



CE 0088



USER MANUAL

Mini MIRI[®] Dry / Humidity Multiroom Incubators

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Rx only



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Return Procedure

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Esco Medical warrants this instrument to be free from defects in materials and workmanship under regular use and service for two (2) years from the original purchase date. The provided instrument is calibrated and maintained following this manual. During the warranty period, Esco Medical will, at our option, either repair or replace a product that proves to be defective at no charge, provided you return the product (shipping, duty,

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- Accident, alteration, abuse or misuse of the instrument
- Fire, water damage, theft, war, riot, hostility, acts of God such as hurricanes, floods, etc.

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- Use a double-walled carton of sufficient strength for the weight being shipped
- Use heavy paper or cardboard to protect all instrument surfaces. Use non-abrasive material around all projecting parts
- Use at least four inches of tightly packed, industrial-approved, shock-absorbent material all around the instrument

Esco Medical will not be responsible for lost shipments or instruments received in damaged condition due to improper packaging or handling. All warranty claim shipments must be made on a prepaid basis (freight, duty, brokerage, and taxes). No returns will be accepted without a Return Materials Authorization ("RMA") number. Please contact Esco Medical to obtain an RMA number and receive help with shipping/customs documentation.

Re-calibration of instruments, which have a recommended annual calibration frequency, is not covered under warranty.

Warranty Disclaimer

If your instrument is serviced and/or calibrated by someone other than Esco Medical Ltd. and their representatives, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization.

In all cases, breaking the tamper-resistant Quality Seal should be avoided at all cost, as this seal is key to your original instrument warranty. In an event where the seal must be broken to gain internal access to the instrument, you must first contact Esco Medical Ltd.

You will be required to provide us with the serial number for your instrument, as well as a valid reason for breaking the Quality Seal. You should break this seal only after you have received factory authorization. Do not break the Quality Seal before you have contacted us! Following these steps will help ensure that you will retain the original warranty on your instrument without interruption.

WARNING

Unauthorized user modifications or applications beyond the published specifications may result in an electrical shock hazard or improper operation. Esco Medical will not be responsible for any injury sustained due to unauthorized equipment modifications.

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THIS PRODUCT CONTAINS NO USER-SERVICEABLE COMPONENTS.

UNAUTHORIZED REMOVAL OF THE INSTRUMENT COVER SHALL VOID THIS AND ALL OTHER EXPRESSED OR IMPLIED WARRANTIES.

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1 How to use this manual

The manual is designed to be read by sections and not ideally from cover to cover. It means that if the manual is read from start to finish, there will be some repetition and overlap. We recommend the following method for going through the manual: first, familiarize yourself with the safety instructions; then, proceed to the essential user functions needed for operating the equipment on a day-to-day basis; then, review the alarm functions. The menu functions of the user interface detail information that is required only for advanced users. All parts must be read before the device is taken into use. The Validation guide is detailed described in sections 33 – 36. The Maintenance guide is detailed described in section 37. The Installation procedures are detailed described in section 38.

2 Safety warning

- Anyone working with, on or around this equipment should read this manual. Failure to read, understand and follow the instructions given in this documentation may result in damage to the unit, injury to operating personnel, and/or poor equipment performance
- Any internal adjustment, modification or maintenance to this equipment must be undertaken by qualified service personnel
- If the equipment must be relocated, make sure it is appropriately fixed on a support stand or base, and move on a flat surface. When necessary, move the equipment and the support stand/base separately
- The use of any hazardous materials in this equipment must be monitored by an industrial hygienist, safety officer or other suitably qualified individuals. Before you proceed, you should thoroughly understand the installation procedures and take note of the environmental/electrical requirements
- In this manual, important safety-related points will be marked with the following symbols:



NOTE

It is used to direct attention to a specific item.



WARNING

Use caution.

- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

3 Indication for use

The Esco Medical Mini MIRI® incubators are intended to be used to provide a stable culture environment at or near body temperature and CO₂/N₂ or premixed gases and humidification (in Mini MIRI® Humidity) for the development of gametes and embryos during in vitro fertilization (IVF) / assisted reproduction technology (ART) treatments.

4 About the product

Esco Medical Mini MIRI® Dry and Mini MIRI® Humidity incubators are multi-room CO₂/O₂ incubators.

Direct warming of the dishes in the chambers gives superior temperature conditions in comparison to conventional incubators.

The compartment's temperature will remain stable up to 1 °C (even when a lid is open for the 30s) and recover within 1 min after it is closed.

The Esco Medical Mini MIRI® incubators have 2 completely separate culture heat chambers. Each chamber has its heated lid and warming plate for the Petri dish. Mini MIRI® Dry and Mini MIRI® Humidity capacity for 35mm Petri dish are 16 pcs and 60mm and 4-well Petri dishes – 8 pcs.

To ensure maximum performance, the system of Mini MIRI® Dry and Mini MIRI® Humidity has 4 completely separate PID temperature controllers. They control and regulate the temperature in culture chambers and lids. Compartments do not affect each other's temperatures in any way. The top and the bottom of each compartment are separated with a PET layer so that the lid temperature would not affect the bottom. For validation purposes, each compartment has a PT-1000 sensor built-in. The circuitry is separated from the unit's electronics, so it remains a genuinely separate validation system.

The incubators have to be supplied with 100% CO₂ and 100% N₂ or premixed gas (for instance, 5% CO₂; 5% O₂ and 90% N₂) to control the CO₂ and O₂ concentrations the culture chambers.

A dual-beam infra-red CO₂ sensor with extremely low drift rates controls the CO₂ level. A chemical, medical-grade oxygen sensor controls the level of O₂.

Gas recovery time is less than 3 min after opening the lid. Mini MIRI® Dry and Mini MIRI® Humidity incubators are fitted with two gas sample ports that allow the user to validate gas concentration by sampling gas from the individual compartment.

The incubator features a recirculated gas system where gas is continuously put into the compartment and taken out at the same rate. Gas is cleaned via 254 nm UVC light with direct gas contact between the bulb and gas, then through a VOC filter and a HEPA filter. The UVC light has filters that inhibit any 185 nm radiation that would produce dangerous ozone. The VOC filter is located under the UVC light.

UVC light modules and HEPA-VOC filters are not applied on Mini MIRI® Humidity. Complete gas repletion in the system takes less than 5 min.

The total gas consumption is very low. Less than 2 l/h CO₂ and 5 l/h N₂ in use.

For safety reasons, the incubator has a complete gas control system that consists of a pressure regulator (preventing dangerous gas pressure problems), gas flow sensors (actual consumption can be accumulated), gas pressure sensors (then the user knows that the pressure and variation can be logged to avoid dangerous conditions), gas filters (to prevent valve problems).

Petri dish location in a compartment is easy to reach and safe because of the compartment numbering and the ability to write on the white lid with a pen.

The incubator has been primarily developed and designed to incubate gametes and embryos with an overlay of either Paraffin or mineral oil.

In the case of Mini MIRI® Dry and Mini MIRI® Humidity, the upright LED display is large, clear and easy to read from a distance. The user can tell if the parameters are correct without going near the unit.

A pH sensor port is part of the DAQ package. The user can plug any standard BNC pH probe into the unit and measure the pH in the samples at will.

If an open culture (any culture where the culture media is not covered with a layer of oil) is used, the user must switch the device to open culture mode.

 **Refer to section “16.4 The culture mode” for more detailed information.**

The incubator can be connected to a PC running the Esco Medical data logging software for long-term data logging and data storage.

The devices are manufactured under a full EU certified 13485 ISO quality management system.

This product fulfills the requirements of EN6060-1 3rd edition standards as a Class I equivalent device suited for continuous operation. It also conforms to the EU Council directive's 93/42/EEC requirements concerning medical devices and is classified as a Class IIa device under rule II.

Personnel Protective Equipment (89/686/EEC) and Machine Directive (2006/42/EC) are not applicable for Mini MIRI® incubators.

5 Transport, Storage and Disposal

5.1 Transportation requirements

The device is packed in a carton box, and it is wrapped in polyethylene. The box is affixed to a pallet with special straps.

A visual inspection should be done if there is any damage. If there was no damage found, the Mini MIRI® Dry or Mini MIRI® Humidity incubator are prepared to be transported.

These labels should be glued on the box:

- Label with the marked packing date
- Label with the product name and serial number
- Label with the country of origin
- Warning labels “Fragile” and “Handle with care”

5.2 Storage and operation environment requirements

5.2.1 Storage requirements

The device may only be store under the following conditions:

- The unit can be in store for one year. If stored longer than one year, the unit must be re-returned to the manufacturer for a new release test
- Store between -20 °C and + 50 °C temperature limits
- Keep away from direct sunlight
- Caution: consult the accompanying documents for important safety-related information such as warnings and precautions that cannot be presented on the device itself for various reasons
- Do not use if the packing material is damaged
- Keep dry

5.2.2 Operation environment requirements

The device may only be used under the following conditions:

- Do not see the device at an environmental temperature exceeding 30 °C
- Keep away from direct sunlight
- Keep dry
- Indoor use only

5.3 Disposal

Information on the unit's handling as per the WEEE Directive (Waste Electrical and Electronic Equipment).



The device may have been used for treating and processing infectious substances. Therefore, the device and device components may be contaminated. Before disposal, the whole device must be disinfected or decontaminated.

The unit contains reusable materials. All components (except for the VOC/HEPA and HEPA filters) can be discarded as electrical waste after cleaning and disinfection.

Please note that the VOC/HEPA and HEPA filters must be discarded following the applicable national regulations for particular solid waste.

6 Accessories supplied

- 1 VOC/HEPA filter capsule (only for Mini MIRI® Dry model)
- 1 humidity bottle (only for Mini MIRI® Humidity model)
- 2 HEPA filter for input gas supply
- 2 warming blocks
- 4 warranty labels
- 1 pump box calibration tool (only for Mini MIRI® Humidity model)
- 1 USB stick containing Esco Medical Data logger software and a PDF version of the user manual
- 1 medical grade power cord
- 1 3,5 mm external alarm jack connector
- 1 set of fast male connectors with 15 silicone pipes

7 Safety symbols and labels

Several user labels on Mini MIRI® Dry and Mini MIRI® Humidity incubators surface to guide the user. User labels are shown below.

Table 7.1 Packing box and electrical safety labels

Description	Image
<p>Packing box label:</p> <ol style="list-style-type: none"> 1. If stored longer than the shelf life, the unit must be returned to the manufacturer for a new release test. 2. Shipping temperature between -20 °C and +50 °C. 3. Keep away from direct sunlight. 4. Caution: consult the accompanying documents for important safety-related information such as warnings and precautions that cannot be presented on the device itself for various reasons. 5. Consult instructions for proper use of the device. 6. Do not use it if the packing material is damaged. 7. Rx Only. 8. Keep dry. 	
<ol style="list-style-type: none"> 1. Consult instruction for use. 2. Warning on the back of the device indicates that an earth connection is needed and the mains information and an "ON/OFF" push button. 3. "Lightning bolt" indicates the potential risk of electrical shock (never remove any cover). 	

Table 7.2 Device labels

Description	Image
<ol style="list-style-type: none"> 1. Model. 2. Mains power rating. 3. CE mark. 4. Not protected against the ingress of water. 5. Manufacturer’s address and country of origin. 6. View instruction for use. 7. Observe WEEE. 8. Upper limit of temperature. 9. Keep away from direct sunlight. 10. Keep dry. 11. Logo and serial number. 12. Year of manufacture. 13. Rx only. 	

Table 7.3 Info labels on the Mini MIRI® Dry and Mini MIRI® Humidity incubators

Description	Image
USB communication port	
CO ₂ inlet	
N ₂ inlet	
Alarm port	
Compartments numbers are indicated in the top corner of the lid with a label	
Humidification bottle ¹	
VOC/HEPA filter ²	

¹ Only for Mini MIRI® Humidity model

² Only for Mini MIRI® Dry model

Compartment numbers are shown in the picture below and also indicated on the top of the lid with labels:



Figure 7.1 Compartment numbers

8 Important safety instructions and warnings

8.1 Before installation

1. Do not use the product if the package is damaged. Contact Esco Medical or the local representative.
2. Read the user manual thoroughly before use.
3. Always keep these instructions easily accessible near the device.

8.2 During installation

1. Never place this unit on top of other equipment that might heat it.
2. Place this unit on a flat, hard and stable surface.
3. Never place the unit on a carpet or similar surfaces.
4. Do not defeat the safety purpose of the grounding-type (earthing) plug.
5. A grounding-type (earthing) plug has two blades and a third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician to replace the outlet.
6. Always connect the power cord to a properly grounded outlet and only use the cord that came with the device.
7. Do not install the device near any heat sources such as radiators, heat registers, stoves or other apparatus that produce heat.
8. Do not use this device near water sources.
9. Use only 100% concentration CO₂ and 100% concentration N₂ or premixed gases.
10. Always use an external HEPA filter for input CO₂/N₂ or premixed gas.
11. Do not use this product if the room temperature exceeds 30 °C.
12. Place this unit in a location with adequate ventilation to prevent internal heat build-up. Leave at least 10 cm clearance from the rear, 30 cm from the top and 20 cm from left and right to prevent overheating and allow access to the ON/OFF switch in the back.
13. This unit is intended for indoor purposes only.
14. The unit must be connected to a suitable uninterrupted power supply (UPS) source.

8.3 Post-installation

1. Refer all servicing to qualified service personnel.
2. Servicing is required according to the service manual as well as in cases when the device has been damaged in any way, e. g. suppose the apparatus has been dropped, exposed to rain or moisture or does not operate normally. Mini MIRI® Dry and Mini MIRI® Humidity incubators contain high voltage components that may be hazardous.
3. Unplug this apparatus during lightning storms or when unused for an extended period of time.
4. Protect the power cord from being walked on or pinched, particularly at the plug, convenience receptacles, and the point where it exits from the apparatus.
5. Perform temperature and gas calibration at the intervals described in the manuals.
6. Never leave the lids of the compartment open for more than 10 sec while in use.
7. VOC/HEPA filters must be changed every 3 months (no change is required in the Mini MIRI® Humidity multiroom incubator).
8. A maintenance plan must be fulfilled to keep the device safe.
9. NEVER block gas supply holes in the compartment.
10. Ensure that CO₂/N₂ or premixed gas supply pressures are kept stable at 0.4 – 0.6 bar (5.80 – 8.70 PSI).
11. Never use any other except Esco Medical filter. Otherwise, the warranty will be void.
12. Do not use the device without a proper Esco Medical VOC/HEPA filter attached.

