ESCO MEDICAL

CE 0123

USER MANUAL

MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

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Rx only

CERTIFIED INCUBATION

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Copyright Information

Caution: Federal law restricts this device to sale by or on a licensed healthcare practitioner's order.

Only to be used by a trained and qualified professional. The device is sold under exemption 21 CFR 801 Subpart D.

"Material in this manual is provided for informational purposes only. The contents and the product described in this manual (including any appendix, addendum, attachment or inclusion) are subject to change without notice. Esco makes no representations or warranties as to the accuracy of the information contained in this manual. In no event shall Esco be held liable for any damages, direct or consequential, arising out of or related to the use of this manual."

Unpacking and Inspection

Follow standard receiving practices upon receipt of the medical device. Check the shipping carton for damage. If the damage is found, stop unpacking the medical device. Notify the freight carrier and ask for an agent to be present while the medical device is unpacked. There are no special unpacking instructions, but be careful not to damage the medical device when unpacking it. Inspect the medical device for physical damage such as bent or broken parts, dents, or scratches.

Claims

Our routine method of shipment is via common carrier. If physical damage is found, upon delivery, retain all packing materials in their original condition and immediately contact the carrier to file a claim.

If the medical device is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact your local sales representative or Esco Medical Technologies, UAB immediately.

Standard Terms and Conditions

Refunds & Credits

Please note only serialized products (products labeled with a distinct serial number) and accessories are eligible for a partial refund and/or credit. Non-serialized parts and accessory items (cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. In order to receive a partial refund/credit, the product must not have been damaged. It must be returned complete (meaning all manuals, cables, accessories, etc.) within 30 days of original purchase, in "as new" and resalable condition. The *Return Procedure* must be followed.

Return Procedure

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number obtained from Esco Medical Technologies, UAB Customer Service. All items being returned must be sent *prepaid* (freight, duty, brokerage and taxes) to our factory location.

Restocking Charges

Products returned within 30 days of original purchase are subject to a minimum restocking fee of 20% of the list price. Additional charges for damage and/or missing parts and accessories will be applied to all returns. Products that are not in "as new" and resalable condition are not eligible for credit return and will be returned to the customer at their own expense.

Certification

This medical device has been thoroughly tested/inspected and found to meet Esco Medical Technologies, UAB manufacturing specifications when shipped from the factory.

Calibration measurements and testing are traceable and done according to Esco Medical Technologies, UAB ISO certification.

Warranty and Product Support

Esco Medical Technologies, UAB warrants this medical device to be free from defects in materials and workmanship under regular use and service for two (2) years from the original purchase date, provided the medical device is calibrated and maintained following this manual. During the warranty period, Esco Medical Technologies, UAB 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, brokerage and taxes prepaid) to Esco Medical Technologies, UAB. Any transportation charges incurred are the purchaser's responsibility and are not included within this warranty. This warranty extends only to the original purchaser. It does not cover damage from abuse, neglect, accident or misuse, or as the result of service or modification by parties other than Esco Medical Technologies, UAB.

IN NO EVENT SHALL ESCO MEDICAL TECHNOLOGIES, UAB BE LIABLE FOR CONSEQUENTIAL DAMAGES.

No warranty shall apply when any of the following causes damage:

- Power failure, surges, or spikes.
- Damage in transit or when moving the medical device.
- An improper power supply such as low voltage, incorrect voltage, defective wiring or inadequate fuses.
- Accident, alteration, abuse or misuse of the medical device.
- Fire, water damage, theft, war, riot, hostility, *acts of God* such as hurricanes, floods, etc.

Only CultureCoin® products (those items bearing a distinct serial number tag) and their accessory items are covered under this warranty.

PHYSICAL DAMAGE CAUSED BY MISUSE OR PHYSICAL ABUSE IS NOT COVERED UNDER THE WARRANTY. Items such as cables and non-serialized modules are not covered under this warranty.

This warranty gives you specific legal rights and you may have other rights, which vary from province to province, state to state, or country to country. This warranty is limited to repairing the medical device per Esco Medical Technologies, UAB specifications.

When you return the medical device to Esco Medical Technologies, UAB for service, repair or calibration, we recommend shipment using the original shipping foam and container. If the original packing materials are not available, we recommend the following guide for repackaging:

- Use a double-walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all medical device 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 medical device.

Esco Medical Technologies, UAB will not be responsible for lost shipments or medical devices 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 Technologies, UAB to obtain an RMA number and receive help with shipping/customs documentation.

Re-calibration of the medical device, which has a recommended annual calibration frequency, is not covered under warranty.

Warranty Disclaimer

If your medical device is serviced and/or calibrated by someone other than Esco Medical Technologies, UAB 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 medical device warranty. In an event where the seal must be broken to gain internal access to the medical device, you must first contact Esco Medical Technologies, UAB.

You will be required to provide us with the serial number for your medical device, 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 medical device without interruption.

WARNING

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

ESCO MEDICAL TECHNOLOGIES, UAB DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR APPLICATION.

THIS PRODUCT CONTAINS NO USER-SERVICEABLE COMPONENTS.

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

Table of contents

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 that are 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 described in detail in sections 34 – 37. The Maintenance guide is described in detail in section 38. The Installation procedures are described in detail in section 39.

☞ **Digital versions of the English user manual and all translated versions are available on our website, www.esco-medical.com.**

To locate them, simply follow these steps:

1. Click on the "Products" tab in the navigation menu.
2. Scroll down and select "MIRI® Time-Lapse Incubator".
3. Continue scrolling further down to find the "Literature & Resources" section.
4. Click on the "Information for Users" tab.

2 Safety warning

- Only personnel operating this equipment must read the user manual. Failure to read, understand and follow the instructions given in this documentation may result in damage to the device, injury to the 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 it 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 must thoroughly read and understand the installation procedures and adhere to environmental/electrical requirements.
- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

- In this manual, important safety-related points will be marked with the following symbols:

NOTE

Used to direct attention to a specific item.

WARNING

Use caution.

3 Intended purpose/use

Esco Medical MIRI® TL family`s multiroom IVF incubators are intended to provide an environment with controlled temperature, CO_2 and other gases for the development of embryos. This model has an integrated inverted microscope and imaging system for embryo viewing. The device use is limited up to six days (199 hours), covering the time from post-fertilization to day 6 of the development.

4 About the product

The Esco Medical MIRI® TL family`s multiroom IVF incubator are a CO_2/O_2 incubators with time-lapse capability. In the MIRI® TL6 it is possible to incubate up to 84 embryos, whereas in the MIRI® TL12 – up to 168 embryos can be incubated simultaneously. The multiroom IVF incubators can generate time-lapse images and provide them to identify development quality and stages.

The only dish used with MIRI® TL6 and MIRI® TL12 multiroom IVF incubators is the CultureCoin®.

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

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

The Esco Medical MIRI® TL6 multiroom IVF incubator has 6 completely separate culture heat chambers, whereas MIRI® TL12 has 12 chambers. Each chamber has its own heated lid and a room for one CultureCoin® dish.

To ensure maximum performance, the system of MIRI® TL6 multiroom IVF incubator has 12 completely separate PID temperature controllers, whereas MIRI® TL12 has 24. They control and regulate temperature in culture chambers and lids. Chambers do not affect each other's temperatures in any way. The top and the bottom of each chamber is separated with a PET layer so that the lid temperature would not affect the bottom. For

validation purposes, each chamber has a PT-1000 sensor built in. The circuitry is separated from the device's electronics so it remains a truly separate validation system.

The multiroom IVF incubator has to be supplied with 100% CO_2 and 100% N_2 in order to be able to control the CO_2 and O_2 gas concentrations in the culture chambers.

A dual beam infrared CO_2 sensor with extremely low drift rates controls the CO_2 concentration. A chemical medical grade oxygen sensor controls the concentration of O_2.

Gas recovery time is less than 3 min after opening the lid for up to 30 seconds. To validate gas concentration, the MIRI® TL6 multiroom IVF incubator is fitted with 6 gas sample ports that allow the user to sample gas from the individual chamber, whereas MIRI® TL12 has 12.

The multiroom IVF incubator features a recirculated gas system where gas is continuously put into the chamber 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/HEPA filter. The UVC light has filters that inhibit any 185 nm radiation that would produce dangerous ozone. The VOC/HEPA filter is located under the UVC light.

Complete gas repletion in the system takes less than 5 min.

The total gas consumption is very low. Less than 2 l/h CO_2 and 5 l/h N_2 in use.

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

The CultureCoin® dish location in a chamber is easy to reach and locate because of the chamber numbering and the ability to write on the white lid with a pen.

The multiroom IVF incubator has been primarily developed and designed for incubation of gametes and embryos with an overlay of either Paraffin or mineral oil.

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 device.

The software is running on the built-in touchscreen. PC controls a microscopy system that can generate an image every 5 min. When compiled, these images can be viewed as a time-lapse movie.

The Software contains logging functions for a long-term data logging and storage. Web module enables the QC data to be transferred for off-site evaluation – by performing this, the manufacturer can provide a valuable service to the customers.

The user can plug any standard BNC pH probe to the device and measure the pH in the samples at will.

MIRI® TL family`s multiroom IVF incubators are stationary devices. The term refers to equipment that, once installed and placed into service, is not intended to be moved from one place to another.

With Esco Medical MIRI® TL family's multiroom IVF incubators could work only individuals who have formal education in a relevant field of healthcare or medical discipline.

Esco Medical MIRI® TL family's multiroom IVF incubators are used for in vitro fertilization (IVF) patients. Patients are women in their reproductive years who have fertility health issues. The intended target group indication is IVF treatment. There are no intended target group contraindications.

The device is manufactured under a full EU certified 13485 ISO quality management system.

This product fulfils the requirements of EN60601-1 3rd edition standards as a Class I type B equivalent device suited for continuous operation. It also conforms to the requirements of the Regulation (EU) 2017/745 concerning medical devices and is classified as a Class IIa device under rule II.

