature and CO₂ controls will reset to last programmed temperature and CO₂.

How to start

After conducting prerequisites on the prior page, take following steps.

1. Turning on: In the status of Incubator power off, TURN the main power of incubator ON **while pressing two buttons (^ & CAL/MODE) directed with CLEAN MODE at same time.**



2. Then, temperature display indicates CLEAN and CO₂ display indicates 480 which means the remaining time of hot air decontamination. See below.



3. Once 8 hours program is over, all displays return to normal and show present CO₂ and Temperature.
4. Then, both CO₂ and temperature reset to last programmed setup and both controls start working to reach temperature and CO₂ to last programmed values.

DO NOT OPEN THE DOOR until appropriate low temperature is confirmed through temperature display and feeling the incubator.

Appendix II (Oxygen Control)

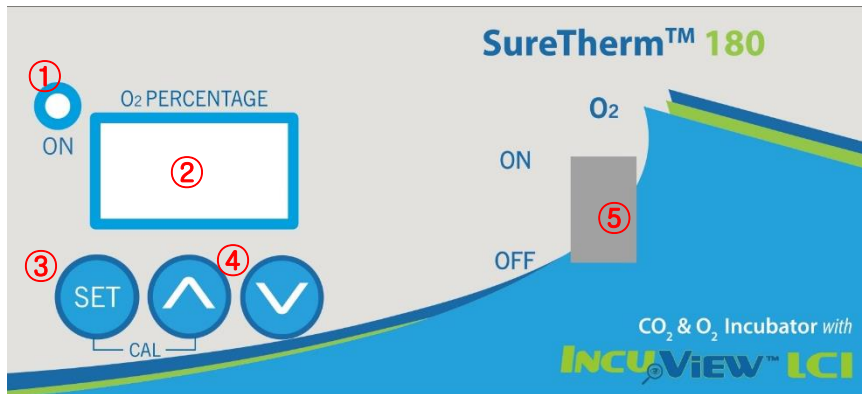
1. Prerequisite

Before Set-up of the Oxygen Density, please ensure the below:

1. Oxygen control in this incubator is only available for Hypoxia conditions that have an oxygen level that is lower than atmospheric oxygen(approx. 21%).
2. Supply N₂(nitrogen) gas by connecting PVC tube to the cylinder (or pipe line) with proper Nitrogen gas regulator. Please consult with your gas provider to select proper regulator for Nitrogen Control.
3. Regulate N₂ supplying pressure in 1 ~ 1.5 bar (1 bar is recommended for above 5% and 1.5 bar for less than 5%.)
4. Make sure that the inner glass door is securely closed to seal the chamber. When there is a low oxygen level, the nitrogen gas pressure can be strong.

Note: It is NOT necessary to disassemble the oxygen sensor when oxygen control is not used or when hot air decontamination is processed.

2. Control Panel



- ① : N₂ Supply Status Pilot Lamp : Pilot lamp ON means inflow of gas
- ② : O₂ Gas % Display Window
- ③ : O₂ Gas Setting Button
- ④ : Adjustment Buttons
- ⑤ : Oxygen Control On/Off Switch

3. Setting up Oxygen

Turn on the O₂ power switch and the Oxygen display will indicate “-----” for 1minute.

Then, the display will display to the measured oxygen reading.

Press SET button and the value begins flashing with current set-up value.

In such status, adjust the value with UP(^) and DOWN (V) key.

After adjustment, press SET button again to save the change.

* If you don't press "SET" button finally after change, the new set-up will not be saved.

Oxygen setup range is 1% to 19%.



Caution

In case of lower Oxygen set-up than 10%, N₂ gas consumption will be at a fast rate of use.

Oxygen sensor is not exposed, but please note that if accessing oxygen sensor,

CAUTION: the oxygen sensor is very hot to prevent condensation.

4. Calibration of Oxygen Display

4.1 Before the calibration, make sure the following

1. Calibration is recommended when the deviation is significantly larger than $\pm 0.5\%$ from setting value.
2. The deviation should be validated by a precisely calibrated oxygen analyzer and trained personal.
3. The measurement of oxygen in chamber should be conducted after enough stabilization time at setting value for at least 30min ~ 1hour.

4.2 Calibration

1. Press **SET** & **^** buttons together at the same time.
2. The Display will be flashing with last calibrated value. In that status, adjust the value with up and down buttons. For example, if the display is 9% while actually measured value is 10%, adjust the value by +1% from previous calibrated value. This will lead current oxygen reading to change by +1% and to be 10%.
3. After adjustment, press "**SET**" and "**^**" key together to save the change.