9 Getting started

 **Mini MIRI® Dry or Mini MIRI® Humidity incubators must be installed by authorized and trained personnel only!**

1. Follow the guidelines in the safety instructions and warnings section.
2. Connect the mains cable to the UPS.
3. Connect the mains cable to Mini MIRI® Dry or Mini MIRI® Humidity incubator.
4. Connect gas sample lines.
5. Set the gas pressure on the external gas regulator at 0.4 – 0.6 bar (5.80 – 8.70 PSI).
6. Switch on Mini MIRI® Dry or Mini MIRI® Humidity incubator in the back.
7. Observe for standard functionality.
8. Let the unit warm up and stabilize for 20 min.
9. Follow the guidelines in the Validation guide.
10. Complete user training and finish reading instructions.
11. After a burn-in phase of 24-hours, the unit is ready for use IF the testing is successful.

 **If the device is going to be used in a clinical setting, clean and disinfect the device before use. It is not delivered sterile or in a clinically acceptable clean state. Consult the cleaning instructions section in this manual for the manufacturer's recommended guidelines!**

10 Mains connection

Mini MIRI® Dry and Mini MIRI® Humidity incubators come with a detachable main power cord. The power cord is prepared for the country in which the unit is intended to be used.

 **Do not defeat the safety purpose of the grounding-type plug! A grounding type plug has two blades and a third prong. It is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician to replace the outlet.**

The power requirement is 230V 50 Hz OR 115V 60Hz. The built-in power supply has a switch-mode that automatically adjusts to the correct mains power between 100V-250V AC 50-60 Hz.



Figure 10.1 Power supply

11 Gas connections

There are two gas inlets on the back of the unit. These ports are marked “N₂ 100% Inlet” and “CO₂ 100% Inlet”.



Figure 11.1 Gas inlets

CO₂ inlet should be connected to a 100% concentration of CO₂. CO₂ control in the compartment is available in the range from 1.9% to 9.9%.

The N₂ inlet should be connected to 100% concentration N₂ if low oxygen conditions are required. The O₂ control in the compartments is available in the range from 3.9% - 19.9% by infusing N₂.

The premixed gas inlet should be connected to the CO₂ inlet.

 **Gas pressure for both inlets should be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) and it must be kept stable!**

Always use a high-quality pressure regulator that can be set with the required precision for both gases.



Figure 11.2 Pressure regulator

Connect the CO₂ gas to the CO₂ inlet with a suitable silicone tube. Ensure the tube is fastened with a clip so that it does not accidentally loosen itself during sudden pressure fluctuation. Use the supplied 0.2µ HEPA filter on the gas line just before the inlet on the incubator. Notice the direction.

Connect the N₂ inlet to the Nitrogen Bottle / CO₂ inlet to the premixed Bottle.



Figure 11.3 Gas filter

👉 Mini MIRI® Dry or Mini MIRI® Humidity incubators can also run-on premixed gas. It is a more expensive option for gas consumption. It also means the user cannot adjust the CO₂ and O₂ levels without changing the gas supply. Please read the “14 Installation with premixed gas” section below for more information about using the device on premixed gas.

12 HEPA/VOC filter (not available in the US)

👉 HEPA/VOC filter is not available in the Mini MIRI® Humidity model.

VOCs are hydrocarbon-based compounds that are found in fuel, solvents, adhesives, and other compounds. Examples of VOCs include isopropanol, benzene, hexane, formaldehyde, vinyl chloride.

VOCs can also occur in medical gases, such as CO₂ and N₂. It is essential to use in-line VOC filters for your medical gases to prevent these fumes from entering your incubators.

Unexpected sources of VOCs are commonly found in IVF labs. These can include cleaning agents, perfumes, cabinetry, grease on the wheels of equipment, and sources in HVAC equipment.

VOCs are typically measured in parts per million (ppm). They can also be reported in parts per billion (ppb). For IVF labs, VOCs' recommended count is below 0.5 ppm; the total quantity of VOCs should be <0.2 ppm or preferably zero.

High levels of VOCs (over 1 ppm) are toxic to embryos, resulting in poor embryo development and even probable failure to reach the blastocyst stage.

VOC levels in the 0.5 ppm range will typically allow for acceptable blastocyst development and reasonable pregnancy rates but will result in a high percentage of miscarriages.

A combined HEPA and VOC filter (carbon filter) are integrated into the Mini MIRI® Dry incubator's construction. Before entering the incubator, the gas is sent through the filter in a single pass. Then upon return from the compartment, the gas is filtered again. The recirculation system constantly filters the gas present in the incubator.

The combined HEPA and VOC filter is mounted on the back of the device for easy access and replacement (only in the Mini MIRI® Dry model).

12.1 Installation of new filter capsule (only in the Mini MIRI® Dry model)

The two blue caps that are installed on the filter can be discarded during unwrapping. Correct filter performance is crucial for system performance.

 **Filter element must be changed every 3 months. Mark the date when it is put on and make sure to keep this interval!**

Start by putting the blue fittings on the filter into the filter holder sockets. The flow arrow on the incubator and the filter should point in the same direction.

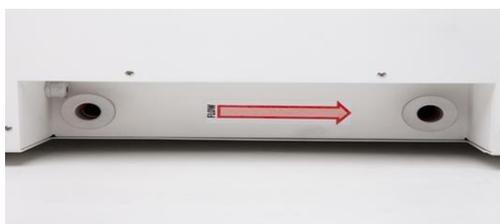


Figure 12.1 The flow arrow on the incubator



Figure 12.2 The way of pulling the filter



Figure 12.3 Filter in place

Then, simultaneously press both angle fittings (using both hands) into the holes till they snap into place. The last 4 mm step should feel stiff.

⚠ A filter element that is fitted incorrectly will cause the unit not to work not as intended. This is dangerous!

The filter is removed by gently pulling it straight out using both hands.

⚠ Never run the Mini MIRI® Dry incubator with the filter element missing! Dangerous particle contamination could occur!

13 User interface

In the following chapters, the functions associated with the keys and menu items will be explained. User interface handles daily used functions and more advanced adjustments that might be made to the device. The main keys and their purpose are presented in table 13.1.

Table 13.1 The main keys and their purpose

Description	Image
<p>Rotary button Use to toggle and select items on the menu to change their status. It is also used to change the temperature and gas setpoints values</p>	
<p>ON/OFF button It is located in the REAR of the unit</p>	
<p>Alarm key It mutes an audible alarm and visually indicates the alarm condition by a flashing red circle of light. The audio alarm will come back on automatically after 5 min. It can be muted again</p>	
<p>Display panel Shows the information on the current status of the unit. The display consists of 7 x high brightness 16 segment LEDs. The first one is red to indicate a user warning. The other 6 are blue and used to display normal running conditions</p>	

13.1 Activating the heat and gas controls

Heat and gas control systems are activated using the “ON/OFF” switch in the rear.

Soon after system activation, the main display will alternate the reading between the following 4 parameters:

Temperature	= Temperature in °C
CO ₂	= CO ₂ Concentration in %
O ₂	= O ₂ Concentration in %
Mode	= Open/ Oil Culture

13.2 System menu

Press and hold the rotatory button for 3 seconds to access the menu.

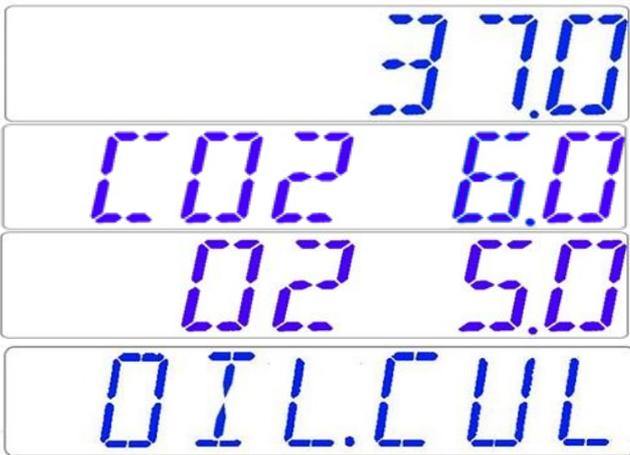
Navigate in the menu by:

- Rotating rotatory button clockwise (↻) or anticlockwise (↺) = previous OR next
- Pressing rotatory button = enter, change OR accept

Rotate the rotatory button (↺) to exit the menu entirely.

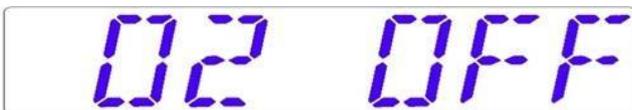
13.3 Status

Alternating between the 4 values under normal running conditions:



Force scroll between parameters with rotating rotatory button (↻) or (↺).

 If the O₂ regulator is deactivated, the system will display “O2 OFF”.



👉 If the use mode is Open Culture (no oil or Paraffin overlay culture), the device shall be set for that and will display:



13.4 Main menu

Press the rotatory button – enter the menu.
You can exit the menu by rotating the rotatory button (↺).



Temperature is the first category when you enter the menu.
You can press the rotatory button to enter the Temperature sub-menu.



Rotate the rotatory button (↺) to scroll further down in the menu.
You can press the rotatory button to enter the CO₂ sub-menu.



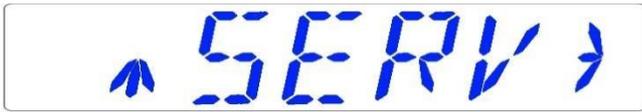
Rotate the rotatory button (↺) to scroll further down in the menu.
You can press the rotatory button to enter the O₂ sub-menu.



Rotate the rotatory button (↺) to scroll further down in the menu.
You can press the rotatory button to enter the UVC light sub-menu (not available in Mini MIRI® Humidity).



Rotate the rotatory button (↺) to scroll further down in the menu.
You can press the rotatory button to enter the Service sub-menu.



13.4.1 Temperature sub-menu

Press the rotatory button on the temperature menu to enter the temperature sub-menu. Calibrate temperature by pressing the rotatory button and rotating it (↶) or (↷) to adjust.



Move to the next sub-menu item with (↶) rotation or one step up with (↷) rotation.

Example - how to calibrate the temperature:

The temperature has to be measured with a suitable and calibrated device. With a quality thermometer, it has been estimated that T1 is 37.4 °C. Locate "T1 CAL" in the sub-menu and press the rotatory button. The display should show:



Rotate the rotatory button (↶) until the temperature measured by the thermometer is displayed on the panel. In this case, we want to adjust to 37.4 °C. Rotate (↶) till the display shows 37.0, 37.1, 37.2, 37.3 and 37.4. When temperature equals measured temperature, press the rotatory button. The value is stored and the temperature sensor for the T1 area has been modified.

 **Calibration procedure is the same for T1 - T4.**

13.4.2 CO₂ sub-menu

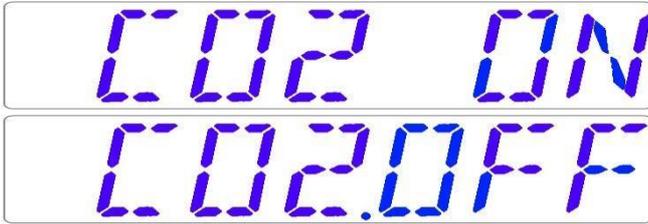
Press the rotatory button on the CO₂ menu to enter the CO₂ sub-menu. The first item in the CO₂ sub-menu is CO₂ sensor calibration:



Calibrate CO₂ by pressing the rotatory button and rotating it (↶) or (↷) to adjust. Move to the next CO₂ sub-menu item with (↶) rotation or one step up with (↷) rotation.



Toggle CO₂ regulation on/off by pressing the rotatory button and rotating it (↶) or (↷).



👉 **The default status for the CO₂ control is OFF.**

Move to the next CO₂ sub-menu item with (↶) rotation or one step up with (↷) rotation. CO₂ flow rate is shown (it cannot be adjusted):



It shows the amount of CO₂ gas put into the system while regulating. The volume is shown in liters/hour. It usually will fluctuate along with the CO₂ regulation.

Move to the next CO₂ sub-menu item with (↶) rotation or one step up with (↷) rotation. CO₂ internal pressure rate is shown (it cannot be adjusted on the incubator. It is adjusted on the external gas regulator):



The value is in bar and it must be 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times.

Example – how to calibrate CO₂:

CO₂ gas concentration has to be measured with a suitable and calibrated device. The real CO₂ concentration has been estimated to be 6.4% on one of the gas sample ports. Each port is suitable for this purpose.

Locate “CO₂ CAL” in the CO₂ sub-menu and press the rotatory button. The display should show:



Rotate rotator button (↶) to adjust the CO₂ calibration to the desired level by (↶) or (↷) rotation. In this case, we want to change to 6.4%. Rotate (↶) till the display shows 6.0, 6.1, 6.2, 6.3 and 6.4. When CO₂ equals measured CO₂, press the rotatory button. The value is stored and the CO₂ sensor calibration has been modified.

👉 **Pure CO₂ 100% gas recovery till 5% is less than 4 minutes.**

👉 **Calibration is done by adjusting the CO₂ level according to a measurement taken from the gas sampling outlet, using a precision CO₂ measurement device only.**

⚠️ **Calibration values should only be changed based on measurements taken by a trained user or technician.**

13.4.3 O₂ sub-menu

Press the rotatory button on the O₂ menu to enter the O₂ sub-menu.
The first item in the O₂ sub-menu is O₂ sensor calibration:



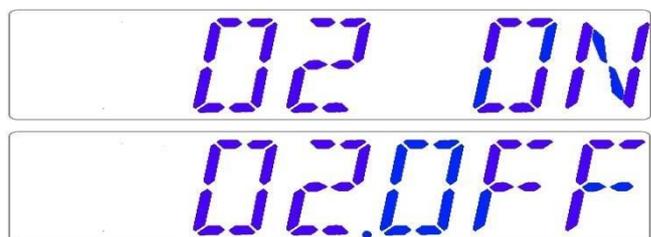
The image shows a rectangular LCD display with a blue dot-matrix font. The text "O2CAL" is displayed in the center of the screen.

Calibrate O₂ by pressing the rotatory button and rotating it (↶) or (↷) to adjust.
Move to the next O₂ sub-menu item with (↶) rotation or one step up with (↷) rotation.



The image shows a rectangular LCD display with a blue dot-matrix font. The text "O2REG" is displayed in the center of the screen.

Toggle O₂ regulation on/off by pressing the rotatory button and rotating it (↶) or (↷).