Personal Protective Equipment (89/686/EEC) and Machine Directive (2006/42/EC) is not applicable for the MIRI® TL family`s multiroom IVF incubators. Also, the MIRI® TL family`s multiroom IVF incubators does not contains or incorporates: a medical substance, including a human blood or plasma derivate; tissues or cells, or their derivates, of human origin; or tissues or cells of animal origin, or their derivatives, as referred to in Regulation (EU) No. 722/2012.

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 no damage is found, the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator can be prepared for transport.

These labels should be glued on the box:

- Label with handling symbols and the marked packing date.
- Label with the product name and serial number.

5.2 Storage and operation environment requirements

5.2.1 Storage requirements

The device may only be store under the following conditions:

- The device can be in storage for one year. If stored longer than one year, the device must be returned to the manufacturer for a new release test.
- The device can be stored at temperatures between -20 °C and +50 °C.
- Keep away from direct sunlight.
- Do not use if the packing material is damaged.
- Keep dry.

⚠ **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.**

5.2.2 Operation environment requirements

The device may only be used under the following conditions:

- Operating humidity: 5 – 95% RH (Non-Condensing).
- Operating altitude – up to 2000 meters (6560 feet or 80kPa – 106kPa).
- Non-operating altitude – more than 2000 meters (6560 feet or more than 80kPa – 106kPa).
- Environmental temperature: 18 – 30 °C.
- Away from direct sunlight.
- Kept dry.
- For indoor use only.

⚠ **The device should not be installed or operated near windows.**

5.3 Disposal

Information on handling of the device 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. Device must be disinfected or decontaminated prior to disposal.**

The device 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 special solid waste.

6 Supplied service parts and accessories

Service parts provided with the device are listed below:

- 1 × VOC/HEPA filter capsule.
- 2 × external 0.22µm HEPA filters for input gas supply.
- 1 × USB stick containing a PDF version of the English version of the user manual and all available translations.
- 1 × medical grade power cord.
- 1 × 3.5 mm external alarm jack connector.
- 3 × 5m Patch cord.
- 1 × Wireless router.

⚠ **Included service parts vary depending on the configuration of the device. For the exact part list, please refer to the Packing List document provided together with the device.**

Accessories:

- 1 CultureCoin® dish package (25×CultureCoin®).

7 Safety symbols and labels

There are several user labels on the surface of the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators to guide the user. User labels are shown below.

Table 7.1 Packing box and electrical safety labels

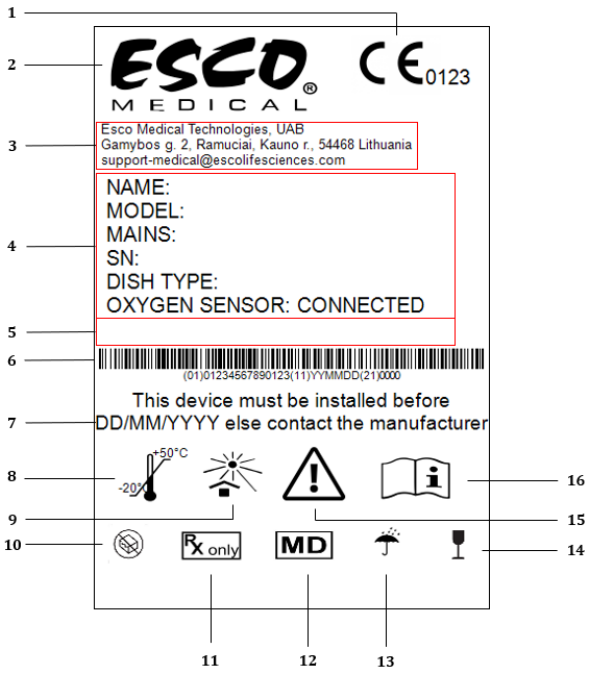
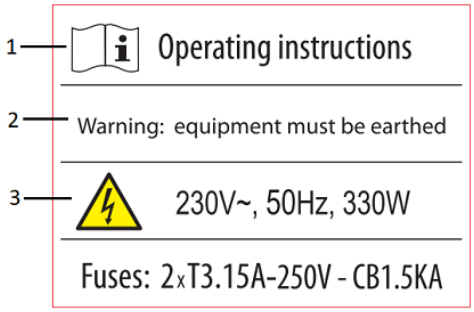
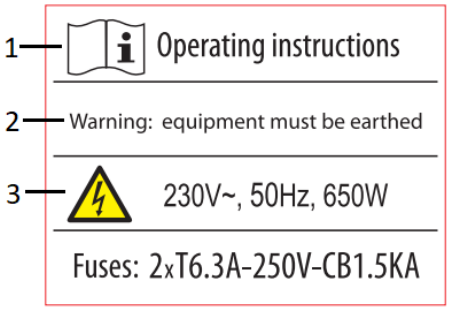
Description	Image
Packing box label for the MIRI® TL6 and MIRI® TL12: 1. CE mark. 2. Logo. 3. Manufacturer`s contact information. 4. Information about packed medical device (name, model, mains, serial number (SN), included dish type). 5. Free space for additional information. 6. UDI-DI code. 7. If stored longer than the shelf life, the device must be returned to the manufacturer for a new release test. 8. Shipping temperature between -20 °C and +50 °C. 9. Keep away from direct sunlight. 10. Do not use it if the packing material is damaged. 11. Rx only. 12. Medical Device. 13. Keep dry. 14. Fragile. 15. 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. 16. Consult instructions for proper use of the device.	
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).	MIRI® TL6 multiroom IVF incubator  MIRI® TL12 multiroom IVF incubator 

Table 7.2 Device label

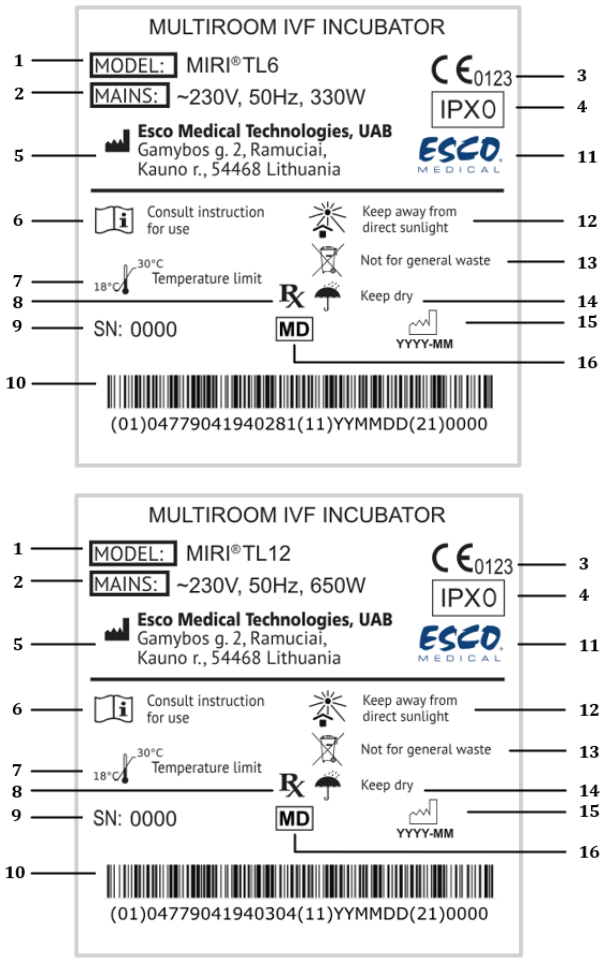
Description	Image
1. Model. 2. Mains power rating. 3. CE mark. 4. Not protected against the ingress of water. 5. Manufacturer's address and country of origin. 6. View instructions for use. 7. Temperature limit. 8. Rx only. 9. Serial number. 10. UDI-DI code. 11. Logo. 12. Keep away from direct sunlight. 13. Observe WEEE. 14. Keep dry. 15. Date of manufacture. 16. Medical device.	

Table 7.3 Labels on the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

Description	Image
USB communication port[1]	
USB communication port line 1[2]	
USB communication port line 2[2]	
CO_2 inlet	
N_2 inlet	

[1] Only in the MIRI® TL6 model
[2] Only in the MIRI® TL12 model

Description	Image
BNC pH	
Alarm port	
Chamber numbers are indicated on the top corner of the lid with a label	
Maximum pressure 0.8 bar	
VOC/HEPA filter	
Ethernet	
TL on/off	
PT 1000 validation sensors	
Gas sample ports	

The connected external device to signal input/output connections should be compliant with the appropriate safety standard for medical equipment EN 60601-1. It applies to USB and Ethernet connections.

Chamber numbers are shown in the pictures below and also indicated on top of lids with a label.

Figure 7.1 Chamber numbers on the MIRI® TL6 multiroom IVF incubator

Figure 7.2 Chamber numbers on the MIRI® TL12 multiroom IVF incubator

8 Important safety instructions and warnings

8.1 Before installation

1. Do not use the product if the package is damaged. Contact Esco Medical Technologies, UAB 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 device on top of other equipment that gives off heat.
2. Place this device on a flat, hard and stable surface.
3. Do not place the device on a carpet or similar surfaces.
4. Do not defy the safety purpose of the grounding-type (earthing) plug.
5. A grounding-type (earthing) plug with two blades and a third prong are 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 CO_2 and 100% concentration N_2 gases.
10. Always use an external 0.22µm HEPA filter to input CO_2 and N_2 gases.
11. Do not use this product if the room temperature exceeds 30 °C.
12. Place this device 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 device is intended for indoor purposes only.
14. The device must be connected to a suitable uninterrupted power supply (UPS) source.