5. Troubleshooting and additional suggestions

1. If O₂ is too much overshooting and hard to control to reach at nearest set point, check the pressure of Nitrogen gas from regulator. If it is higher than 1 ~ 1.5 bar, lower it to 1 ~ 1.5 bar.
And also, check the leakage in line of gas or in sealing of glass door. Also, check the fitting of the connections or the gas solenoid valve for damage or leakage.
2. The life time of installed oxygen sensor is normally 5 years at normal atmospheric oxygen level like 21% according its manufacturer. But, the sensor in this incubator is used at abnormal condition than normal atmospheric condition. So, the life time can be shorter than 5 years depending how the incubator is used. So, if the Oxygen reading is far incorrect or there is large deviation in display from actually measured value, the replacement of oxygen sensor is recommended.
3. When incubator is at standard atmospheric level (no nitrogen supply), the oxygen level should be near 21%. If this is not the case, the oxygen sensor should be examined for potential malfunction.
3. Replacement of the oxygen sensor should only be conducted by a trained technician. Since oxygen sensor gets very hot, the power of incubator should be turned off prior to the replacement.
4. Do not replace oxygen sensor with the other oxygen sensors than originally installed one. It simply will not work and it may cause damage in its control board or sensor. Please contact authorized distributor or service agent when the replacement is needed.

Appendix III (Humidity Set-up)

6.1 Precaution



Compliance

- * To avoid contamination inside the incubator and water, sterile distilled water must be used.
- * Make sure all components for humidification fully dry after cleaning with no water remaining. When incubator is not used, make sure all materials inside chamber are dried. If water is remaining in the incubator while is not used being used but, the door is sealed, there can be condensation which can cause corrosion inside incubator.
- * Water should be filled high enough to make sponge stick of humidifier continuously wet for humidification.
- * The filter set (sponge and its plastic holder) can be cleaned with ethanol. The humidifier and its parts are not autoclavable. After cleaning, make sure ethanol is fully dried out before use.
- * Secure connection of cable to the humidifier so it keeps working when humidification is required.
- * When using Hot Air Decontamination, remove the humidifier and its filter parts. Set the humidity at 0% and disconnect the cable of humidifier to get it out of incubator. During the hot air decontamination, humidity display keeps showing the humidity % inside the chamber.
- *The water container of the humidifier can be remained in the chamber during hot air decontamination but, it should be fully dried without any water remaining. All parts of humidifier except water container should be removed before running hot air decontamination.

**** Please be aware of condensation which can occur in cases as below.**

- When the door is open, heating and humidification stop and humidity can go down sharply. After the door is closed, both heating and humidification are reactivated automatically. At this time, some condensation can occur on the glass door because steam is generated to the glass door immediately after the door is closed. Once temperature is stabilized, condensation will disappear.

- If opening and closing door is frequent, condensation may occur frequently.

- * Please be aware that there should be larger fluctuation in Humidity display when humidity is high.
e.g.) When 95% humidity is set, humidity display can be fluctuating in 94~98%.
- * If humidification is not necessary, please set humidity value very low like 0% and disconnect the humidifier.
- * It is recommended that humidifier filters be disinfected with UV light after use for a certain period of time.

6.2 Installation

1. Find the water container with humidifier and its cable connection inside incubator like photo #1.
 2. Open the cover of container and fill sterile distilled water into the tray as much as sponge stick can soak.
 3. Cover and place the tray carefully at the bottom of incubator chamber.
 4. And connect the cable and place the tray close to the back of chamber.
 5. Close the inner glass door and outer door.
- * When humidification is activated, if temperature inside is low, there should be some condensation.
To avoid such condensation, begin humidity setup once temperature is stabilized.
6. Set the target value by press set button once and change calibration value press set button twice.



#1. The Tray with Humidifier and Cable



#2. Disconnecting the cable before taking tray out



#3. Open the cover of Tray



#4. Fill sterile distilled water. Carefully put tray back and connect the cable



6.3 Set-up



Setting Up Humidity (RH)

- Press SET button to enter the mode of humidity setting.
- Then, the display will flicker.
- Adjust the RH value with up and down buttons.
- Press SET button to save the value finally.
- ※ Press the SET button finally to program the value.
- ※ **Only Humidification is available. (Ambient +5% to 95%)**
- ※ **Dehumidification is not available.**

Service and Contact

Service on the instrument should only be performed by qualified service personnel. To request service or technical support, please contact Benchmark Scientific or your local Benchmark Scientific representative.

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