The image shows two stacked rectangular LCD displays with a blue dot-matrix font. The top display shows "O2 ON" and the bottom display shows "O2 OFF".

👉 **The Default status for the O₂ control is OFF.**

Move to the next O₂ sub-menu item with (↶) rotation or one step up with (↷) rotation.
N₂ flow rate is shown (it cannot be adjusted):



It shows the amount of N₂ gas put into the system while regulating. The volume is shown in liters/hour. It usually will fluctuate along with the O₂ regulation.

Move to the next O₂ sub-menu item with (⤵) rotation or one step up with (⤴) rotation. N₂ internal pressure rate is shown (it cannot be adjusted on the incubator. It is adjusted on the external gas regulator):



The value is in bar and it must be 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times.

Example - How to calibrate O₂:

O₂ gas concentration has to be measured with a suitable and calibrated device. The real O₂ concentration has been estimated to be 5.3% on one of the gas sample ports. Each port is suitable for this purpose.

Locate “O₂ CAL” in the O₂ sub-menu and press the rotatory button. The display should show:



Rotate rotator button (⤵) to adjust the O₂ calibration to the desired level by (⤵) or (⤴) rotation. In this case, we want to change to 5.3%. Rotate (⤵) till the display shows 5.0, 5.1, 5.2 and 5.3. When O₂ equals measured O₂, press the rotatory button. The value is stored and the O₂ sensor calibration has been modified.

👉 Calibration is done by adjusting the O₂ level according to a measurement taken from the gas sampling outlet, using a precision O₂ measurement device only.

👉 Calibration values should only be changed based on measurements taken by a trained user or technician.

13.4.4 UV-C light sub-menu (the functionality is not available in the US):

👉 UV-C light function is not available in the Mini MIRI® Humidity model.

Press the rotatory button on the UV-C menu to enter the UV-C light sub-menu.



Toggle UV-C light regulation on/off by pressing the rotatory button and rotating it (⤴) or (⤵).



👉 The default status for the UV-C light is “ON”.

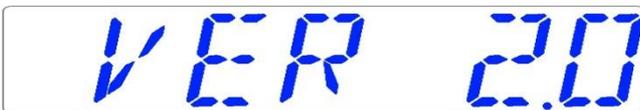
The UV light will automatically switch off when the unit is turned off.

👉 For optimal air cleaning, it is recommended to have the UV-C light set to “ON” when the unit is used.

13.4.5 Service sub-menu

Press the rotatory button on the service menu to enter the service sub-menu.

The display will show the currently installed firmware version:



Ver 2.0 is only shown as an example. Consult Esco Medical or the local representative for the number of the latest version.

Move to the next service sub-menu item with (⤴) rotation or one step up with (⤵) rotation.

The display will show the “GAS” function:



Press the rotatory button to enter and rotate (⤴) or (⤵) to choose “PREMIX” or “CO₂/O₂”. Press the rotatory button to chooses premixed or CO₂/O₂ gas mode.

 **When using the premixed gas mode, it is necessary to use a premixed gas with higher gradation than the setpoint. For example, if you need to achieve a 5% CO₂ gas setpoint, premixed gas should have 6% CO₂ in its mixture.**

Then exit the menu by (⏪) or press the rotatory button and hold it until the main menu does not appear.

14 Installation with premixed gas

Mini MIRI® Dry and Mini MIRI® Humidity incubators have primarily been designed to run on 100% CO₂ and 100% N₂. It can also run with a premixed gas. Running on 100% CO₂ and 100% N₂ gases, the device accuracy will be significantly higher (< 0.2% from the selected setpoint) compared to using the device on premixed gas. A premixed gas is usually used for simpler incubation systems that do not contain any CO₂ and O₂ sensors and have no gas mixing capabilities.

This section describes how to install Mini MIRI® Dry or Mini MIRI® Humidity incubator at an IVF clinic running with premixed gas.

 **The Premixed gas concentration must be chosen specifically to match the requirement of the culture medium. As the concentration cannot be altered by Mini MIRI® Dry or Mini MIRI® Humidity incubators, the media's resulting pH will depend on the correct concentration choice.**

 **Be advised that premixed gas consumption will be significantly higher compared to pure gas. Recover to the setpoint will be longer.**

14.1 Installation procedure at the site

Follow all the instructions in the installation manual and the guidelines in the user manual's safety instructions and warnings section.

Instead of connecting Mini MIRI® Dry or Mini MIRI® Humidity incubators to either only 100% CO₂ or both 100% CO₂ and 100% N₂, the incubator is attached to only a premixed source.

Premixed gas should only be connected to the CO₂ gas port (a 4 mm diameter hose barb).

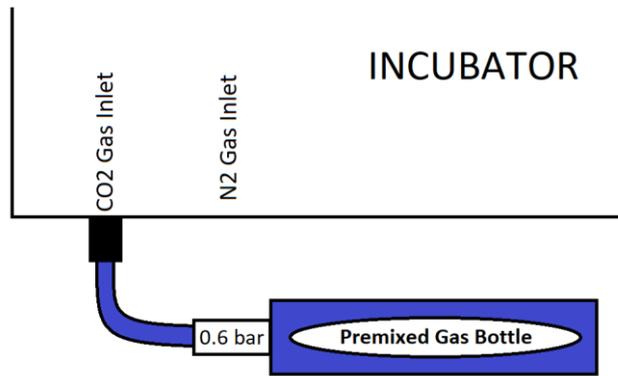


Figure 14.1 Premixed gas connections to the incubator

👉 Please read the “11 Gas connection” section in this manual above for more detailed gas connection requirements.

Measure the gas concentration from the premixed gas bottle with a calibrated gas analyzer. The result of the measurement is significant for the set-up of the device and the correct operation.

CO₂ regulation must be “ON” in Mini MIRI® Dry and Mini MIRI® Humidity incubators menu. CO₂ is generally as a default set to “ON” and O₂ to “OFF”.

Mini MIRI® Dry and Mini MIRI® Humidity incubators must be set to premix gas work mode.

Please follow these instructions:

Press the rotatory button – enter the menu.
You can exit the menu by rotating the rotatory button (↻).



Press the rotatory button on the service menu to enter the service sub-menu.



The display will show the currently installed firmware version. Move to the next service sub-menu item with (↻) rotation or one step up with (⬆) rotation.

The display will show the “GAS” function:



Press the rotatory button to enter the service sub-menu and rotate (↶) or (↷) to choose "PREMIX". Press the rotatory button to select the premixed gas work mode.

Then exit the menu by (↷) or press the rotatory button and hold it until the main menu does not appear.

 **The CO₂ setpoint must be 0.1% lower than the premixed gas measured value (i.e., 4.9% if 5.0% measured).**

 **The O₂ setpoint must be 1% higher than the premixed gas measured value gas (i.e., 5.0% if 6.0% measured).**

For changing the CO₂ and O₂ setpoints, please read the 16.2 and 16.3 sections in this manual.

 **If the setpoints are not set up correctly, a continual gas flow may occur, which will lead to high gas consumption and incorrect recovery times.**

 **Mini MIRI® Dry and Mini MIRI® Humidity incubators contain a high-grade CO₂ and O₂ sensor. They will measure the incoming premixed gas. Make sure that sensors are reading the anticipated gas percentage in the display of the device. That is a percentage that is the proximity of the values on the certificate of the gas bottle. If this is not the case, it must be established if the bottle's concentration per the certificate is correct. If so, Mini MIRI® Dry and Mini MIRI® Humidity sensors must be calibrated. Refer to the user manual for gas calibration. If the gas bottle does not contain the expected mixture, contact the gas bottle supplier.**

14.2 User training

Explain the user:

1. As seen in the display, the gas concentration values must be 0.1% (CO₂ lower and O₂ higher) from the values they expect. If they try to change the setpoint or the calibration to get rid of the offset, the regulation will not work.
2. They cannot set the setpoints they would typically do when using 100% CO₂ and 100% N₂ as the source gas. It is an inherent compromise of using premixed gas. Mini MIRI® Dry and Mini MIRI® Humidity incubators cannot change the gas composition of the premixed gas.
3. If the media's pH is not correct, they must get a new mixture of premixed gas. They cannot adjust anything on the incubator.
4. If they change to another concentration, Mini MIRI® Dry and Mini MIRI® Humidity setpoints must be adjusted accordingly, as described above. They should also check the flow rates when they change to a new bottle if it does not precisely contain the same gas mixture.

15 Alarms

The display will show a red “A” and the affected parameter’s status message on a single fault condition. An audio signal can be muted by pressing the alarm key once (toggled on/off for 5-minutes). There will be a red arrow that indicates if the alarm is triggered due to too high or too low values, and the audio on/off key will blink red:



Figure 15.1 Alarm key which indicates the alarm condition

The audio pattern is 3 short beeps followed by a 3-second pause. All alarms have the same audio pattern.

15.1 Temperature alarms

All 2 compartments can trigger a temperature alarm if their temperature varies over ± 0.5 °C from the setpoint.

 **Remember that changing the setpoint more than ± 0.5 °C from the current temperature will result in an alarm. The same goes for all calibration adjustments.**

The number will indicate the zone triggering the alarm following “A”.

Temperature is too high in compartment 2:



Temperature is too low in compartment 1:



The display will lock-on the alarm condition and will stop alternating between the standard status messages. If the mute key is pressed, the display will shift to normal status and show the parameters for 5 minutes until the audio alarm comes back on again. The mute alarm key will still show the alarm condition by blinking red while the alarm is muted.

The zone layout and sensor placement are described in the section “17 Surface temperatures and measuring temperature”.

If a temperature sensor malfunctions, it will be indicated by the following warning:



It denotes that the sensor in compartment 2 has failed. As a safety precaution, the heating of the affected area will be switched off.

15.2 Gas level alarms

15.2.1 CO₂ alarms

The CO₂ gas level alarm is activated if the concentration of the CO₂ gas deviates more than $\pm 1\%$ from the setpoint.

 **Remember that changing the setpoint more than $\pm 1\%$ from the current gas level will result in a gas level alarm. The same goes for all calibration adjustments.**

CO₂ gas % is too low:



CO₂ gas % is too high:



The display will lock-on the alarm condition and will stop alternating between the standard status messages. If the mute key is pressed, the display will shift to normal status and show the parameters for 5 minutes until the audio alarm comes back on again. The mute alarm key will still show the alarm condition by blinking red while the alarm is muted.

15.2.2 O₂ alarms

The O₂ gas level alarm is activated if the concentration of the O₂ gas deviates more than $\pm 1\%$ from the setpoint.

 **Remember that changing the setpoint more than $\pm 1\%$ from the current gas level will result in a gas level alarm. The same goes for all calibration adjustments.**

O₂ gas % is too low:



O₂ gas % is too high:



The display will lock-on the alarm condition and will stop alternating between the standard status messages. If the mute key is pressed, the display will shift to normal status and show the parameters for 5 minutes until the audio alarm comes back on again. The mute alarm key will still show the alarm condition by blinking red while the alarm is muted.

15.3 Gas pressure alarms

15.3.1 CO₂ pressure alarm

If the CO₂ gas supply is not attached correctly or incorrect CO₂ gas pressure is applied to the system, the Mini MIRI® incubator will go into CO₂ gas pressure alarm mode. The display will show “CO₂ P”, which indicates an incorrect incoming gas pressure. If the pressure falls below 0.3 bar (4.40 PSI) or rises above 0.7 bar (10.20 PSI), it will trigger the alarm.



 “P” stands for pressure.

The display will lock-on the alarm condition and will stop alternating between the standard status messages. If the mute key is pressed, the display will shift to normal status and show the parameters for 5 minutes until the audio alarm comes back on again. The mute alarm key will still show the alarm condition by blinking red while the alarm is muted.

15.3.2 N₂ pressure alarm

If the N₂ gas supply is not attached correctly or incorrect N₂ gas pressure is applied to the system, the Mini MIRI® Multiroom incubator will go into N₂ gas pressure alarm mode. The display will show “N₂ P”, which indicates an incorrect incoming gas pressure. If the pressure falls below 0.3 bar (4.40 PSI) or rises above 0.7 bar (10.20 PSI), it will trigger the alarm.



👉 “P” stands for pressure.

The display will lock-on the alarm condition and will stop alternating between the standard status messages. If the mute key is pressed, the display will shift to normal status and show the parameters for 5 minutes until the audio alarm comes back on again. The mute alarm key will still show the alarm condition by blinking red while the alarm is muted.

15.4 Multiple alarms

When there are two or more alarms, the display will indicate this by showing first “A MULTI” and then the alarm conditions:



The flow will be forced according to the alarms. The temperature alarms have 1st priority, gas level alarms 2nd, and gas pressure alarms 3rd.

15.5 Alarm UV-C light (the functionality is not available in the US)

👉 UV-C light function is not available in the Mini MIRI® Humidity model.

The alarm on UV-C light will show only as a warning message during the normal status. A red “S” will appear. **There will be no audio alarm.**



The user should consult the distributor for further guidance or service inspection. Only when the UV-C light works again, the “S” will disappear.

15.6 Loss of power alarm

If the power is disconnected, the incubator will give an audio alarm for approximately 4 seconds, and the LED in the mute alarm key will flash.



Figure 15.2 Alarm key which indicates the alarm condition

16 Changing the setpoints

16.1 The temperature setpoint

The temperature setpoint can be adjusted in the range between 24.9 °C to 40.0 °C.

 **The default temperature setpoint is 37.0 °C.**

To change the temperature setpoint, follow these instructions:

1. When the display shows the current temperature:



2. Press the rotatory button and rotate (↶) or (↷) to adjust the setpoint.
3. After changing the temperature value, press the rotatory button to save the setpoint.

If the display does not show the current temperature reading, rotatory button rotation (↶) or (↷) will toggle between the temperature, CO₂, O₂ and mode readings.

16.2 The CO₂ gas concentration setpoint

The CO₂ concentration can be adjusted in the range between 1.9% to 9.9%.

 **The default CO₂ setpoint is 6.0%.**

To change the CO₂ gas concentration setpoint, follow these instructions:

1. When the display shows the CO₂ gas concentration:



2. Press the rotatory button and rotate (↶) or (↷) to adjust the setpoint.
3. After changing the value, press the rotatory key once more to save the value.

If the display does not show the current temperature reading, rotatory button rotation (↶) or (↷) will toggle between the temperature, CO₂, O₂ and mode readings.

16.3 The O₂ gas concentration setpoint

The O₂ concentration can be adjusted in the range between 3.9% to 19.9%.