8.3 Post installation

1. Refer all servicing procedures to qualified service personnel.
2. Servicing is required according to the service manual as well as 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. The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators contain high voltage components that may be hazardous.
3. Unplug this device 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, the socket 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 open for more than 10 sec while in use.
7. VOC/HEPA filters must be changed every 3 months.
8. A maintenance plan must be fulfilled to keep the device safe.
9. NEVER block gas supply holes in the chamber.
10. Ensure that CO_2 and N_2 gas supply pressures are kept stable at 0.4 – 0.6 bar (5.80 – 8.70 PSI).
11. Never use any other filters except those provided by Esco Medical Technologies, UAB. Otherwise, the warranty will be void.
12. Do not use the device without a proper Esco Medical Technologies, UAB VOC/HEPA filter attached.

9 Getting started

⚠ **The MIRI® TL6 and MIRI® TL12 multiroom IVF 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 the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator.
4. Connect gas 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 the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator in the back.
7. Switch on the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator PC on the back.
8. Observe for standard functionality.
9. Let the device warm up and stabilize for 20 min.
10. Follow the guidelines in the Validation guide (refer to the "34 The validation guide" section of the User Manual).
11. Complete user training and finish reading instructions.

12. After a burn-in phase of 24 hours, the device is ready for use IF the testing is successful.

☞ **Clean and disinfect the device before use. It is not delivered sterile or in a clinically acceptable cleanliness state. Refer to the "23 Cleaning instructions" section of the User Manual for the manufacturer's recommended guidelines!**

10 Mains connection

The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators come with a detachable medical grade power cord. The power cord is prepared for the country in which the device is intended to be used.

The ON/OFF switch provides the user with a means to isolate the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator from the mains.

⚠ **Do not defy the safety purpose of the grounding-type plug! A grounding-type plug has two blades and a prong, which 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 50Hz OR 115V 60Hz. The built-in power supply has a switch mode that automatically adjusts to the correct mains power between 100V-240V AC 50-60 Hz.

Figure 10.1 Power supply

11 Gas connections

There are two gas inlets on the back of the device. These ports are marked "CO_2 100% Inlet" and "N_2 100% Inlet".

Figure 11.1 Gas inlets

CO_2 inlet should be connected to a 100% concentration of CO_2. CO_2 control in the chamber is available in the range from 2.9% to 9.9% in both MIRI® TL6 and MIRI® TL12 multiroom IVF incubators.

N_2 inlet should be connected to a 100% concentration N_2 if low oxygen conditions are required. O_2 control in the chambers is available in the range from 2.0% to 20.0% in the MIRI® TL6 multiroom IVF incubator and in the range from 5.0% to 20.0% in the MIRI® TL12 multiroom IVF incubator by infusing N_2 gas. O_2 concentration control is achieved by infusing N_2 to push out excess O_2 in the gas system.

☞ 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 CO_2 gas to the CO_2 inlet with a suitable silicone tube. Ensure that the tube is fastened with a clip so that it does not accidentally loosen itself during a sudden pressure fluctuation. Use the supplied 0.22µm HEPA filter on the gas line just before the inlet on the multiroom IVF incubator. Notice the flow direction.

Connect the N_2 inlet to the Nitrogen Bottle in a similar way.

Figure 11.3 0.22µm external HEPA filter for incoming CO_2 / N_2 gas

12 VOC/HEPA filter

Volatile organic compounds (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 CO_2 and N_2. It is essential to use in-line VOC filters to prevent these fumes from entering your multiroom IVF incubators for your medical gasses.

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, the recommended count is below 0.5 ppm; the total quantity of VOCs should be below <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 an acceptable blastocyst development and reasonable pregnancy rates but will likely result in a high percentage of miscarriages.

A combined VOC/HEPA filter (carbon filter) are integrated into the construction of the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator. Before entering the multiroom IVF incubator, the gas is sent through the filter in a single pass. Then, upon return from the chamber, the gas is filtered again. The recirculation system constantly filters gas in the multiroom IVF incubator.

The combined VOC/HEPA filter is mounted on the device's back to ease access and replacement.

12.1 Installation of a new filter capsule

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

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

☞ **The VOC/HEPA filter must be changed when there are no embryos in the device.**

Start by putting the blue fittings on the filter into the filter holder sockets. The flow arrow on the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator and the filter should point in the same direction (see Figure 12.1).

Figure 12.1 The flow arrow on the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

Then, simultaneously press both angle fittings (using both hands) into the holes till they snap into place (see Figure 12.2). The last 4 mm step should feel stiff.

Figure 12.2 VOC/HEPA filter insertion and removal procedure

Figure 12.3 Correctly installed VOC/HEPA filter

⚠ **A VOC/HEPA filter that has been installed incorrectly may cause gas leakage and contamination to appear in the incubator.**

The VOC/HEPA filter is removed by gently pulling it straight out using both hands (see Figure 12.2).

⚠ **Never run the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator if the VOC/HEPA filter is missing! Gas leakage and dangerous particle contamination could occur!**

13 User interface

In the following chapters, the functions associated with 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
ON/OFF keys It is located in the REAR of the device. 1st key turns on the device, and 2nd key turns on the PC.	
Alarm key It mutes an audible alarm and visually indicates the alarm condition by a flashing red. The audio alarm will come back on automatically after 5 min. It can be muted again.	
Touch display panel Shows the information about the current status of the device. The display is used to navigate through the menu and change values for temperature and gas concentrations.	

13.1 Activating the heat and gas controls

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

Figure 13.1 MIRI® TL6 multiroom IVF incubator's rear

The "Please Wait" message appears on the screen while the system is booting up for work.

Figure 13.2 Loading view

Soon after system activation, the main display will show the following parameters:

- Chambers 1 – 6 bottom and lid temperatures (only in the MIRI® TL6 model).
- Chambers 1 – 12 bottom and lid temperatures (only in the MIRI® TL12 model).
- Current CO_2 concentration, CO_2 concentration setpoint and pressure.
- Current O_2 concentration, O_2 concentration setpoint and N_2 pressure.

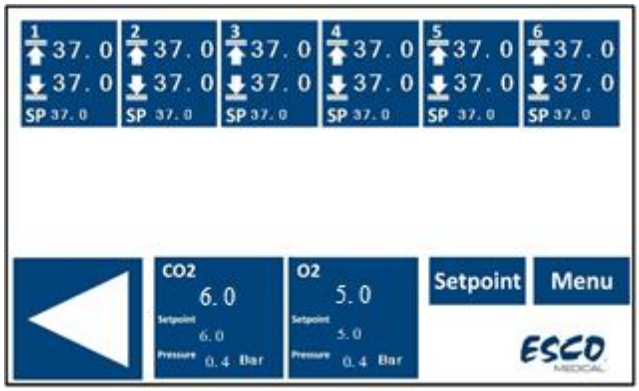


Figure 13.3 Main display in the MIRI® TL6 multiroom IVF incubator

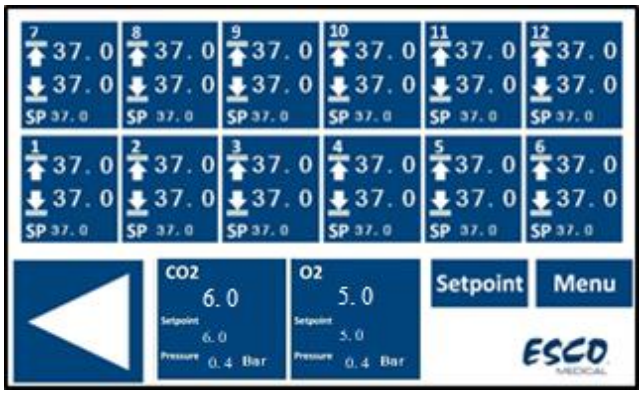


Figure 13.4 Main display in the MIRI® TL12 multiroom IVF incubator

The user can directly access the second main display from the main display by pressing the (◁) button.

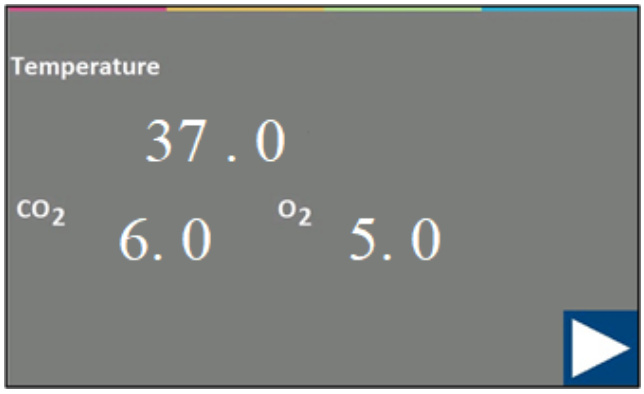


Figure 13.5 The second main display

The second display shows temperature, CO_2 and O_2 setpoint values. If the O_2 regulation is turned off, the display will show "OFF".

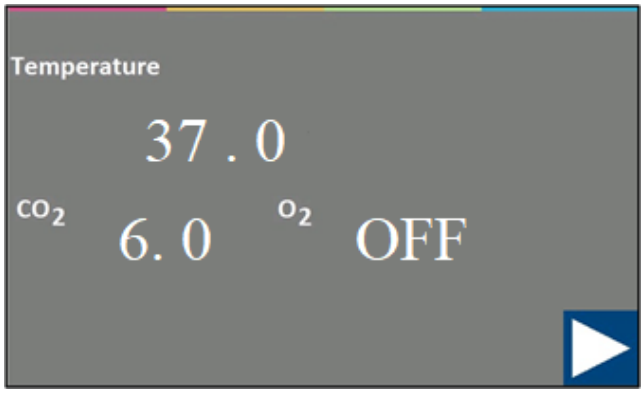


Figure 13.6 The second main display

Exit back to the main display by pressing the (▷) button.

13.2 Temperature setpoint

☞ The MIRI® TL6 multiroom IVF incubator user interface images will be used as an example for all the temperature setpoints.

The temperature setpoint can be adjusted in the range of 28.7 °C to 41.0 °C in both MIRI® TL6 and MIRI® TL12 multiroom IVF incubators.