 **The default O₂ setpoint is 5.0%**

To change the O₂ gas concentration setpoint, follow these instructions:

1. When the display shows the O₂ gas concentration:



2. Press the rotatory button and rotate (↶) or (↷) to adjust the setpoint.
3. After changing the value, press the rotatory key once more to save the value.

If the display does not show the current temperature reading, rotatory button rotation (↶) or (↷) will toggle between the temperature, CO₂, O₂ and mode readings.

16.4 The culture mode

The culture mode can be set for under oil culture or open culture. “Under oil” culture mode is used in the culture media has an oil or Paraffin overlay. Open culture is used if the culture media does not have any overlay.

 **The default setting is “Oil culture” mode.**

To change the culture mode, follow these instructions:

1. When the display shows the culture mode:



2. Press the rotatory button and rotate (↶) or (↷) to change the mode.
3. When the display shows the desired/correct mode, press the rotatory button. The mode is now set.

If the display does not show the current mode reading, rotatory button rotation (↶) or (↷) will toggle between the temperature, CO₂, O₂ and mode readings.

Open culture is possible in a 4-well (or similar type of dish) in volumes not under 0.8 mL per well without oil overlay for up to a maximum of 4 hours. The Osmolality will change rapidly after that and reach over 300 mOsm/kg. Culturing up to 8 hours in 0.8 mL volumes can be done with a nearly unchanged osmolality.

In “Oil culture” mode, lid temperature is kept 0.2 – 0.3 °C above the temperature setpoint. In “Open culture” mode, lid temperature will be increased in 1.0 °C above the temperature setpoint.

Difference between open culture mode and oil culture mode

The significant difference between open culture mode and oil culture mode is the amount of heat in the lid. Oil accumulates temperature, so higher lid temperature can be accumulated in oil and transferred in media, elevating temperature around the embryo.

Open culture mode is designed not for embryo culturing but (if there is a need) for media equilibration. Do not use open culture mode longer than 4 h. Media volume should be not less than 0.8 mL (in 4 well dish). If the media stays longer without oil coverage, a high risk of media osmolality changes appears.

If you have any questions or uncertainty, consult Esco Medical or your local representative before using open culture mode in the Mini MIRI® Multiroom incubator.

17 Surface temperatures and measuring temperature

In this section, Mini MIRI® Dry and Mini MIRI® Humidity incubators temperature controls system is described in more detail.

Mini MIRI® Dry and Mini MIRI® Humidity incubators are equipped with 4 completely separate PID controllers for temperature measurement. Each controller is responsible for controlling the temperature of a separate area.

Each of the 4 available areas is equipped with its separate temperature sensor and heater, allowing the user to adjust the temperature in every area separately, thus achieving higher precision.

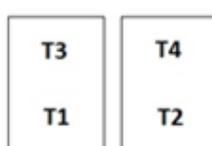


Figure 17.1 Temperature zones

Each area can be calibrated separately, using the item corresponding to the respective area in the menu. These items are placed in the menu and they are named: T1 CAL, T2 CAL, T3 CAL and T4 CAL.

An overview of the areas associated with the sensor names is shown in the table below.

Table 17.1 Areas associated with sensors

Area	Bottom	Lid
Compartment 1	T1	T3
Compartment 2	T2	T4

To calibrate the temperature in a particular area, please find the corresponding sensor name and adjust it according to a measurement taken using a high-precision thermometer.

 **Temperature calibration is done by adjusting the Tx (where x is the sensor number) according to a measurement done on the spot relevant to the dish placement.**

 **After temperature adjustment, give it at least 15 minutes for the temperature to stabilize, use the thermometer to verify correct temperatures on each area.**

Be careful when changing the calibration settings – make sure that only the altered value corresponds to where the measurement is done. Give the system time to adjust.

 **There is no crossover heating between the 2 compartments: this is a unique feature of Mini MIRI® Dry and Mini MIRI® Humidity incubators. Lid temperature will, however, affect the bottom temperature in a compartment. The delta-T should always be 0.2 °C. Thus, if the bottom temperature is 37.0 °C, the lid should be 37.2 °C.**

Note: how to calibrate the temperature at the T1 area can be found in section 13.4.1 of this manual.

 **“T1” is used to adjust the bottom temperature of compartment 1. “T3” is used to adjust the temperature on the lid in the same compartment. Remember that the delta-T between the top and the bottom should always be 0.2 °C.**

 **Adjust according to a high precision measurement done with a suitable sensor placed in a dish with media and a mineral oil overlay. Place the dish in one of the designated spots indicated on the heating insert.**

 **Proceed to validate if the lid temperature is precisely 0.2 °C higher than the bottom temperature.**

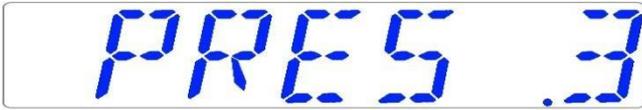
 **Stick a suitably calibrated sensor to the middle of the lid area and close the lid. Wait 15 minutes and record the temperature reading. Adjust “T3” to the desired level, using the same procedure as described above. It may be necessary to do iterations before the zone is thoroughly calibrated.**

The 2nd compartment is adjusted/calibrated in the same manner.

18 Pressure

18.1 CO₂ gas pressure

The CO₂ pressure can be read out in the CO₂ sub-menu:



The CO₂ pressure is shown in bar. External pressure must be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times. It cannot be adjusted on the incubator; it must be done on the external gas regulator.

 Remember, there is a pressure alarm on the pressure limits if the pressure falls below 0.3 bar or rises above 0.7 bar (4.40 – 10.20 PSI).

 The internal pressure sensor cannot be calibrated by the user. Under normal circumstances, the pressure sensor is replaced every 2 years according to the maintenance plan.

18.2 N₂ gas pressure

The N₂ pressure can be read out in the O₂ sub-menu:



The N₂ pressure is shown in a bar. External pressure must be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times. It cannot be adjusted on the incubator; it must be done on the external gas regulator.

 Remember there is a pressure alarm on the pressure limits if the pressure falls below 0.3 bar or rises above 0.7 bar (4.40 – 10.20 PSI).

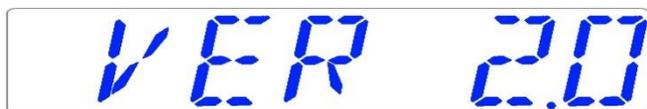
 The internal pressure sensor cannot be calibrated by the user. Under normal circumstances, the pressure sensor is replaced every 2 years according to the maintenance plan.

19 Firmware

The firmware installed on your Mini MIRI® Dry or Mini MIRI® Humidity incubators is upgradeable. Whenever a critical update is available, it will be provided to our distributors around the world – they will make sure that your incubator runs with the newest available firmware. A service technician can do this during the scheduled annual service.

Please follow these steps to check the firmware which is currently installed on your unit:

In the menu, locate the Service sub-menu “SERV” and rotate the rotatory button (↻). The display will show the currently installed firmware version:



Ver 2.0 is only shown as an example. Consult Esco Medical or the local representative for the number of the latest version.

Rotate the rotatory button (↻) to exit back to the menu.

20 SAFE Sense function

There is a possibility to purchase Mini MIRI® Dry or Mini MIRI® Humidity incubator with an integrated SAFE Sense system.

BCSI created this system to provide pH monitoring within a closed environment (an incubator) to measure pH without disturbing the maintained optimal conditions.

Please read more about SAFE Sense software in the SAFE Sense User manual.

21 Cleaning instructions

21.1 Considerations about a sterile device

Mini MIRI® Dry and Mini MIRI® Humidity incubators are not sterile devices. They are not delivered sterile state and it is not possible to keep them sterile while in use.

However, their design was created with great care to make it easy for the user to keep the device sufficiently clean during use and not contaminate the key components.

The design features intended to provide cleanliness include:

- A circulated air system
- A HEPA filter continually cleans the incoming gas
- A HEPA/VOC filter, which continually cleans the air inside the system (only for Mini MIRI® Dry model)
- A removable heat optimization plate can be removed and cleaned (cannot be autoclaved!). As this serves as the main holding area for samples, this should be the highest priority to keep clean
- Compartments with sealed edges that can be cleaned
- Use of aluminum and PET parts that withstand cleaning well

21.2 Manufacturer recommended cleaning procedure

 **Always validate the cleaning procedures locally; for more guidance, consult your manufacturer or the distributor.**

The routine cleaning procedure is recommended for regular processing and maintenance. The combination of standard cleaning procedures and disinfection procedures is recommended for event-related concerns such as media spills, visual accumulation of soil and/or other evidence of contamination. It is also recommended to clean and disinfect Mini MIRI® Dry and Mini MIRI® Humidity incubators immediately after any media spills.

Periodic cleaning of the device (with no embryos inside)

Wearing gloves and good handling techniques are essential to successful cleaning.

1. It is recommended to clean the unit with an aqueous 70% isopropyl alcohol. Moisten a sterile wipe and clean all the device's internal and external surfaces by rubbing the wipe against the surfaces.
2. After wiping, leave the device's lids open for some time to ensure that all alcohol fumes evaporate.
3. Finally, use purified or sterile water is used to wipe the surfaces of the device.
4. Inspect the device – if it is visually clean, consider it ready for use.

If the device is not visually clean, repeat the process from step 1.

21.3 Manufacturer recommended disinfection procedure

Disinfection of the device (with no embryos inside)

The use of gloves and good handling techniques are essential for successful disinfection.

Proceed with the following steps (this procedure has been demonstrated during the on-site training program as part of the installation protocol):

1. Power off Mini MIRI® Dry or Mini MIRI® Humidity incubator (rear panel).
2. Open the lids.
3. Use the required disinfectant to disinfect the internal surface and a glass plate on the lid's top. Use sterile wipes to apply the disinfectant.
4. Wipe all internal surfaces and the top of the lid with three wipes at least. Repeat until the wipes are not discolored.
5. Change your gloves, and after 10 minutes of contact time, spray sterile water on the surfaces and wipe them with a sterile wipe.
6. Inspect the device – if it is visually clean, consider it ready for use. If the device is visually not clean, go to step 3 and repeat the procedure.
7. Turn on Mini MIRI® Dry or Mini MIRI® Humidity incubator (rear panel).

22 Heat optimization plates

Insert the heat optimization plate. The heat optimization plate will ensure full contact with the dish. It generally results in much more stable temperature conditions concerning the cells. The plate fits the compartment, and it is taken out for cleaning.

⚠ Do not use autoclave at the inserts. It will damage the inserts as high temperature bends them out of shape.

Place the dish where it fits the pattern. The heat optimization plates can be applicable for both Nunc® or Falcon® dishes.

👉 Use only the correct type of heat optimization plates for your dishes.



Figure 22.1 Heat optimization plate

⚠ Never incubate without the plates in place and never use non-ESCO Medical heating optimization plates. It may cause dangerous and unpredictable temperature conditions that may be harmful to the specimens.

23 Humidification

23.1 The Mini MIRI® Dry incubator

The Mini MIRI® Dry incubator is used for culture with mineral oil or Paraffin overlay. Set the culture mode for “Oil culture”. It cannot be used for open culture mode.

The Mini MIRI® Dry incubator must not be irrigated. Humidification of the Mini MIRI® Dry incubator will damage the device – condensation will block internal pipes and damage electronic parts.

Open culture is possible in a 4-well (or similar type of dish) in volumes not under 0.8 mL per well without oil overlay for up to a maximum of 4 hours. The Osmolality will change rapidly after that and reach over 300 mOsm/kg. Culturing up to 8 hours in 0.8 mL volumes can be done with a nearly unchanged osmolality.

In “Oil culture” mode, lid temperature is kept 0.2 – 0.3 °C above the temperature setpoint. In “Open culture” mode, lid temperature will be increased in 1.0 °C above the temperature setpoint.

Please consult Esco Medical or your local representative before using “Open culture” mode in the Mini MIRI® Dry incubator if you have any questions.

👉 “Open culture” mode is designed not for embryo culturing but (if there is a need) for media equilibration.

23.2 The Mini MIRI® Humidity incubator

The Mini MIRI® Humidity incubator system has a built-in humidity sensor. The water bottle is located on the unit's side for easy control of water level and refilling.

The device is designed to run an open culture mode that will ensure a higher humidification rate than the environment. Still, even using humidification, media in dishes must be covered with oil overlay, which reduces evaporation from the media.

👉 Water in humidification bottle must be changed at least once per week.

24 Temperature validation

Mini MIRI® Dry and Mini MIRI® Humidity incubators are equipped with 2 PT-1000 Class-B sensors located in the center of each compartment's bottom.

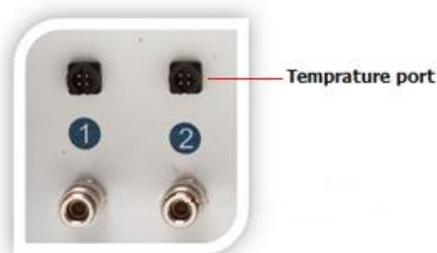


Figure 24.1 PT-1000 Class B sensors

The sensors serve for external validation purposes. They are entirely separate from the circuit of the unit.

The compartment's temperature conditions can be continuously logged through the external connectors on the unit's side without compromising its performance.

Any logging system that uses standard PT-1000 sensors may be used.

Esco Medical can supply an external logging system (MIRI® – GA12) for the sensors.

25 Gas level validation

Gas concentration in each compartment of Mini MIRI® Dry or Mini MIRI® Humidity incubator may be validated by taking a gas sample from one of the 2 gas sample ports on the unit's side, using a suitable gas analyzer.



Figure 25.1 Gas sample ports

Each sample port is directly connected to the corresponding compartment with the same number. The gas sample will be taken ONLY from the specific compartment.

 **An external automatic gas sampler can be connected to the ports for continuous validation.**

 **Before any gas measurement, make sure that the lids had not been opened for at least 5 minutes.**

 **Taking out a large sample volume may affect gas regulation.**

 **Make sure that the gas analyzer is calibrated before use.**

26 Alarm switch for an external system

Mini MIRI® Dry and Mini MIRI® Humidity incubator can be connected to an external monitoring system, ensuring maximum safety, especially during nights and weekends. The incubator is equipped with a 3.5 mm jack connector on the back that can be connected to a monitoring device.

Whenever an alarm goes off (that could be temperature alarm, gas alarms for CO₂ or O₂ levels, low-pressure or high-pressure alarms for CO₂ and N₂ gases) or if the power supply to the unit suddenly cut, the switch is indicating that the unit needs to be inspected by the user.

The connector can be connected either to a voltage source OR to a current source.