☞ The default temperature setpoint is 37.0 °C.

In the MIRI® TL6 multiroom IVF incubator, the user can choose to set one common setpoint for all 6 chambers or set 6 independent temperature setpoints (one for each chamber). In the MIRI® TL12 multiroom IVF incubator it is the same for all 12 chambers.

Multiple setpoints are labelled according to the chamber numbers and the temperature sensors at the chamber's bottom. Chamber one is T1; chamber two is T2, etc.

For more information about multiple temperature setpoints, please read “13.5.4 Temperature Setpoint sub-menu” section below.

To change the temperature setpoint, please follow these instructions:

1. In the main display, press the "Setpoint" button:

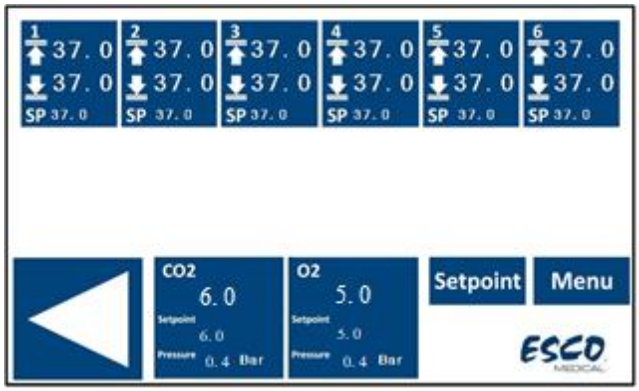


Figure 13.7 Main display view in the MIRI® TL6 multiroom IVF incubator

2. The new setpoint page will appear. Press the "Temperature Setpoint" button:

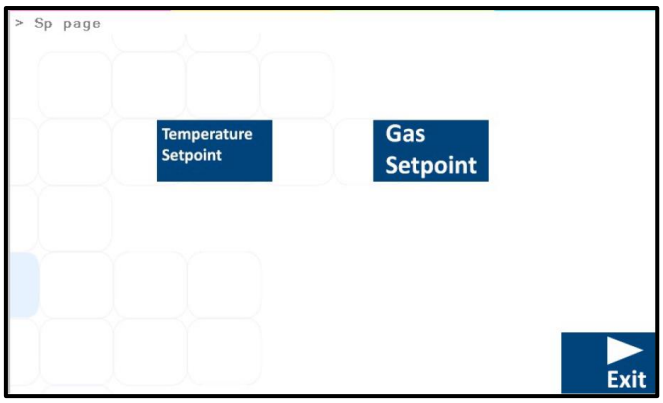


Figure 13.8 Setpoint page display view in the MIRI® TL6 multiroom IVF incubator

3. In the new window, the user can choose the chamber for which he wants to set the setpoint.

To choose the chamber for which the setpoint value should be stated, press the button with the corresponding number.

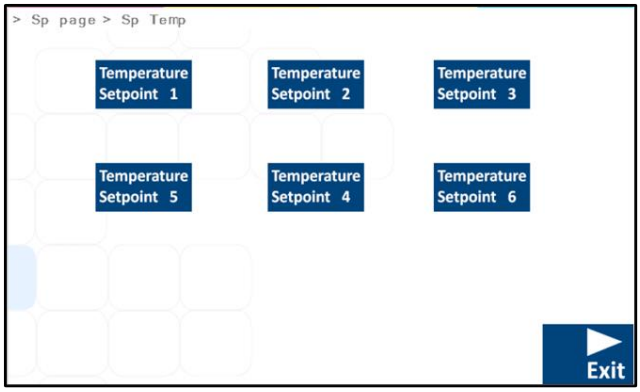


Figure 13.9 Chamber setpoints view in the MIRI® TL6 multiroom IVF incubator

4. Use arrow up and down buttons to set the value: the arrow "DOWN" decreases the value, the arrow "UP" increases the value. One-click changes the value by 0.1 °C.

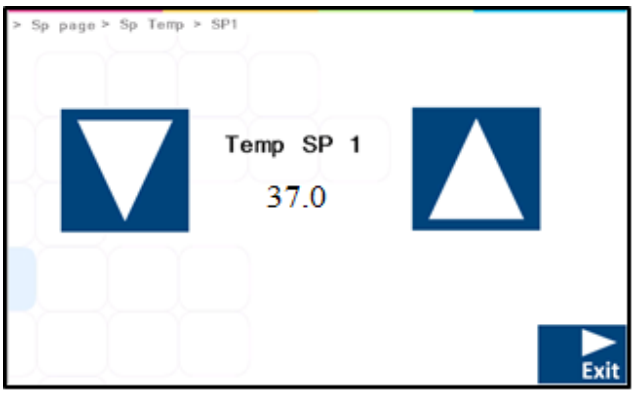


Figure 13.10 Temperature setpoint view in the MIRI® TL6 multiroom IVF incubator

When the desired value is set, press the "EXIT" button. The value will be saved automatically.

Repeat steps for other chambers if "Multi-Temperature SP" is "ON". If "Multi-Temperature SP" is "OFF", the temperature value will automatically be applied to other remaining chambers.

Exit back to the main display by pressing the (▷) button.

13.3 CO_2 setpoint

The MIRI® TL6 multiroom IVF incubator user interface images will be used as an example for all the CO_2 setpoints.

The CO_2 setpoint can be adjusted in the range from 2.9% to 9.9% in both MIRI® TL6 and MIRI® TL12 multiroom IVF incubators.

The default CO_2 setpoint is 6.0%.

To change the setpoint for CO_2 concentration, follow these instructions:

1. In the main display, press the "Setpoint" button:

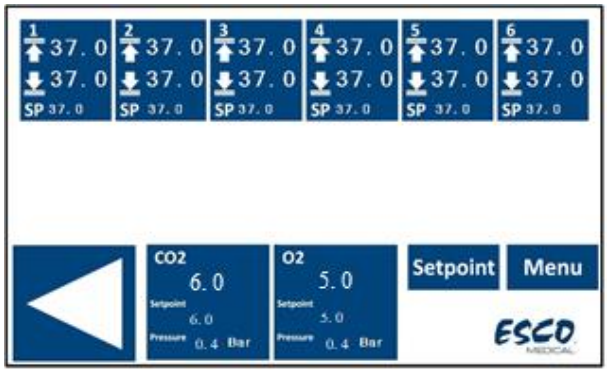


Figure 13.11 Main display view in the MIRI® TL6 multiroom IVF incubator

2. The new setpoint page will appear. Press the "Gas Setpoint" button:

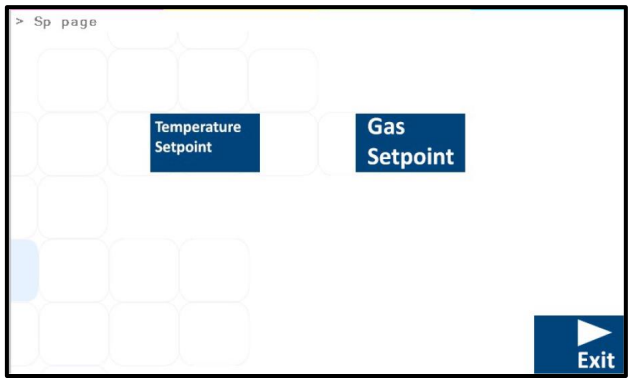


Figure 13.12 Setpoint page view in the MIRI® TL6 multiroom IVF incubator

3. Use arrow up and down buttons to set the value: the arrow "DOWN" decreases the value, the arrow "UP" increases the value. One-click changes the value by 0.1%.

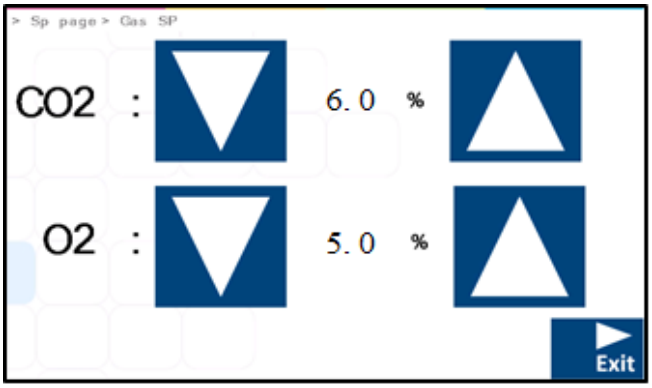


Figure 13.13 Gas setpoint view in the MIRI® TL6 multiroom IVF incubator

When the desired value is set, press the "EXIT" button. The value will be saved automatically.

Exit back to the main display by pressing the (▷) button.

13.4 O_2 setpoint

☞ The MIRI® TL6 multiroom IVF incubator user interface images will be used as an example for all the O_2 setpoints.

The O_2 setpoint can be adjusted from 2.0% to 20.0% in the MIRI® TL6 multiroom IVF incubator and in the range from 5.0% to 20.0% in the MIRI® TL12 multiroom IVF incubator.

☞ The default O_2 setpoint is 5.0%.