 **Note that if a current source is attached to the 3.5 mm jack connector, the maximum current rating is between 0 – 1.0 Amp.**

 If a voltage source is attached, then the limitation is between 0 – 50V AC or DC.

If there is no alarm, the switch within the unit will be in the “ON” position, as illustrated below.

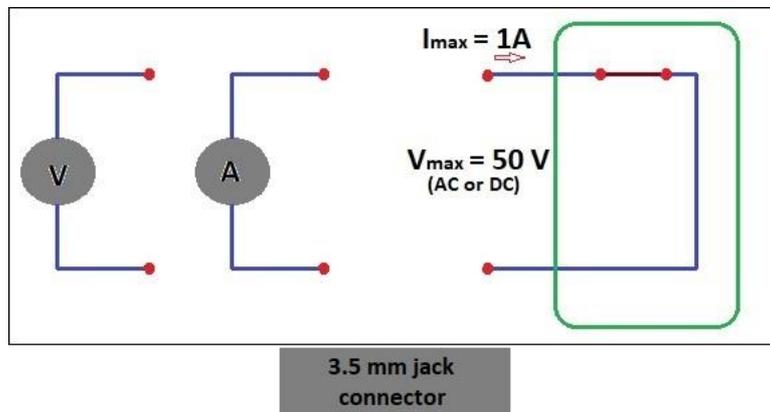


Figure 26.1 No alarm mode

Whenever Mini MIRI® Dry or Mini MIRI® Humidity incubator goes into an alarm mode, the switch will become an “open circuit”. It means that no current can run through the system anymore.

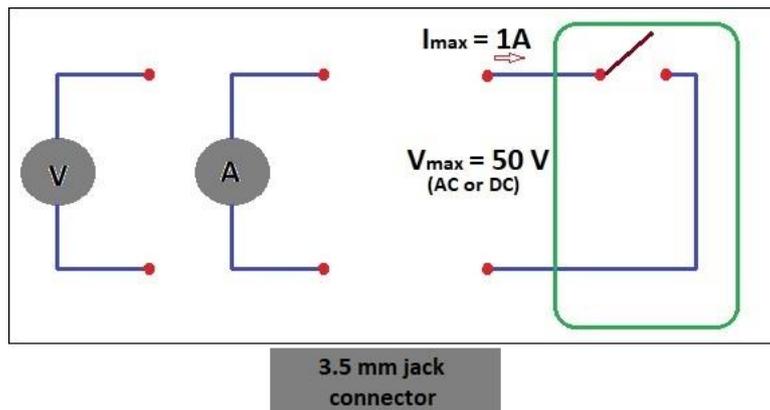


Figure 26.2 “Open circuit” alarm mode

 Whenever the incubator’s power cord is disconnected from the power source, this switch will automatically indicate an alarm! It is an extra safety feature intended to alert the personnel in case of a power cut in the laboratory.

27 Writing area on the compartment lids

Each compartment lid on the Mini MIRI® Dry or Mini MIRI® Humidity incubator is made from white glass, optimized for writing text. The compartment's patient data or content can be noted down for easy reference during the incubation process.

The text can be wiped off with a cloth afterward. Use only a suitable non-toxic pen that allows the text to be erased later and will not damage the incubated samples.



Figure 27.1 Area for patient information

28 Maintenance

Mini MIRI® Dry and Mini MIRI® Humidity incubators are designed to be user-friendly. Reliable and safe operation of this equipment is based on the following conditions:

1. Correct calibration of temperature and gas level, using high-precision equipment in the intervals prescribed based on clinical practice at the laboratory, where Mini MIRI® Dry or Mini MIRI® Humidity incubators are in use. The manufacturer recommends that the period between validation should be no longer than 14 days.
2. Replacement of VOC/HEPA filter and in-line HEPA filters at the correct intervals: 3 months for the VOC/HEPA filter and once at every changeover of the gas bottle for the in-line HEPA filters.
3. In-line HEPA filters must be replaced yearly during annual maintenance.
4. According to the clinical practice intervals, suitable cleaning is in the laboratory where Mini MIRI® Dry and Mini MIRI® Humidity incubators are used. The manufacturer does not recommend periods longer than 14 days between cleaning.

 **It is essential to perform the inspection and service at the intervals indicated in the MAINTENANCE manual. Failure to do so can have serious adverse outcomes, causing the unit to stop performing as expected and cause damage to samples, patients or users.**

 **Warranty is considered to be void if service and maintenance are not followed.**

 **Warranty is considered void if service and maintenance procedures are done not by trained and authorized personnel.**

29 Emergency Procedures

Total loss of power to or on the unit:

- Remove all the samples and place them in an alternative or backup device that is not affected by the problem.
- Without the power source, the internal temperature of Mini MIRI® Dry and Mini MIRI® Humidity will drop below 35 °C after being 10 minutes in an ambient environment of 20 °C.

- The CO₂ concentration will remain within 1% of the setpoint for 30 minutes if the lids remain closed.
- If a longer time to turn the power back on is needed, it may be useful to cover the unit with insulating blankets to slow the temperature drop.

If a single temperature alarm goes off:

- Remove the samples from the affected compartment. They can be relocated to any of the other compartments, which happens to be unoccupied. All compartments are separate so that the remaining ones will function normally.

If multiple temperature alarms go off:

- Remove the samples from the affected compartments. They can be relocated to any of the other compartments, which happens to be unoccupied. All compartments are separate so that the remaining ones will function normally.
- Alternatively, remove the samples from all the affected compartments and place them in an alternative or backup device that is not affected by the problem.

If the CO₂ level alarm goes off:

There will be a 30-minute-long interval during which the user can assess if the condition is temporary or permanent. If the state is permanent, remove all the samples and place them in an alternative or backup device that is not affected by the problem. If the condition is temporary and the CO₂ level is low, keep the lids shut. If the state is temporary and the CO₂ level is high, open a few lids to vent out some CO₂.

If the O₂ level alarm goes off:

Usually, no emergency procedures are necessary in this case. If the condition is judged to be permanent, it may be advantageous to switch off O₂ regulation in the menu.

If the CO₂ pressure alarm goes off:

Inspect the external gas supply and gas supply lines. If the problem is superficial and not readily fixed, follow the guidelines under the section “CO₂ pressure alarm”.

If the O₂ pressure alarm goes off:

Inspect the external gas supply and gas supply lines. If the problem is external and not readily fixed, follow the guidelines under the “O₂ pressure alarm” section.

In case of a gas pressure alarm on the unit:

Inspect the external gas supply and the gas supply lines. If the problem is external and not readily fixed, or if the problem is internal, follow the guidelines under gas level alarm.

30 User Troubleshooting

Table 30.1 Heating system

Symptom	Cause	Action
No heating, the display is off	The unit is switched off at the back or not connected to the power	Switch the device on or connect the power
No heating	The setpoint for temperature is wrong	The temperature is more than 0.5 °C off the set temperature
		Check the desired temperature setpoint
Uneven heating	System not calibrated	Calibrate each zone according to the user manual, using a high precision thermometer

Table 30.2 CO₂ gas regulator

Symptom	Cause	Action
No CO ₂ regulation	The system is not powered	Check power mains
	The system is on standby or switched off	Switch the system on
	CO ₂ gas regulator is off	Activate CO ₂ gas regulator by setting 'CO ₂ ' to 'on' in the menu
	No CO ₂ gas or wrong gas attached to CO ₂ gas input	Check the CO ₂ gas supply, make sure that pressure is kept stable at 0.4 – 0.6 bar (5.80 – 8.70 PSI)
	The actual gas concentration is higher than the setpoint	Check CO ₂ gas setpoint
Poor CO ₂ gas regulation	Lid(s) are left open	Close lid(s)
	Seals missing on the lid(s)	Replace the seals on the lid(s)
'A CO ₂ ' is shown on the display	CO ₂ gas concentration more than ±1% from the setpoint	Allow the system to stabilize by closing all lids
'CO ₂ P' is shown on the display	No/wrong CO ₂ gas pressure to the system	Check the CO ₂ gas supply, make sure that pressure is kept stable at 0.4 – 0.6 bar (5.80 – 8.70 PSI)

Table 30.3 O₂ gas regulator

Symptom	Cause	Action
No O ₂ gas regulation	System not powered	Check mains
	The system is on standby or switched off	Switch the system on
	O ₂ gas regulator is off	Activate O ₂ gas regulator by setting 'O2' to 'on' in the menu
	No N ₂ gas or wrong gas type attached to N ₂ gas input	Check the N ₂ gas supply, make sure that pressure is kept stable at 0.4 – 0.6 bar (5.80 – 8.70 PSI)
	The actual gas concentration is higher than the setpoint	Check O ₂ gas setpoint
Poor O ₂ gas regulation	Lid(s) are left open	Close lid(s)
	Seals missing on the lid(s)	Replace the seals on the lid(s)
'A O2' is shown on the display	O ₂ gas concentration more than $\pm 1\%$ from the setpoint	Allow the system to stabilize by closing all lids
'N2 P' is shown on the display	No/wrong N ₂ gas pressure to the system	Check the N ₂ gas supply and ensure that pressure is kept stable at 0.4 – 0.6 bar (5.80 – 8.70 PSI). If O ₂ regulation is not needed, set the 'O2' to 'off' in the menu to deactivate O ₂ gas regulation and abort the N ₂ gas alarm

Table 30.4 Data Logger

Symptom	Cause	Action
No data is sent to the PC	System not powered	Check mains
	The system is on standby or switched off	Switch the system on
	The data cable between Incubator and PC not correctly attached	Check connection. Use only the cable supplied with the unit
	Data logger software/USB driver not correctly installed	Please refer to the software installation guide

Table 30.5 Display

Symptom	Cause	Action
Missing segment(s) in display	Failure in the PCB	Contact your Esco Medical Distributor to replace the PCB

Table 30.6 Keyboard

Symptom	Cause	Action
The absent or erratic function of keys	Failure in the keys	Contact your Esco Medical Distributor to replace the keys

31 Specifications

Table 31.1 Mini MIRI® Dry incubator specifications

Technical specifications	Mini MIRI® Dry
Overall dimensions (WxDxH)	525 x 420 x 230 mm
Weight	22 kg
Material	Mild steel / Aluminum / PET / Stainless steel
Power supply	115V 60Hz OR 230V 50Hz
Power consumption	90 W
Temperature control range	24.9 °C – 40.0 °C
Gas consumptions (CO ₂) ¹	< 2 liters per hour
Gas consumption (N ₂) ²	< 8 liters per hour
Premixed gas consumption	In purge < 50 liters per hour In normal run < 1 liter per hour
CO ₂ control range	1.9 % – 9.9%
O ₂ control range	3.9 % – 19.9%
CO ₂ gas pressure (input)	0.4 – 0.6 bar (5.80 – 8.70 PSI)
N ₂ gas pressure (input)	0.4 – 0.6 bar (5.80 – 8.70 PSI)
Alarms	Audible and visible for out-of-range temperature, gas concentration and gas pressure.
Shelf life	1 year

Table 31.2 Mini MIRI® Humidity incubator specifications

Technical specifications	Mini MIRI® Humidity
Overall dimensions (WxDxH)	525 x 420 x 230 mm
Weight	22 kg
Material	Mild steel / Aluminum / PET / Stainless steel
Power supply	115V 60Hz OR 230V 50Hz
Power consumption	90 W
Temperature control range	24.9 °C – 40.0 °C
Gas consumptions (CO ₂) ¹	< 4 liters per hour
Gas consumption (N ₂) ²	< 12 liters per hour
Premixed gas consumption	In purge < 50 liters per hour In normal run < 1 liter per hour
CO ₂ control range	1.9 % – 9.9%
O ₂ control range	3.9 % – 19.9%
CO ₂ gas pressure (input)	0.4 – 0.6 bar (5.80 – 8.70 PSI)
N ₂ gas pressure (input)	0.4 – 0.6 bar (5.80 – 8.70 PSI)
Alarms	Audible and visible for out-of-range temperature, gas concentration and gas pressure.
Shelf life	1 year

¹ Under normal conditions (CO₂ setpoint reached at 6.0%, all lids closed)

² Under normal conditions (O₂ setpoint reached at 5.0%, all lids closed)

32 Electromagnetic compatibility

Table 32.1 Electromagnetic emissions

Guidance and manufacturer's declaration – electromagnetic emissions		
Mini MIRI® Dry and Mini MIRI® Humidity incubators are intended for use in the electromagnetic environment specified below. The customer or the user of Mini MIRI® Dry or Mini MIRI® Humidity incubators should ensure that it is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment – guidance
RF emissions CISPR 11	Group 1	Mini MIRI® Dry or Mini MIRI® Humidity incubators do not use RF energy. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	Mini MIRI® Dry or Mini MIRI® Humidity incubators are suitable for use in a hospital environment.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Class A	It is not for domestic establishments.

Table 32.2 Electromagnetic immunity

Guidance and manufacturer's declaration – electromagnetic immunity			
Mini MIRI® Dry and Mini MIRI® Humidity incubators are intended for use in the electromagnetic environment specified below. The customer or the user of Mini MIRI® Dry or Mini MIRI® Humidity incubators should ensure that it is used in such an environment.			
Immunity test	IEC 60601 Test level	Compliance level	Electromagnetic environment- guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Flooring should be wood, concrete or ceramic tiles. If the floor is covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines		
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode		
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % 100V (>95% dip in 100V) for 0.5 cycle 40% 100V (60% dip in 100V) for 5 cycles 70% 100V (30% dip in 100V) for 25 cycles) dip in 100V) for 5 sec		
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	Performance A	The power-frequency magnetic fields' level should be characteristic of a specific location in a commercial or hospital environment.

Guidance and manufacturer’s declaration – electromagnetic immunity

Mini MIRI® Dry and Mini MIRI® Humidity incubators are intended for use in the electromagnetic environment specified below. The customer or the user of Mini MIRI® Dry or Mini MIRI® Humidity incubators should ensure that it is used in such an environment.