To change the setpoint for O_2 concentration, follow these instructions:

1. In the main display, press the "Setpoint" button:

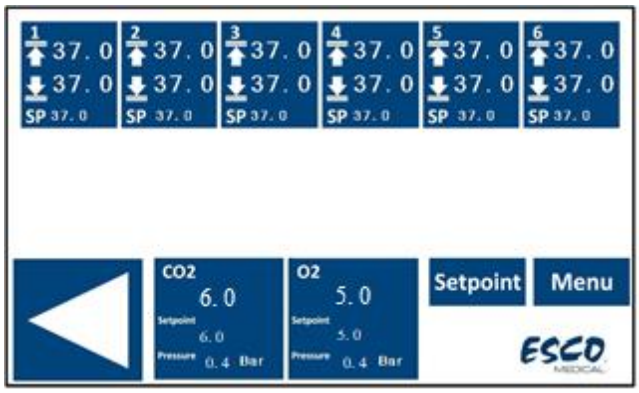


Figure 13.14 Main display view in the MIRI® TL6 multiroom IVF incubator

2. The new setpoint page will appear. Press the "Gas Setpoint" button:

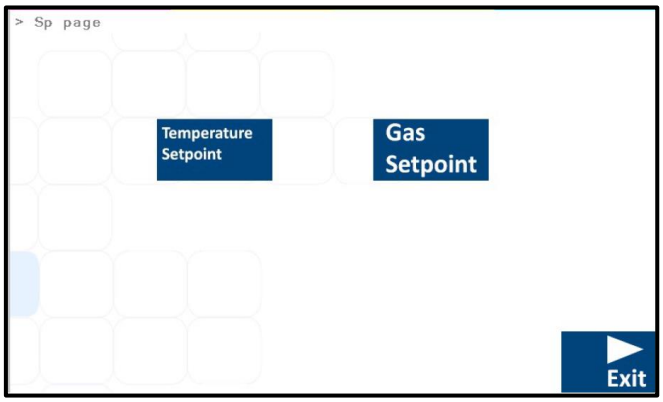


Figure 13.15 Setpoint page view in the MIRI® TL6 multiroom IVF incubator

3. Use arrow up and down buttons to set the value: the arrow "DOWN" decreases the value, the arrow "UP" increases the value. One-click changes the value by 0.1%.

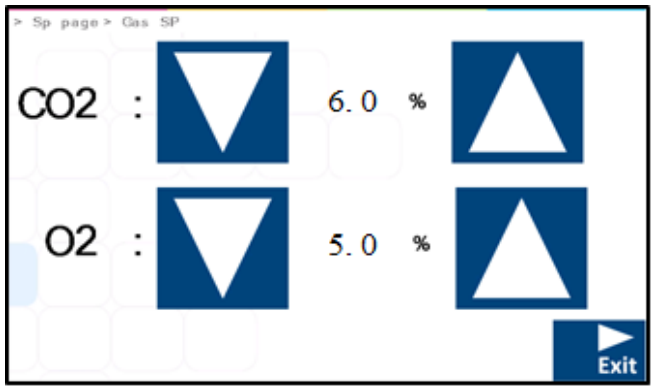


Figure 13.16 Gas setpoint view in the MIRI® TL6 multiroom IVF incubator

When the desired value is set, press the "EXIT" button. The value will be saved automatically.

Exit back to the main display by pressing the (▷) button.

13.5 System menu

In the main display, press the "Menu" button. The main menu consists of 5 sub-menu applications: "Calibration", "CO_2 Setup", "O_2 Setup", "Temperature Setpoint", "UV-C Light".

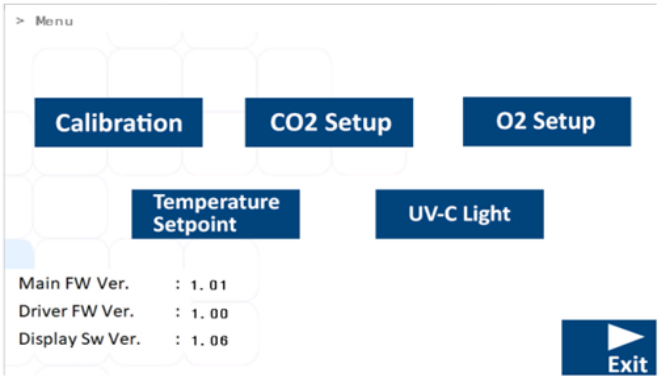


Figure 13.17 System menu view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

Exit back to the main display by pressing the (▷) button.

13.5.1 Calibration sub-menu

Press the "Calibration" button in the main menu view. Calibration can be performed on temperature, CO_2 and O_2 gases.

Figure 13.18 Calibration sub-menu view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

☞ Calibration value change procedure should only be done with a calibrated device and by a trained user or the technician, according to specific measurements.

13.5.1.1 Temperature calibration

Temperature calibration in the MIRI® TL6 multiroom IVF incubator consists of 12 calibration zones.

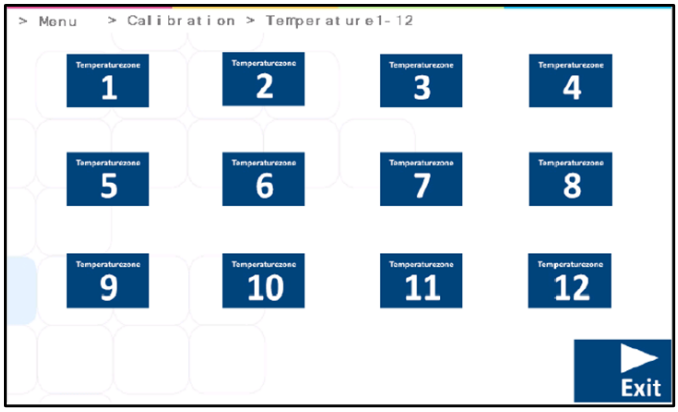


Figure 13.19 12 calibration zones in the MIRI® TL6 multiroom IVF incubator

Each chamber has two internal temperature sensors. One in the chamber lid and another in the chamber's bottom.

Temperature calibration in the MIRI® TL12 multiroom IVF incubator consists of two separate calibration zones: "Chamber 1-6" and "Chamber 7-12".

Figure 13.20 Calibration zones of Chambers 1-6 and Chambers 7-12 in the MIRI® TL12 multiroom IVF incubator

Select the chamber that needs to be calibrated. When a specific chamber for calibration is chosen, a new display window will appear.

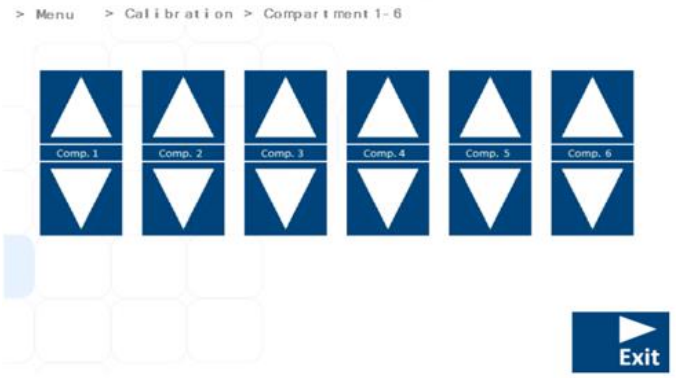


Figure 13.21 Temperature calibration zones for Chambers 1-6 in the MIRI® TL12 multiroom IVF incubator

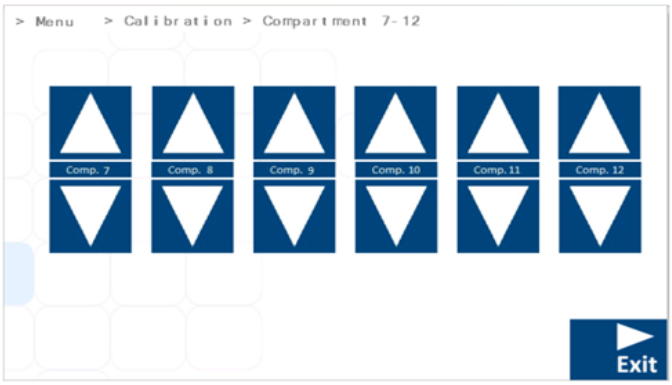


Figure 13.22 Temperature calibration zones for Chambers 7-12 in the MIRI® TL12 multiroom IVF incubator

In the MIRI® TL12 multiroom IVF incubator, each of the 12 chambers consist of "UP" and "DOWN" buttons. To calibrate the chamber's lid temperature, use the "UP" button and to calibrate the chamber's bottom temperature use the "DOWN" button.

In the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators, zones' temperature calibration can be done using the "UP" and "DOWN" buttons.

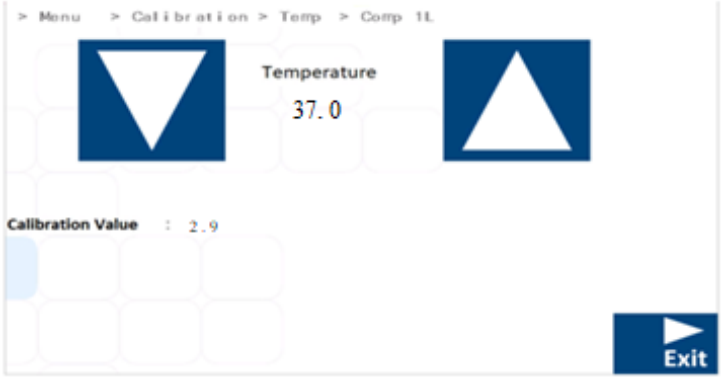


Figure 13.23 Zone T1 calibration view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

Each chamber has two internal temperature sensors. One in the chamber's lid and another in the chamber's bottom.

Example – how to calibrate temperature:

The temperature has to be measured with a suitable and calibrated device. With a high-quality thermometer, it has been determined that T1 is 37.4 °C. Calibrate and adjust the temperature by pushing (+) or (-) keys.

Adjust the temperature by pressing the (+) key 4 times when T1 is chosen. The display will show the steps from 37.0 °C, 37.1 °C, 37.2 °C, 37.3 °C and 37.4 °C. The new value is now stored, and T1 sensor calibration has been completed.

☞ **The calibration procedure is the same for T1 – T12 (for the MIRI® TL6 multiroom IVF incubator) and T1 – T24 (for the MIRI® TL12 multiroom IVF incubator).**

☞ **"T1" is used to adjust the bottom temperature of chamber 1. "T7" is used to adjust the lid's temperature in the same chamber. Remember that the ΔT between the top and bottom should always be 0.2 °C.**

Exit back to the main display by pressing the (▷) button.

13.5.1.2 CO_2/O_2 calibration

The CO_2 and O_2 calibration menu page are shown below:

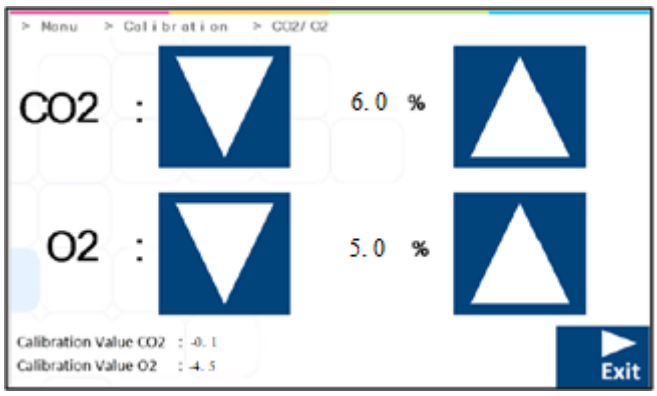


Figure 13.24 CO_2 and O_2 calibration view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators

Calibrate the CO_2 and O_2 gas concentration setpoints by pressing the "UP" or "DOWN" buttons.

Example – how to calibrate CO_2:

The real CO_2 concentration is measured with a suitable and calibrated device on one of the gas sample ports (all ports can be used for this purpose). It was determined to be 6.4%.

Adjust the calibration to the desired concentration by pressing the “UP” and „DOWN“ buttons. In this case, the goal is to adjust CO_2 gas concentration to 6.4%. Press the “UP” button so that thedisplay shows 6.0, 6.1, 6.2, 6.3 and 6.4%. The new value is now stored, and the CO_2 sensor calibration has been completed.

☞ **Calibration is performed by adjusting the CO_2 concentration according to the gas sampling outlet's measurement by an external reliable CO_2 measurement device.**

⚠ **Calibration value change procedure should only be done with a calibrated device and by a trained user or the technician, according to specific measurements.**

☞ **CO_2 gas recovery to 5% is less than 3 minutes while inflating 100% CO_2 gas.**

☞ **The offset value is displayed in the CO_2 calibration window along with the CO_2 concentration value. In this case, the real CO_2 concentration was measured to be 6.4%. By pressing the “UP” button four times, it will take time to change the display's CO_2 concentration value, but the offset value will change immediately. By following this value, the user can see how much the CO_2 calibration value changed without delay.**

Example – how to calibrate O_2:

The real O_2 concentration is measured with a suitable and calibrated device on one of the gas sample ports (all ports can be used for this purpose). It was determined to be 5.3%.

Adjust the calibration to the desired concentration by pressing the “UP“ and “DOWN“ buttons. In this case, the goal is to adjust O_2 gas concentration to 5.3%. Press the “UP” button so that the display shows 5.0, 5.1, 5.2 and 5.3 %. The new value is now stored, and the O_2 sensor calibration has been completed.

☞ **Calibration is performed by adjusting the O_2 concentration according to the gas sampling outlet's measurement by an external reliable O_2 measurement device.**

⚠ **Calibration value change procedure should only be done with a calibrated device and by a trained user or the technician, according to specific measurements.**

☞ **The offset value is displayed in the O_2 calibration window along with the O_2 concentration value. In this case, the real O_2 concentration was measured to be**

5.3%. By pressing the "UP" button three times, it will take time to change the display's O_2 concentration value, but the offset value will change immediately. By following this value, the user can see how much the O_2 calibration value changed without delay.

Exit back to the main display by pressing the (▷) button.

13.5.2 CO_2 Setup sub-menu

Press the "CO_2 Setup" button in the main menu view. The user can activate or deactivate the CO_2 regulation. If the CO_2 regulation is activated, the setpoint value must be set.

Figure 13.25 CO_2 Setup sub-menu view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator

The default status for CO_2 control is "OFF".

The CO_2 flow rate is shown when the setpoint value is set. The flow rate cannot be adjusted because this is the amount of CO_2 gas that is put into the system while regulating. The volume is shown in litres per hour. It usually will fluctuate along with the CO_2 regulation.

The CO_2 pressure value is shown in bar. The external pressure must be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times. It cannot be adjusted on the multiroom IVF incubator; it must be done on the external gas regulator.

Exit back to the main display by pressing the (▷) button.

13.5.3 O_2 Setup sub-menu

Press the "O_2 Setup" button in the main menu view. The user can activate or deactivate the O_2 regulation. If the O_2 regulation is activated, the setpoint value must be set.

Figure 13.26 CO_2 Setup sub-menu view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator

☞ **The default status for O_2 control is "OFF".**

☞ **The O_2 regulation in MIRI® TL6 and MIRI® TL12 multiroom IVF incubator is achieved by displacing O_2 gas with N_2 in order to achieve desired O_2 concentration.**

The N_2 flow rate is shown when the setpoint value is set. The flow rate cannot be adjusted because this is the amount of N_2 gas put into the system while regulating. The volume is shown in litres per hour. It usually will fluctuate along with the N_2 regulation.

The N_2 pressure value is shown in bar. The external pressure must be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times. It cannot be adjusted on the multiroom IVF incubator; it must be done on the external gas regulator.

Exit back to the main display by pressing the (▷) button.

13.5.4 Temperature Setpoint sub-menu

Choose temperature setpoint settings according to the desired working conditions.

If "Multi Temp SP" is "ON", it means that temperature values are individual in each chamber.
If "Multi Temp SP" is "OFF", it means that temperature values **are the same in all chambers**.

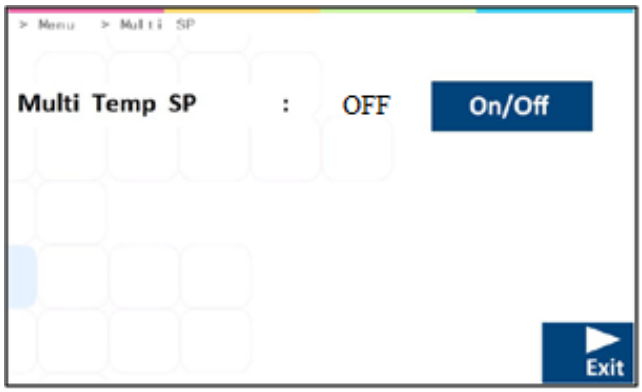


Figure 13.27 Multi-temperature setpoint view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator

When the desired option is set, press the "EXIT" button. The option will be saved automatically.

☞ **When the MULTI temperature setpoint is “OFF”, all chambers' temperature setpoint is set according to T1 by default. If the MULTI temperature setpoint is “OFF”, changing any chamber's temperature setpoint value will apply the same value to all remaining chambers. If the MULTI temperature setpoint is “ON”, each chamber has different setpoint values. When returning from “ON” mode to “OFF”, all setpoints are automatically set to the T1 area value.**

☞ **It is recommended to keep the MULTI temperature settings to “OFF” if all chambers run at the same temperature. Adjusting the setpoint will be easier, as it will only have to be done once instead of twelve times (i.e., for individual chambers).**

Exit back to the main display by pressing the (▷) button.

13.5.5 UV-C Light sub-menu

Press the “UV-C Light” button in the main menu view.

Figure 13.28 UV-C Light regulation in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator

The default status for the UVC light is "ON".

The UV-C light will automatically switch off when the device is turned off.

For gas disinfection insurance, it is recommended that the UV-C light be set to "ON" when the device is being used.

Exit back to the main display by pressing the (▷) button.

14 Alarms

In the case of an alarm condition, an alarm key and an audible alarm signal will turn on while the corresponding alarm(s) will be visible on the segment display matrix. An audio signal can be muted by pressing the alarm key once (muted ON/OFF for 5 minutes). A red “A” will be displayed on the LED matrix, followed by an alarm cause and an arrow pointing up or down (depending on the nature of the alarm condition) and the value of the alarm cause. For example, if the temperature is too low in chamber 1, the display will show "A1↓ 36.3". The alarm button backlight will pulse if at least one error condition is present in the system.

Figure 14.1 Alarm key, which indicates the alarm condition

The audio pattern is 3 and 2 short beeps separated by a 1-second pause. All alarms have the same audio pattern. The audio sound pressure level is 61.1 dB(A).

⚠ **Make sure that the ambient sound pressure level does not exceed 62 dB(A) because the user will not hear the alarm!**

☞ **The MIRI® TL6 multiroom IVF incubator user interface images will be used as an example for all the alarms.**

14.1 Temperature alarms

All 6 chambers in the MIRI® TL6 multiroom IVF incubator and 12 chambers in the MIRI® TL12 multiroom IVF incubator can trigger a temperature alarm if their temperature deviates more than ±0.5 °C from the setpoint.

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

In the picture below, the temperature in the T4 zone in chamber 4 is too high compared to the setpoint. The affected area's value will appear red on display.

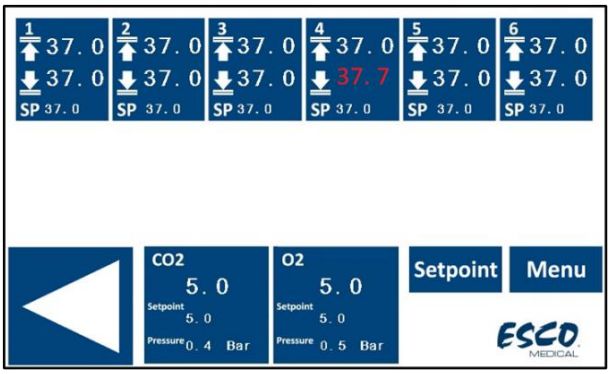


Figure 14.2 High-temperature alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

In the picture below, the temperature in the T1 zone in chamber 1 is too low compared to the setpoint. The affected area's value will appear red on display.