Immunity test	IEC 60601 Test level	Compliance level	Electromagnetic environment- guidance
<p>Conducted RF IEC 61000-4-6</p> <p>Radiated RF IEC 61000-4-3</p>	<p>10 Vrms 150kHz to 80 MHz in ISM bands</p> <p>3 V/m 80 MHz to 2.5 GHz</p>	<p>3V/m from 80MHz to 2.5 GHz</p>	<p>Portable and mobile RF communications equipment should be used no closer to any part of Mini MIRI® Dry or Mini MIRI® Humidity incubator, including cables, than the recommended separation distance calculated according to the equation, applicable to the transmitter’s frequency.</p> <p>Recommended separation distance</p> <p>$d = 0.35 P$</p> <p>$d = 0.35 P$ 80MHz to 800MHz $d = 0.7 P$ 800MHz to 2.5GHz</p> <p>P is the maximum power output rating of the transmitter in watts (W) according to the transmitter manufacturer, <i>d</i> is the recommended separation distance in meters (m).</p> <p>As determined by an electromagnetic site survey, field strengths from fixed RF transmitters should be lower than the compliance level in each frequency range.</p> <p>Interference may occur in the vicinity of the equipment.</p>

Table 32.3 Recommended separation distances

Recommended separation distances between portable and mobile RF communication equipment and Mini MIRI® Dry or Mini MIRI® Humidity incubators			
Mini MIRI® Dry or Mini MIRI® Humidity incubators are intended to be used in an electromagnetic environment in which radiated RF disturbances are controlled. The customer, or Mini MIRI® Dry or Mini MIRI® Humidity incubator user, can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters). According to the communications equipment's maximum output power, Mini MIRI® Dry or Mini MIRI® Humidity incubators are recommended below.			
The rated maximum output power of the transmitter	Separation distance according to the frequency of the transmitter (m)		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5GHz $d = 2.3\sqrt{P}$
0.01 W	0.1m	0.1m	0.2m
0.1 W	0.4m	0.4m	0.7m
1 W	1.2m	1.2m	2.3m
10 W	3.7m	3.7m	7.4m
100 W	11.7m	11.7m	23.3m
For transmitters rated at a maximum output power not listed above, the recommended separation distance <i>d</i> in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where <i>P</i> is the maximum output power rating of the transmitter in watts (w), according to the transmitter manufacturer.			
NOTE 1: at 80 MHz and 800 MHz, the higher frequency range's separation distance applies.			
NOTE 2: These guidelines may not apply in all situations.			
Electromagnetic propagation is affected by absorption and reflections from structures, objects and people.			

Medical Devices may be affected by cellular telephones and other personal or household devices not intended for medical facilities. It is recommended to ensure that all equipment used near Mini MIRI® Dry or Mini MIRI® Humidity incubators product complies with the medical electromagnetic compatibility standard and checks before use that no interference is evident or possible. If the interference is suspected or probable, switching off the offending device is the specific solution as it is the usual practice in aircraft and medical facilities.

Medical electrical equipment must be treated with special precautions indicated by EMC and must be installed and put into service according to the EMC information provided. Portable and mobile RF communications equipment can affect medical electrical equipment.

33 The Validation guide

33.1 Product release criteria

The Esco Medical Mini MIRI® Dry and Mini MIRI® Humidity incubator undergo strict quality and performance testing before being released for sale.

33.1.1 Performance

Each component used in Mini MIRI® Dry and Mini MIRI® Humidity incubator is tested during the manufacturing process to ensure a defect-free unit.

Before release, the incubator is tested per a release test having a duration of at least 24 hours, using high-performance thermometers and gas analyzers, along with real-time data logging to ensure that the unit lives up to expected performance standards.

Pass I: Internal sensor temperature variation from setpoint within ± 0.1 °C absolute.

Pass II: Internal sensor CO₂ concentration variation from setpoint within $\pm 0.2\%$ absolute.

Pass III: Internal sensor N₂ concentration variation from setpoint within $\pm 0.2\%$ absolute.

Pass IV: Gas flow CO₂ less than 2 l/h (for Mini MIRI® Humidity model – less than 4 l/h).

Pass V: Gas flow N₂ less than 8 l/h (for Mini MIRI® Humidity model – less than 12 l/h).

33.1.2 Electrical safety

An electric safety test is also carried out using a high-performance medical safety tester with each unit to ensure that electric requirements for medical devices defined by the EN60601-1 3rd edition standards are met.

33.1.3 Communication & data logging

Each unit is connected to a computer running the Mini MIRI® data logging software. Gas is supplied to the unit, and the system is activated. The data received by the PC program is analyzed to ensure communication between the incubator and the PC.

33.1.4 Gas concentration levels and consumption

A leak test is performed on each compartment. The maximum leakage allowed through the seals is 0.0 l/h.

The average CO₂ gas variation must stay within setpoint $\pm 0.2\%$ absolute on all external sampling and internal sensor readings.

The gas flow under regular operation in the Mini MIRI® Dry is less than 2 liters per hour, whereas in the Mini MIRI® Humidity – 4 liters per hour. The average should be below 2 liters on Mini MIRI® Dry, whereas in Mini MIRI® Humidity – below 4 liters.

The average N₂ gas variation must stay within setpoint $\pm 0.2\%$ absolute on all external and internal sensor readings.

The gas flow under regular operation in the Mini MIRI® Dry is less than 2 liters per hour, whereas in the Mini MIRI® Humidity – 8 liters per hour. The average should be below 2 liters on Mini MIRI® Dry, whereas in Mini MIRI® Humidity – below 12 liters.

33.1.5 Cosmetic

- No misalignment in the lids.
- Each lid should be opened and closed easily.
- The seals for the lids must be appropriately attached and aligned.
- No scratches or missing paint on the cabinet.
- Overall, the device must be presentable as a high-quality item.
- The heat optimization plates are checked for misalignment and shape. These are placed into the compartments to check for any mismatch due to the compartment and aluminum blocks' sizes.

34 Validation on-site

Even though at Esco Medical, we strive to do the most comprehensive tests before the device is shipped to the customer, there is no way to be sure that everything is still OK at the location when the device is set up.

Therefore, in keeping with established good medical device practice, we have set up a validation test regimen that must be completed before the device can be accepted into clinical use.

In the following, we describe these tests and the equipment necessary to perform them.

A test documentation form is also provided. A copy must be provided to Esco Medical for internal device tracking and device history record.

34.1 Mandatory equipment

 **All equipment must be of high quality and calibrated.**

- A thermometer with a suitable sensor for measuring in a droplet of media covered with Paraffin oil with a resolution minimum of 0.1 °C
- A thermometer with a suitable sensor for measuring on an aluminum surface with a resolution minimum of 0.1 °C
- A CO₂ analyzer with a range of 0.0 – 10.0%.
- An O₂ analyzer with a range of 0.0 – 20.0%.
- A Pressure tester with a range of 0.0 – 1.0 bar.
- A Multimeter.

34.2 Recommended additional equipment

 **All equipment must be of high quality and calibrated.**

- A VOC meter able to measure the most common volatile organic compounds at least at the ppm-level.
- A sample should be taken just above Mini MIRI® Dry or Mini MIRI® Humidity incubator with the laser particle counter. The reading should be noted down as the background particle level.

Recommended additional equipment can be used for further installation testing that will minimize the likelihood of problems on-site.

35 Testing

35.1 Gas supply CO₂

For the regulation system to maintain the correct CO₂ concentration level in the Mini MIRI® Dry or Mini MIRI® Humidity incubator compartments, the device must be connected to a stable source of 100% CO₂ 0.4 – 0.6 bar (5.80 – 8.70 PSI) of pressure.

Measure the CO₂ concentration in the gas supply by routing the gas line into a bottle without a lid and a suitably large opening. Set the pressure/flow so that the bottle is flushed continually with gas, without increasing pressure in the bottle (i.e., the amount of gas exiting the bottle should be equal to the gas volume entering the bottle).

 **Pressure build-up will affect the measured CO₂ concentration, as CO₂ concentration is pressure-dependent.**

Sample from the bottle near the bottom with the gas analyzer.

PASS: CO₂ concentration measured must be between 98.0% - 100%.

 **Use of CO₂ gas with moisture will damage the flow sensors. Moisture level must be verified on the gas manufacturer's certificate: only 0.0 ppm v/v Max is permissible.**

35.1.1 About CO₂

Carbon dioxide (CO₂) is a colorless, odorless, non-combustible gas. Carbon dioxide above the triple point temperature of -56.6 °C and below the critical point temperature of 31.1 °C can exist in both a gaseous and a liquid state.

Bulk liquid carbon dioxide is commonly maintained as a refrigerated liquid and vapor at pressures between 1,230 kPa (approx. 12 bar) and 2,557 kPa (approx. 25 bar). Carbon dioxide may also exist as a white opaque solid with a temperature of -78.5 °C under atmospheric pressure.



A high concentration of carbon dioxide (10.0% or more) can asphyxiate quickly without warning with no possibility of self-rescue regardless of the oxygen concentration.

The User should make sure the CO₂ used is safe and moisture-free. Below is a list of some common component concentrations. Please note that the values given are NOT the proper amounts, only an example:

- Assay 99.9% v/v min.
- Moisture 50 ppm v/v max. (20 ppm w/w max).
- Ammonia 2.5 ppm v/v max.
- Oxygen 30 ppm v/v max.
- Oxides of Nitrogen (NO/NO₂) 2.5 ppm v/v max each.
- The non-volatile residue (particulates) 10 ppm w/w max.
- The non-volatile organic residue (oil and grease) 5 ppm w/w max.
- Phosphine 0.3 ppm v/v max.
- Total volatile hydrocarbons (calculated as methane) 50 ppm v/v max. of which 20 ppm v/v.
- Acetaldehyde 0.2 ppm v/v max.
- Benzene 0.02 ppm v/v max.
- Carbon Monoxide 10 ppm v/v max.
- Methanol 10 ppm v/v max.
- Hydrogen Cyanide 0.5 ppm v/v max.
- Total Sulphur (as S) 0.1 ppm v/v max.

35.2 Gas supply N₂

For the regulation to maintain the correct O₂ concentration levels in the Mini MIRI® Dry or Mini MIRI® Humidity incubator compartments, the device must be connected to a stable source of 100% N₂ at 0.4 – 0.6 bar (5.80 – 8.70 PSI) of pressure.

Measure the N₂ concentration in the gas supply by routing the gas line into a bottle without a lid and a suitably large opening. Set the pressure/flow so that the bottle is flushed continually with gas, without increasing pressure in the bottle (i.e., the amount of gas exiting the bottle should be equal to the gas volume entering the bottle).

Sample from the bottle near the bottom with the gas analyzer.



A gas analyzer that can measure 0% O₂ accurately can be used. 100% N₂ = 0 % O₂.

PASS: N₂ concentration measured must be between 95.0%– 100%.



The use of N₂ gas with moisture will damage the flow sensors. Moisture level must be verified on the gas manufacturer's certificate: only 0.0 ppm v/v Max is permissible.

35.2.1 About N₂

Nitrogen makes up a significant portion of the earth's atmosphere with 78.08% by volume. Nitrogen is a colorless, odorless, tasteless, non-toxic, and almost inert gas. Nitrogen is principally shipped and used in either gaseous or liquid form.



N₂ gas can act as a simple asphyxiant by displacing air.

The User should make sure the N₂ used is safe and moisture-free. Below is a list of some standard component concentrations. Please note that the values given are NOT the proper amounts, only an example:

- Research Grade 99.9995%.
- Contaminant.
- Argon (Ar) 5.0 ppm.
- Carbon Dioxide (CO₂) 1.0 ppm.
- Carbon Monoxide (CO) 1.0 ppm.
- Hydrogen (H₂) 0.5 ppm.
- Methane 0.5 ppm.
- Oxygen (O₂) 0.5 ppm.
- Water (H₂O) 0.5 ppm.

35.3 CO₂ gas pressure check

Mini MIRI® Dry and Mini MIRI® Humidity require a pressure of 0.4 – 0.6 bar (5.80 – 8.70 PSI) on the input CO₂ gas line. This gas pressure must be held stable at all times.

For safety, this unit has a built-in digital gas pressure sensor that monitors the incoming gas pressure and alerts the User if any drop is detected.

Remove the inlet gas line for the CO₂ gas. Attach the gas line to the gas pressure measuring device.

PASS: The value must be 0.4 – 0.6 bar.

Please refer to the “18.1 CO₂ gas pressure” section for more information.

35.4 N₂ gas pressure check

Mini MIRI® Dry and Mini MIRI® Humidity require a pressure of 0.4 – 0.6 bar (5.80 – 8.70 PSI) on the input N₂ gas line. This gas pressure must be held stable at all times.

For safety, this unit has a built-in digital gas pressure sensor that monitors the incoming gas pressure and alerts the User if any drop is detected.

Remove the inlet gas line for the N₂ gas. Attach the gas line to the gas pressure measuring device.

PASS: The value must be 0.4 – 0.6 bar.

Please refer to the “18.2 N₂ gas pressure” section for more information.

35.5 Voltage supply

The voltage on-site must be verified.

Measure the UPS's output plug that the Mini MIRI® Dry or Mini MIRI® Humidity incubator will be connected. Also, check that the UPS is attached to a properly grounded mains outlet.

Use a multimeter set for AC.

PASS: 230V ± 10.0%
115V ± 10.0%

35.6 CO₂ gas concentration check

The CO₂ gas concentration is checked for deviation. The gas sample port on the back of the unit is used. Use sample port-2 for validation.

 **Remember not to open any lid at least 15 min before starting the test nor during the testing itself.**

Hook-up the gas analyzer inlet tube to the sample port. Make sure that the fit is perfect and that no air can enter or exit the system.

The gas analyzer must have a gas return port connected to the incubator (i.e., another compartment). Only measure while the value on the gas analyzer stabilizes.

Please refer to the "13.4.2 CO₂ sub-menu" section for more information on how to perform the CO₂ gas calibration.

PASS: CO₂ concentration measured must not deviate more than ± 0.2% from the setpoint.

35.7 O₂ gas concentration check

The O₂ gas concentration is checked for deviation. The gas sample port on the back of the unit is used. Use sample port-2 for validation.

 **Remember not to open any lid at least 10 min before starting the test nor during the testing itself.**

Hook-up the gas analyzer inlet tube to the sample port. Make sure that the fit is perfect and that no air can enter or exit the system.

The gas analyzer must have a gas return port connected to the incubator (i.e., another compartment). Only measure while the value on the gas analyzer stabilizes.

Please refer to the "13.4.3 O₂ sub-menu" section for more information on how to perform the CO₂ gas calibration.

PASS: O₂ concentration measured must not deviate more than $\pm 0.2\%$ from the setpoint.

35.8 Temperature check: Compartment bottoms

The first part of the temperature check is performed using a thermometer with a sensor suitable for measuring temperature in a droplet of media covered with Paraffin oil, with a resolution of 0.1 °C as a minimum.

At least 6 dishes prepared in advance (with at least one microdroplet of media approximately 10 – 100 µL in each dish). The media should be covered with a layer of Paraffin oil. The dishes need not be equilibrated, as the pH will not be measured during the validation tests.

The dishes are placed with at least one dish in each compartment. The dishes should be placed on the corresponding size slot on the heat optimization plates.

Let the incubator warm the dishes and stabilize for at least 1-hour.

Open a compartment lid, remove the cover from the dish and place the sensor tip inside the droplet.

If the measuring device has a fast response time (less than 10 seconds), the quick droplet measurement method should give a useful result.

If the measuring device is slower, a method for retaining the sensor in the droplet spot must be found. Usually, taping the sensor led to a spot inside the compartment bottom is possible. Then close the lid and wait until the temperature has stabilized. Be careful when closing the lid so as not to dislocate the sensor placement in the droplet.

Place the thermometer sensor on each zone and verify the temperature.

If calibration is needed, please refer to the "13.4.1 Temperature sub-menu" section for more information on how to perform the temperature calibration.

PASS: all temperatures measured on the bottom of the compartments where the dishes are located must not deviate more than ± 0.1 °C from the setpoint.

35.9 Temperature check: Compartment lids

The second part of the temperature validation is performed using a thermometer with a suitable sensor for measuring temperature on an aluminum surface, with a resolution of 0.1 °C as a minimum.

Tape the sensor to the center of the lid and carefully close the lid. Ensure that the tape keeps the sensor in complete contact with the surface area of the aluminum.

 **Taping the inside of the lid is not an optimal procedure, as the tape will act as an insulator from the heat generated by the bottom heater. However, it is a usable compromise if the taped area's size is kept small and the tape used is strong, thin and light.**

Place the thermometer on each zone and verify the temperature.

Pass: all temperatures measured on the compartments' lid must not deviate more than ± 0.2 °C from the setpoint.

If calibration is needed, please refer to the "13.4.1 Temperature sub-menu" section for more information on how to perform the temperature calibration.

 **An iterative process may be needed if differences in the temperature levels are found and compensated through the calibration procedures. Bottom and lid temperatures will affect each other to some extent. There will be no crossover heat noticeable between compartments.**

35.10 6-hour stability test

Following the careful validation of the single parameter, a 6-hour (minimum duration) check must be initiated.

The device must be set up as closely as to the condition under which it will be running in clinical use.

If the preference of CO₂ setpoint is 6.0% or temperature is different from the default setting, an adjustment needs to be done before the test.

If the device will not be clinically operational with the O₂ regulation activated, but there is N₂ gas available, the test should be conducted with O₂ regulation switched on and with N₂ gas supply.

If the N₂ is not available, the test can be done without it.

Make sure that the Escó Medical data logger software is running.

Check that parameter are logged and give a meaningful reading. Let the device run without interfering for at least 6 hours. Analyze the results on the graphs.

Pass I: Internal sensor temperature variation from set point is within ± 0.1 °C absolute.

Pass II Internal sensor CO₂ concentration variation from setpoint within $\pm 0.2\%$ absolute.

Pass III: Internal sensor N₂ concentration variation from setpoint within $\pm 0.2\%$ absolute.

Pass IV: Gas flow CO₂ less than 2 l/h (for Mini MIRI® Humidity model – less than 4 l/h).

Pass V: Gas flow N₂ less than 8 l/h (for Mini MIRI® Humidity model – less than 12 l/h).

35.11 Cleaning

 **Always validate the cleaning procedures locally or consult the manufacturer or the distributor for more guidance.**

After the testing has been conducted successfully, it should be cleaned again before the device is taken into clinical use.

Inspect the unit for physical signs of dirt or dust. The unit should look generally tidy.

- Clean the unit externally with a lint-free cloth moistened with a 70% alcohol solution.
- Switch off the device and remove the mains lead.
- Remove all heat optimization plates and clean them with a lint-free cloth soaked with a 70% alcohol solution.
- Wipe the inside of the 2 compartments with a lint-free cloth moistened with a 70% alcohol solution.
- Wipe the lids in the same way.
- Let the lids remain open for 5 minutes.
- Wipe the 2 compartments and the heat optimization plates with a lint-free cloth soaked in sterilized water.
- Wipe the lids in the same way.
- Let the lids remain open for 10 minutes.
- Re-insert the heat optimization plates.
- Close the lids.
- Attach the power again and switch-on the incubator.
- Let the incubator run empty for at least 20 minutes before inserting a sample.

35.12 Test documentation form

 The "Installation report" form must be completed with the tests-passed status filled by installation personnel and submitted to Esco Medical before the device is taken into clinical use.

35.13 Recommended additional testing

35.13.1 A VOC meter (only for Mini MIRI® Dry model)

A sample should be taken just above the Mini MIRI® Dry or Mini MIRI® Humidity incubator with the VOC meter. The reading should be noted down as the background VOC level. Then a sample is taken from the gas sample port number – 2.

Pass: 0.0 ppm VOC.

 Ensure that the sample lines do not contain any VOC.

35.13.2 A laser particle counter

A sample should be taken just above the Mini MIRI® Dry or Mini MIRI® Humidity incubator with the laser particle counter. The reading should be noted down as the background particle level. Then a sample is taken from the gas sample port number – 2.

Pass: 0.3-micron < 100 ppm.

 Ensure that the sample lines do not contain any particles.

36 Clinical use

Congratulations! Your device is now ready for clinical use with the validation tests completed and the test report submitted to Esco Medical.

It should provide many years of stable service.

It is necessary to monitor the performance of the device continually.

Use the below scheme for in-use validation.

 Do not attempt to run the Mini MIRI® Dry or Mini MIRI® Humidity incubator for clinical purposes without access to high-grade quality control validation equipment.

Table 36.1 Validation intervals

Task	Every day	Every week
Temperature check		X
CO ₂ gas concentration check	X	
O ₂ gas concentration check	X	
Check log for anomalies		X
CO ₂ gas pressure check	X	
N ₂ gas pressure check	X	

36.1 Temperature check

The temperature check is performed using a high-precision thermometer. Place the thermometer on each zone and verify the temperature. Calibrate if necessary.

Please refer to the "13.4.1 Temperature sub-menu" section for more information on how to perform the temperature calibration.

PASS:

- **All temperatures measured on the bottom of the compartment in the locations where the dishes would be placed must not deviate more than ± 0.2 °C from the setpoint.**
- **All temperatures measured on the lid must not deviate more than ± 0.5 °C from the setpoint.**

36.2 CO₂ gas concentration check

The CO₂ gas concentration is checked for deviations. The gas sample port on the side of the unit is used for this. Use sample port-2 for validation. It is essential to have a high-precision gas analyzer for CO₂ and O₂ available to do the test.

Please follow these simple rules while testing gas concentration:

- Check the CO₂ gas setpoint.
- Check the actual CO₂ gas concentration to ensure the setpoint is reached, and gas concentration is stabilized around the setpoint.
- Remember not to open any lids for at least 10 min, before starting the test or during the testing itself.

Please refer to the "13.4.2 CO₂ sub-menu" section for more information on how to perform the CO₂ gas calibration.

PASS: CO₂ concentration measured must not deviate more than $\pm 0.2\%$ from the setpoint.

36.3 O₂ gas concentration check

The O₂ gas concentration is checked for deviations. The gas sample port on the side of the unit is used for this. Use sample port-2 for validation. It is essential to have a high-precision gas analyzer for CO₂ and O₂ available to do the test.

Please follow these simple rules while testing gas concentration:

- Check the O₂ gas setpoint.
- Check the actual O₂ gas concentration to ensure the setpoint is reached, and gas concentration is stabilized around the setpoint.
- Remember not to open any lids for at least 10 min, before starting the test or during the testing itself.

Please refer to the "13.4.3 O₂ sub-menu" section for more information on how to perform the O₂ gas calibration.

PASS: O₂ concentration measured must not deviate more than $\pm 0.2\%$ from the setpoint.

 Gas analyzers use a small pump to draw outgas from the location being sampled. The pump capacity varies from brand to brand. The gas analyzer's ability to return the gas sample to the incubator (loop sampling) avoids negative pressure and ensures accuracy. Performance of Mini MIRI® Dry and Mini MIRI® Humidity will not be affected. The gas in the compartment is not under pressure, and the reading is just an artifact based on unsuitable measuring equipment. Contact Esco Medical or the local distributor for further guidance.

36.4 CO₂ gas pressure check

The Mini MIRI® Dry or Mini MIRI® Humidity requires a pressure of 0.4 – 0.6 bar on the input CO₂ gas line. This gas pressure must be held stable at any time.

For safety reasons, this unit has a built-in digital gas pressure sensor control that monitors the incoming gas pressure and alerts the user if any drop is detected.

It is recommended to check the CO₂ gas pressure in the menu by inspecting the value for an item called 'CO₂ P' (CO₂ pressure).

PASS: The value must be 0.4 – 0.6 bar.

Please refer to the "18.2 N₂ gas pressure" section for more information.

36.5 N₂ gas pressure check

The Mini MIRI® Dry or Mini MIRI® Humidity requires a pressure of 0.4 – 0.6 bar on the input N₂ gas line. This gas pressure must be held stable at any time.

For safety reasons, this unit has a built-in digital gas pressure sensor control that monitors the incoming gas pressure and alerts the user if any drop is detected.

It is recommended to check the N₂ gas pressure in the menu by inspecting the value for an item called 'N2 P' (N₂ pressure).

PASS: The value must be 0.4 – 0.6 bar.

Please refer to the “18.1 CO₂ gas pressure” section for more information.

37 The Maintenance guide

Your Mini MIRI® Dry or Mini MIRI® Humidity incubator from Esco Medical contains high precision quality components. These components are chosen to ensure the high durability and performance of the equipment.

However, continual validation of the performance is necessary.

User validation should be done as a minimum according to instructions given in the "33 The validation guide" section.

If problems are encountered, contact Esco Medical or your local representative.

However, to sustain the high-performance level and avoid system errors, the owner is responsible for having a certified technician who performs components replacements according to table 37.1.

These components must be replaced in the time intervals specified below. Failure to follow these instructions may, in the worst-case scenario, result in damage to the specimens in the incubator.



Warranty void if service intervals are not followed according to table 37.1.



Warranty void if non-original parts are used or non-trained and non-authorized personnel carry out the servicing.

The table below shows time intervals in which components must be replaced:

Table 37.1 Service interval plan

Component name	Every month	Every 3 month	Every year	Every 2 years	Every 3 years	Every 4 years
VOC/HEPA filter capsule ¹		X				
Humidification Bottle ²	X					
HEPA in-line filter for CO ₂ gas			X			
HEPA in-line filter for N ₂ gas			X			
O ₂ sensor			X			
CO ₂ sensor						X
UV light ¹			X			
Cooling fan					X	
Internal gas pump ¹				X		
Pump module ²				X		
Proportional valves					X	
Gas lines					X	
Flow sensors				X		
Pressure regulators						X
Internal 0.2µ filter for CO ₂			X			
Internal 0.2µ filter for N ₂			X			
A firmware update (if a new version has been released)			X			

37.1 VOC/HEPA filter capsule (only for Mini MIRI® Dry model)

The VOC/HEPA filter capsule is placed on the incubator unit's back for easy replacement. In addition to the active carbon component, this capsule also has an integrated HEPA filter inside, enabling it to remove particles and volatile organic compounds from the air being re-circulated to the compartments. Because of the carbon component's lifespan, all VOC filters' lifetime is limited, and they must be replaced often. According to table 37.1, the VOC filter installed in the MIRI® incubator must be replaced every 3 months.

Please follow these safety precautions when changing the VOC filter:

- Always use the original filter (contact Esco Medical or your local distributor for more details or ordering).
- Change filter every 3 months.
- Failure to change the filter on time will result in low/no air-cleaning within the system.
- Warranty void if wrong/non-original filter is used.

Please refer to the “12.1 Installation of a new filter capsule” section for the replacement instructions.

¹ Only for the Mini MIRI® Dry model

² Only for the Mini MIRI® Humidity model

37.2 Humidification bottle (only for Mini MIRI® Humidity model)

A humidification bottle contains water that is used to maintain the humidity in the chamber. It needs to be changed every month.

Water in the humidification bottle must be changed at least once per week.

37.3 In-line HEPA filter for CO₂ gas

The round-shape in-line 0.2 μ HEPA filter for CO₂ gas removes any particles found in the incoming CO₂ gas. Failure to use the HEPA filter may cause damage to the high precision flow sensor, calculate the amount of CO₂ gas entering the system, and disturb the CO₂ regulator system.

Please follow these safety precautions when changing the filter:

- Always use the original filter (contact Esco Medical or your local distributor for more details or ordering).
- Change the filter once every year.
- Failure to change the filter on time will result in low/no cleaning of incoming CO₂ gas.
- Warranty void if wrong/ non-original filter is used.

Please refer to the service manual for replacement instructions.

37.4 In-line HEPA filter for N₂ gas

The round-shape in-line 0.2 μ HEPA filter for N₂ gas removes any particles found in the incoming N₂ gas. Failure to use the HEPA filter may cause damage to the high precision flow sensor, calculate the amount of N₂ gas entering the system, and disturb the N₂ regulator system.

Please follow these safety precautions when changing the filter:

- Always use the original filter (contact Esco Medical or your local distributor for more details or ordering).
- Change the filter once every year.
- Failure to change the filter on time will result in low/no cleaning of incoming N₂ gas.
- Warranty void if wrong/ non-original filter is used.

Please refer to the service manual for replacement instructions.

37.5 O₂ sensor

The oxygen regulation uses the Oxygen sensor to keep the O₂ gas concentration at a desired level inside the chambers. The lifetime of this sensor is limited due to its construction. From the day the sensor is unpacked, a chemical process is activated within the sensor core. The chemical reaction

is entirely harmless to its surroundings. Still, it is necessary for measuring the amount of oxygen with very high precision needed in the Mini MIRI® Dry and Mini MIRI® Humidity incubators.

After 1-year, the chemical process in the sensor core stops and the sensor must be replaced. Therefore, it is essential to replace this sensor **WITHIN year from the date it was unpacked and installed.**

 **Oxygen sensors must be replaced at least once every year from the date they were installed in the unit. Irrespective of the incubator being used or not.**

In the Mini MIRI® Dry or Mini MIRI® Humidity incubator "Installation report" form, the User will see when this sensor was installed. This date must be used to calculate the date for the following O₂ sensor change.