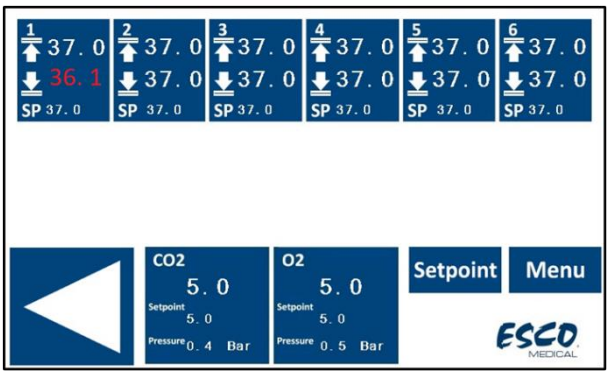


Figure 14.3 Low-temperature alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

If the mute key is pressed, the display will still show a red value, and the sound will be muted for 5 minutes until the audio alarm goes off again. The mute alarm key will still show the alarm condition by blinking red when the alarm is muted.

Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there is a temperature alarm.

If there is a malfunction with the temperature sensors, it will be indicated by the warning:

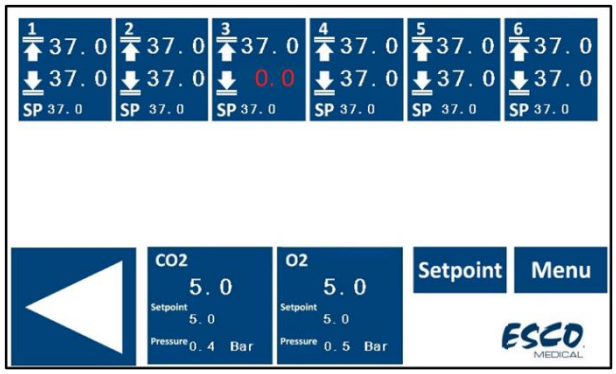


Figure 14.4 Temperature sensor malfunction view on the main display in the MIRI® TL6 multiroom IVF incubator

The T3 temperature sensor in chamber 3 is malfunctioning, and as a safety precaution, the heating for the affected zone will be shut down.

14.2 Gas concentration alarms

14.2.1 CO_2 alarms

The CO_2 concentration alarm is activated if the concentration of CO_2 gas deviates more than ±1% from the set value.

Remember that changing the setpoint more than ±1% from the current gas concentration will result in a CO_2 concentration alarm. The same goes for all calibration adjustments.

In the picture below, the CO_2 concentration is too low compared to the setpoint.

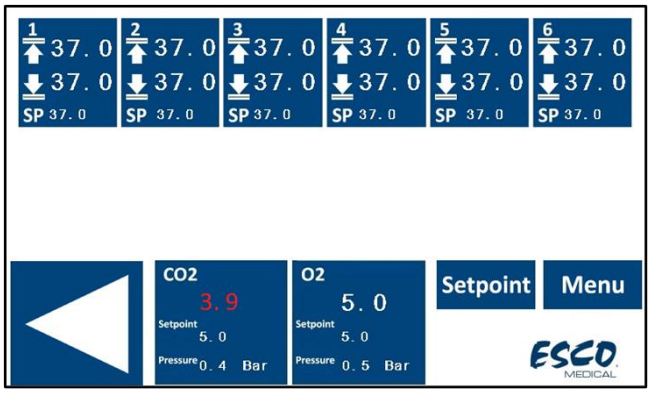


Figure 14.5 Low CO_2 concentration alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

If the mute key is pressed, the display will still show a red value, and the sound will be muted for 5 minutes until the audio alarm goes off again. The mute alarm key will still show the alarm condition by blinking red when the alarm is muted.

Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there is a CO_2 concentration alarm.

14.2.2 O_2 alarms

The O_2 concentration alarm is activated if the concentration of O_2 gas deviates more than ±1% from the set value.

Remember that changing the setpoint more than ±1% from the current gas concentration will result in an O_2 concentration alarm. The same goes for all calibration adjustments.

In the picture below, the O_2 concentration is too high compared to the setpoint.

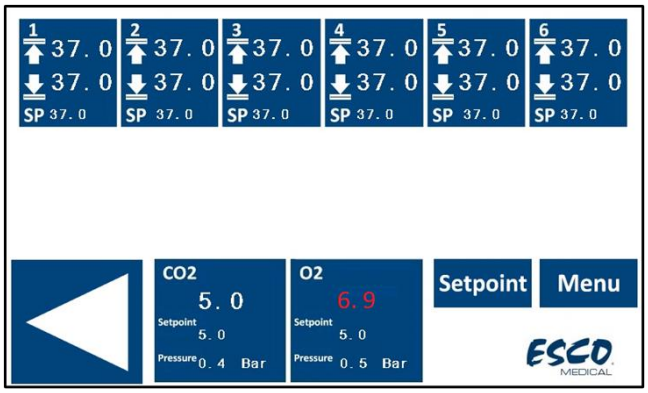


Figure 14.6 High O_2 concentration alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

If the mute key is pressed, the display will still show a red value, and the sound will be

muted for 5 minutes until the audio alarm goes off again. The mute alarm key will still show the alarm condition by blinking red when the alarm is muted.

Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there is an O_2 concentration alarm.

14.3 Gas pressure alarms

14.3.1 CO_2 pressure alarm

If the CO_2 gas supply is not attached correctly or incorrect CO_2 gas pressure is applied to the system, the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator will go into CO_2 pressure alarm mode. CO_2 pressure will be displayed in red, indicating the wrong 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.

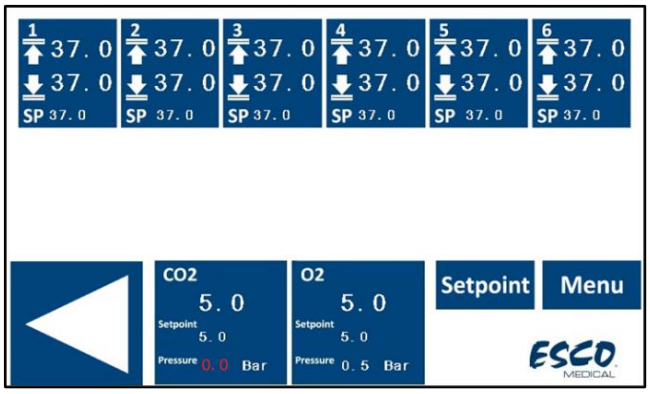


Figure 14.7 CO_2 gas pressure alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

An audible alarm is also activated, but it can be muted by pressing the alarm key. If the mute key is pressed, the audio sound will be muted for 5 minutes.

Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there is a CO_2 pressure alarm.

14.3.2 N_2 pressure alarm

If the N_2 gas supply is not attached correctly or incorrect N_2 gas pressure is applied to the system, the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator will go into N_2 pressure alarm mode. N_2 pressure will be displayed in red, indicating the wrong 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.

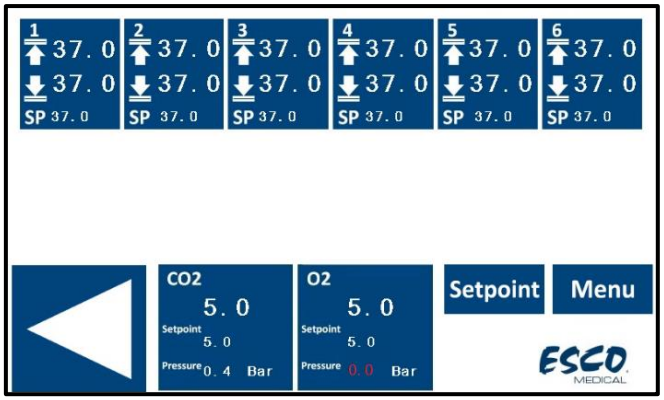


Figure 14.8 N_2 gas pressure alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

☞An audible alarm is also activated, but it can be muted by pressing the alarm key. If the mute key is pressed, the audio sound will be muted for 5 minutes.

☞ Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there is an N_2 pressure alarm.

14.4 Alarm UV-C light

The service UV-C light will appear only as a warning message during the normal status. An audio alarm will not go off.

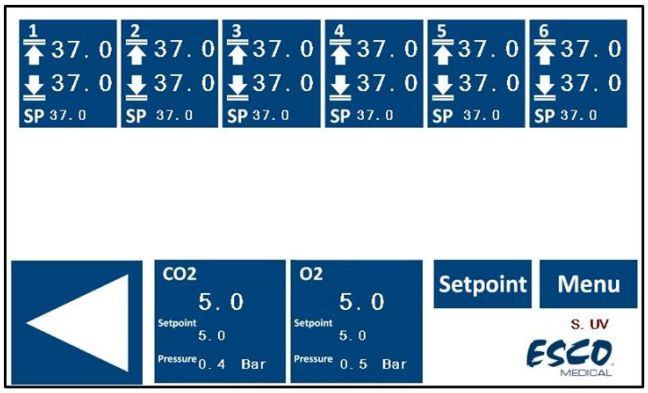


Figure 14.9 UV-C light malfunction alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

The user should consult the distributor for further guidance or service inspection. The "S. UV" will disappear only when the UV-C light will be working again.

☞ Please contact your Esco Medical distributor for more details.

14.5 Multiple alarms

In the picture below, the temperature is too high in the T1 zone, the CO_2 gas is not connected, or the CO_2 pressure is incorrect and there is also a UV-C light malfunction.

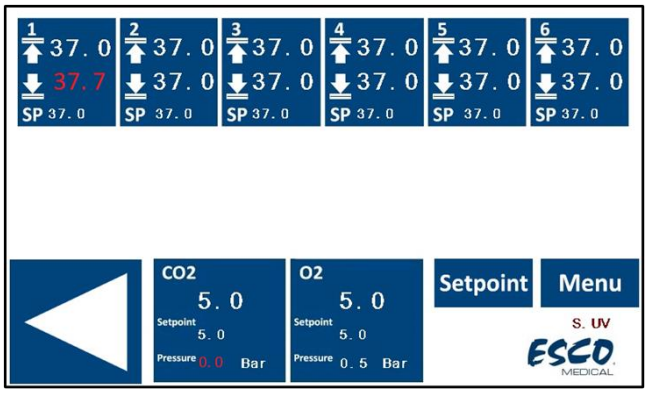


Figure 14.10 Multiple alarm view on the main display in the MIRI® TL6 multiroom IVF incubator

When there are multiple affected parameters, all of them will appear red in the display.