Please follow these safety precautions when changing sensor:

- Always use an original O₂ sensor (contact Esco Medical or your local distributor for more details or ordering).
- Change the O₂ sensor within 1 year from the date of the previous sensor installation.
- Failure to change the oxygen sensor on time will result in low/no regulation of O₂ concentration.
- Warranty void if wrong/ non-original sensor is used.

Please refer to the service manual for replacement instructions.

37.6 CO₂ sensor

The CO₂ regulation uses the CO₂ sensor to keep the gas concentration at the chambers' desired level.

This sensor's lifetime is more than 6 years, but for safety reasons, Esco Medical recommends the sensor to be replaced once every 4-years.

Please follow these safety precautions when changing the sensor:

- Always use an original CO₂ sensor (contact Esco Medical or your local distributor for more details or ordering).
- Change the CO₂ sensor within 4 years from the date of installation.
- Failure to change the CO₂ sensor on time can result in low/no CO₂ gas concentration regulation.
- Warranty void if wrong/ non-original sensor is used.

Please refer to the service manual for replacement instructions.

37.7 UV light (only for Mini MIRI® Dry model)

For safety reasons and to clean the re-circulating air, this equipment has a 254 nm UV light installed. The UV-C light has a limited lifetime and must be replaced every year, according to table 37.1.

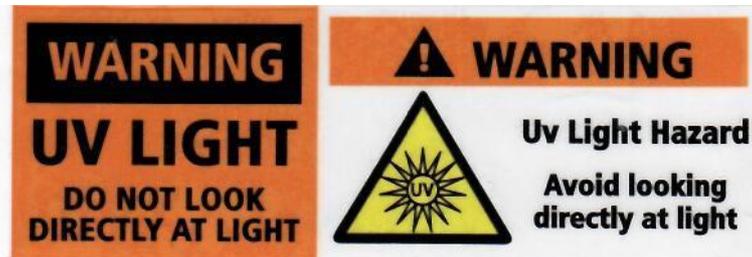


Figure 37.1 UV light warning

⚠ Exposure to UV-C radiation may cause severe damage to your skin and eyes. Always power off before removing any cover.

Please follow these safety precautions when changing the UV-C light:

- Always use an original UV-C light bulb (contact Esco Medical or your local distributor for more details or ordering).
- Change UV-C light bulb within 1 year from date of installation.
- Failure to change the UV-light bulb on time can result in contamination build-up.
- Warranty void if wrong/ non-original UV-light bulb is used.

Please refer to the service manual for replacement instructions.

37.8 Cooling fan

The cooling fan is responsible for cooling down the electronics installed in the unit. A breakdown of the cooling fan will stress the components due to temperature rise within the system. It may cause the electronics to drift, resulting in low temperature and gas regulation.

To avoid this, Esco Medical recommends that the cooling fan be replaced once every 3 years.

Please follow these safety precautions when changing the cooling fan:

- Always use an original fan (contact Esco Medical or your local distributor for more details or ordering).
- Change the fan within 3 years from the date of installation.
- Failure to change the fan may cause the electronics to drift, resulting in low temperature and gas regulations.
- Warranty void if wrong/ non-original fan is used.

Please refer to the service manual for replacement instructions.

37.9 Internal gas pump (only for Mini MIRI® Dry model)

The internal gas pump is used to transport the mixed gas through the VOC/HEPA filter, UV light and the chambers. In time the performance of this pump can be affected, causing a longer recovery time.

Therefore, this pump must be replaced once every 2 years to maintain the fast recovery time after lid openings.

Please follow these safety precautions when changing the internal gas pump:

- Always use an original gas pump (contact Esco Medical or your local distributor for more details or ordering).
- Change the gas pump within 2 years from the date of installation.
- Failure to change the pump may cause slow recovery times or breakdowns.
- Warranty void if wrong/ non-original pump is used.

Please refer to the service manual for replacement instructions.

37.10 Pump module (only for Mini MIRI® Humidity model)

The pump is used to transport the mixed gas through the chambers. In time the performance of this pump can be affected, causing a longer recovery time.

Therefore, this pump must be replaced once every 2 years to maintain the fast recovery time after lid openings.

Please follow these safety precautions when changing the internal gas pump:

- Always use an original gas pump (contact Esco Medical or your local distributor for more details or ordering).
- Change the gas pump within 2 years from the date of installation.
- Failure to change the pump may cause slow recovery times or breakdowns.
- Warranty void if wrong/ non-original pump is used.

Please refer to the service manual for replacement instructions.

37.11 Proportional valves

The internal valves make gas regulation possible. If the proportional valves are worn, gas regulation may be affected. It may cause more prolonged recovery time, incorrect gas concentration or breakdown. Therefore, these proportional valves must be replaced once every 3 years to maintain system safety and stability.

Please follow these safety precautions when changing valves:

- Always use original proportional valves (contact Esco Medical or your local distributor for more details or ordering).
- Change the valves within 3 years from the date of installation.
- Failure to change the valves may cause slow recovery times or breakdowns.
- Warranty void if wrong/ non-original valves are used.

Please refer to the service manual for replacement instructions.

37.12 Gas lines

The internal gas lines are used to transport mixed gas through the VOC/HEPA filter, UV light and the chambers. Over time, the lines' performance can be affected, causing more extended recovery time due to clogging.

Therefore, the gas lines must be replaced once every 3 years to maintain the fast recovery time after lid opening.

Please follow these safety precautions when changing gas lines:

- Always use original gas lines (contact Esco Medical or your local distributor for more details or ordering).
- Change the gas lines within 3 years from the date of installation.
- Failure to change the gas lines may cause slow recovery times or breakdowns.
- Warranty void if wrong/ non-original gas lines are used.

Please refer to the service manual for replacement instructions.

37.13 Flow sensors

The flow sensors are used by the CO₂/N₂ regulations and for logging the unit's gas consumption.

This sensor's lifetime is more than 3 years, but Esco Medical recommends the sensor be replaced once every 2nd year for safety reasons.

Please follow these safety precautions when changing sensors:

- Always use an original flow sensor (contact Esco Medical or your local distributor for more details or ordering).
- Change flow sensors within 2 years from the date of installation.
- Failure to change the flow sensors on time may result in low/no CO₂ and O₂ gas concentration regulation.
- Warranty void if wrong/ non-original sensors are used.

Please refer to the service manual for replacement instructions.

37.14 Pressure regulators

The internal pressure regulators protect the system from too high external gas pressures that would damage the gas circuit's sensitive parts. If the pressure regulators are worn, they may begin to drift and not offer the protection they are supposed to. It could cause breakdowns or leaks in the internal gas circuit. Therefore, the regulators must be replaced once every 4th year to maintain the system safe and stable.

Please follow these safety precautions when changing regulators:

- Always use original pressure regulators (contact Esco Medical or your local distributor for more details or ordering).
- Change the regulators within 4 years from the date of installation.
- Failure to change the regulators may cause breakdowns.
- Warranty void if wrong/ non-original regulators are used.

Please refer to the service manual for replacement instructions.

37.15 Internal 0.2 μ filter for CO₂ gas

The round-shape in line 0.2 μ HEPA filter for CO₂ gas removes any particles found in the incoming CO₂ gas. Failure to use the HEPA filter may cause damage to the high precision flow sensor, calculate the amount of CO₂ gas entering the system, and disturb the CO₂ regulator system.

Please follow these safety precautions when changing the filter:

- Always use the original filter (contact Esco Medical or your local distributor for more details or ordering).
- Change the filter once every year.
- Failure to change the filter on time will result in low/no cleaning of incoming CO₂ gas.
- Warranty void if wrong/ non-original filter is used.

Please refer to the service manual for replacement instructions.

37.16 Internal 0.2 μ filter for N₂ gas

The round-shape in line 0.2 μ HEPA filter for N₂ gas removes any particles found in the incoming N₂ gas. Failure to use the HEPA filter may cause damage to the high precision flow sensor, calculate the amount of N₂ gas entering the system, and disturb the N₂ regulator system.

Please follow these safety precautions when changing the filter:

- Always use the original filter (contact Esco Medical or your local distributor for more details or ordering).
- Change the filter once every year.
- Failure to change the filter on time will result in low/no cleaning of incoming N₂ gas.

- Warranty void if wrong/ non-original filter is used.

Please refer to the service manual for replacement instructions.

37.17 Firmware update

If Esco Medical has released a newer version of the firmware, this should be installed on Mini MIRI® Dry and Mini MIRI® Humidity incubators during the yearly scheduled service.

Please refer to the service manual for instructions on how to update the firmware.

38 The Installation guide

This section describes when and how to install Mini MIRI® Dry and Mini MIRI® Humidity incubator in the IVF clinic.

38.1 Responsibilities

All technicians or embryologists installing the Mini MIRI® Dry or Mini MIRI® Humidity incubator must identify problems and perform any necessary calibrations, adjustments and maintenance.

Installation personnel performing MEA (Mouse Embryo Assay) must be thoroughly familiar with the MEA and all functions of the instrument, calibration and testing procedures, and instruments used in the instrument's testing. MEA test is a supplemental installation test and is not mandatory.

All individuals who will perform installation, repair and/or maintenance of the instrument must be trained by Esco Medical or at a qualified training center. Experienced service technicians or embryologists conduct training to ensure that the installation personnel clearly understand the instrument's functions, performance, testing, and maintenance.

Installation personnel must be updated regarding alterations or additions to this document and the "Installation report" form.

38.2 Before installation

2 – 3 weeks before the installation due, the user/owner at the clinic is contacted via e-mail to plan the exact time to perform the installation. When a convenient time has been determined, travel and accommodation arrangements can be made.

The released Mini MIRI® Dry or Mini MIRI® Humidity incubator must be sent 1 – 3 weeks before installation, depending on the clinic location. Check with shippers about local customs regulations and delays that could arise from that.

The clinic must be informed about the site requirements before installation and should have signed the customer requirement checklist:

1. The lab must have an idle sturdy and stable lab bench for standing operation.
2. The Mini MIRI® Dry or Mini MIRI® Humidity weight is approximately 22 kg.
3. The required space for placement is 1.0 m x 0.6 m.
4. Temperature control should be able to maintain a stable temperature, never exceeding 30 °C.
5. Humidity control to avoid condensation.
6. Uninterrupted power supply (UPS) with 115 or 230 V, minimum 120 W.
7. Proper grounding.
8. CO₂ gas outlet with 0.6 – 1.0 atm above ambient.
9. N₂ gas outlet with 0.6 – 1.0 atm above ambient if the clinic uses reduced oxygen levels
10. Tubes that fit 4 mm hose nipple and HEPA filter.
11. Access to a PC with USB for the data logging.

38.3 Preparing for installation

- Print out the installation test from the validation manual. Make sure it is the latest and current version only.
- Fill out the following blank boxes in the form: Mini MIRI® Dry or Mini MIRI® Humidity incubator serial number (S/N) and customer.
- The service tool kit is checked for content before every installation trip to ensure it contains the necessary tools.
- Always bring the latest versions of firmware and data logging software. Bring these files on a labeled memory stick to the service site.

38.4 Bring the following to the installation site

- "Installation report" form.
- Service manual for the Mini MIRI® Dry or Mini MIRI® Humidity incubators.
- Updated service tool kit.
- Memory stick with the latest released firmware & software.
- High precision thermometer with a resolution not less than 0.1 °C.
- Calibrated gas analyzer with precision at least 0.1% for CO₂ and O₂ and the possibility of returning gas samples to the incubator.
- Extension cable for USB connection.

38.5 Installation procedure at the site

1. Follow the guidelines in the safety instructions and warnings section ("2 Safety warning" section).
2. Connect the power cable to the UPS.
3. Connect the power cable to Mini MIRI® Dry or Mini MIRI® Humidity incubator.
4. Connect the gas lines.
5. Set gas pressure on the external gas regulator at 0.4 – 0.6 bar (5.80 – 8.70 PSI).
6. Switch on the Mini MIRI® Dry or Mini MIRI® Humidity on the back.
7. Observe for standard functionality.

8. Let the unit warm up and stabilize for 30 min.
9. Follow the guidelines in the "33 The Validation guide".
10. Complete user training and finish reading instructions.
11. After a burn-in phase of 24-hours, the unit is ready for use IF the testing is successful.

38.6 User training

1. Mains switch on/off.
2. Explain Mini MIRI® Dry and Mini MIRI® Humidity incubators' essential function and incubation with a multi-room facility to store the samples.
3. Explain temperature control in Mini MIRI® incubator (direct heat transfer with heated lids).
4. Gas regulation on/off.
5. Setpoint for temperature, CO₂ and O₂.
6. Explain how N₂ is used to suppress the O₂ level.
7. Alarm turn off procedure (temperature, CO₂, O₂) and revert times.
8. Insertion and removal of heating inserts from the incubator.
9. How to toggle the "Under oil" and "Open culture" modes, and when which mode should be used.
10. Emergency procedures (can be found in the "29 Emergency Procedures" section).
11. Explain how to clean the device and heating inserts.
12. External measurement and calibration of temperature.
13. External measurement and calibration of gas concentration (InControl or Galaxy).
14. How to add and remove a sample.
15. Demonstrate how to replace the VOC-HEPA filter (can be found in the "12.1 Installation of new filter capsule" section). Applicable only for Mini MIRI® Dry model.
16. Data logger functionality, how to establish a connection and re-connection.

 **Use the User manual section as much as possible to get the User well acquainted with it.**

 **The user/owner is informed that the first VOC filter change is 3 months after installation and 3-month intervals. The first service check is under normal circumstances after 1 year.**

38.7 After the installation

When the installation trip is finished, a copy of the original "Installation report" form must be sent to Esco Medical Ltd. It will be saved with the device records. According to the ISO procedure and Medical Device Directive, a paper copy of the completed and signed installation test form is stored in the unique device's device history record. The date of installation is written in the instrument overview file. The date of installation is also written in the service schedule.

Suppose Mini MIRI® Dry or Mini MIRI® Humidity user or owner make inquiries about a written "Installation report" the completed and signed Installation test form must be sent to the clinic. Any

deviations/complaints/suggestions from the Installation visit are reported in the CAPA system. If a critical error has occurred, information about this will be reported directly to QC or QA.

 **If Mini MIRI® Dry or Mini MIRI® Humidity fails any of the Installation test acceptance criteria, or it in any way suffer from a severe error and incubation parameters are compromised, Mini MIRI® Dry or Mini MIRI® Humidity must be taken out of service until it is repaired/ exchanged, or anew test approves the Mini MIRI® Dry or Mini MIRI® Humidity incubator. The User and owner must be informed about this, and arrangements to solve the problems must be initiated.**