If the mute key is pressed, the display will show a red value and the sound will be muted for 5 minutes until the audio alarm goes off again. The mute alarm key will still show the alarm condition by blinking red when the alarm is muted.

Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there are multiple alarms.

14.6 Loss of power alarm

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

Figure 14.11 Alarm key which indicates the alarm condition

Please refer to the "30 Emergency procedures" section of the User Manual on how to behave when there is a loss of power alarm.

14.7 Summary of the alarms

In the table below, there is a list of every possible alarm in the MIRI® TL family's multiroom IVF incubators.

Table 14.1 Every possible alarm in the MIRI® TL family's multiroom IVF incubators

Alarm name	Conditions	How it is determined	Alarm group	Alarm priority
Low-temperature alarm	If the temperature falls below 0.5 °C from the SP. It is applicable for all chamber's bottom temperature	Each temperature zone sensor reading	Technical	High priority alarm
High-temperature alarm	If the temperature rises above 0.5 °C from the SP. It is applicable for all chamber's bottom temperature		Technical	High priority alarm
Low CO_2 concentration	When the CO_2 concentration drops by 1% from the SP, after 3 min the alarm will turn on	CO_2 sensor reading	Technical	High priority alarm
High CO_2 concentration	When the CO_2 concentration rises by 1% from the SP, after 3 min the alarm will turn on		Technical	High priority alarm
Low O_2 concentration	When the O_2 concentration drops by 1% from the SP, after 5 min the alarm will turn on	O_2 sensor reading	Technical	High priority alarm
High O_2 concentration	When the O_2 concentration rises by 1% from the SP, after 5 min the alarm will turn on		Technical	High priority alarm
Low incoming CO_2 pressure	If the pressure falls below 0.3 bar	Pressure sensor reading	Technical	High priority alarm
High internal CO_2 pressure	If the pressure rises above 0.7 bar	Pressure sensor reading	Technical	High priority alarm
Low incoming N_2 pressure	If the pressure falls below 0.3 bar	Pressure sensor reading	Technical	High priority alarm
High internal N_2 pressure	If the pressure rises above 0.7 bar	Pressure sensor reading	Technical	High priority alarm
UV alarm	If the UV lamp is malfunctioning	UV sensor reading	Technical	Informative alarm

14.8 Alarm verification

In the table below, there is a list of how and when to verify the functionality of the alarm system.

Table 14.2 Alarm verification in the MIRI® TL family's multiroom IVF incubators

Alarm name	How to verify an alarm	When to verify an alarm
High-temperature alarm	Decrease the setpoint value by 3.0 °C from the current setpoint	If you have a suspicion that alarms are malfunctioning
Low-temperature alarm	Put cold metal part (disinfected prior use) in the CultureCoin® placement spot and close the lid	
High CO_2 concentration	Decrease the setpoint value by 3.0% from the current setpoint	
Low O_2 concentration	Increase the setpoint value by 3.0% from the current setpoint	
High O_2 concentration	Open the lid and leave it open for 5 min	
Low CO_2 concentration	Open the lid and leave it open for 3 min	
Low incoming CO_2 pressure	Disconnect the incoming CO_2 gas	
Low incoming N_2 pressure	Disconnect the incoming N_2 gas	

15 Surface temperatures and calibration

The MIRI® TL6 or MIRI® TL12 multiroom IVF incubator temperature control system is described in more detail in this section.

The MIRI® TL6 multiroom IVF incubator is equipped with 12 completely separate PID controllers for temperature measurement, whereas the MIRI® TL12 multiroom IVF incubator has 24. Each controller is responsible for controlling the temperature in a particular area.

Each of the 12 available areas in the MIRI® TL6 multiroom IVF incubator or 24 in MIRI® TL12 multiroom IVF incubator are equipped with its separate temperature sensor and heater, allowing the user to adjust the temperature in every area separately, thus achieving higher precision.

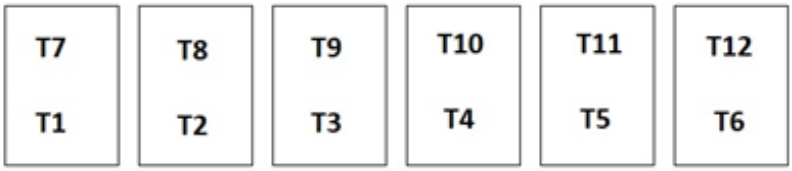


Figure 15.1 Temperature zones in the MIRI® TL6 multiroom IVF incubator

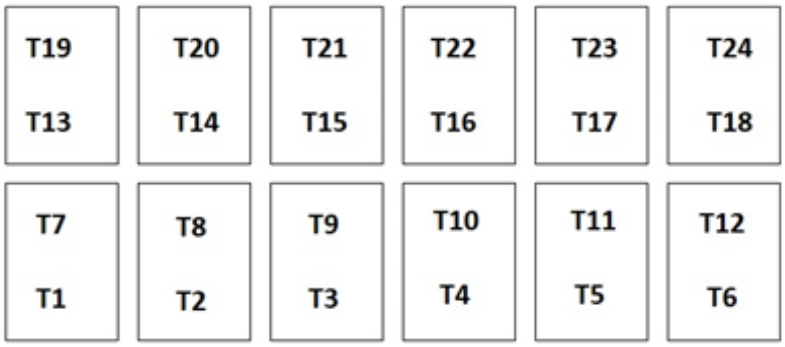


Figure 15.2 Temperature zones in the MIRI® TL12 multiroom IVF incubator

Each area can be calibrated separately, using the item corresponding to the respective area in the menu.

These items are placed in the MIRI® TL6 multiroom IVF incubator menu, and they are named: T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11 and T12.

These items are placed in the MIRI® TL12 multiroom IVF incubator menu, and they are named: T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12 T13, T14, T15, T16, T17, T18, T19, T20, T21, T22, T23 and T24.

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

Table 15.1 Areas associated with sensors in the MIRI® TL6 multiroom IVF incubator

Area	Bottom	Lid
Chamber 1	T1	T7
Chamber 2	T2	T8
Chamber 3	T3	T9
Chamber 4	T4	T10
Chamber 5	T5	T11
Chamber 6	T6	T12

Table 15.2 Areas associated with sensors in the MIRI® TL12 multiroom IVF incubator

Area	Bottom	Lid
Chamber 1	T1	T7
Chamber 2	T2	T8
Chamber 3	T3	T9
Chamber 4	T4	T10
Chamber 5	T5	T11
Chamber 6	T6	T12
Chamber 7	T13	T19
Chamber 8	T14	T20
Chamber 9	T15	T21
Chamber 10	T16	T22
Chamber 11	T17	T23
Chamber 12	T18	T24

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

⚠ **Temperature calibration is done by adjusting the Tx (where x is the sensor number) according to the 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 the correct temperature 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 some time to adjust.

☞ **There is no crossover heating between the 12 chambers: this is a unique feature of the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator. Lid temperature will, however, affect the bottom temperature in a chamber. The ΔT should always be 0.2 °C. Thus, if the bottom temperature is 37.0 °C, the lid should be 37.2 °C.**

Temperature calibration procedure for Chamber 1:

1. Adjust the temperatures according to a high precision measurement done with a suitable sensor.
2. To adjust the temperature of the chamber's bottom. Place the sensor in the middle of the CultureCoin® placement spot. Wait 15 minutes and record the temperature reading. Adjust the "T1" to the desired level, as described in the "13.5.4 Temperature setpoint sub-menu" section of the User Manual. It may be necessary to do iterations before the zone is completely calibrated.
3. Then, stick a suitable and calibrated sensor to the middle of the lid area and close the lid. Wait 15 minutes and record the temperature reading. Adjust the "T7" to the desired level, as described in the "13.5.4 Temperature setpoint sub-menu" section of the User Manual. It may be necessary to do iterations before the zone is completely calibrated.

The chambers 2-6 (MIRI® TL6 multiroom IVF incubator) and 2-12 (MIRI® TL12 multiroom IVF incubator) are adjusted/calibrated in a similar manner.

☞ **The user may check the temperature inside the dish by placing the sensor inside the dish with media and mineral oil overlay.**

⚠ **Calibration value change procedure should only be done with a calibrated device and by a trained user or the technician, according to specific measurements.**

16 Pressure

16.1 CO_2 gas pressure

The CO_2 pressure can be seen in the main display and the "CO_2 Setup sub-menu" .

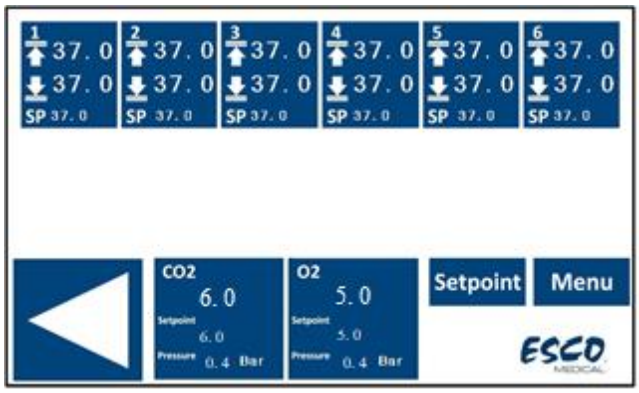


Figure 16.1 Main display view in the MIRI® TL6 multiroom IVF incubator

Figure 16.2 CO_2 Setup sub-menu view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator

The CO_2 pressure value is shown in bar. The external pressure must be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times. It cannot be adjusted on the multiroom IVF incubator; it must be done on the external gas regulator.

☞ **Remember that 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.**

16.2 N_2 gas pressure

The N_2 pressure can be seen in the main display and the "O_2 Setup sub-menu".

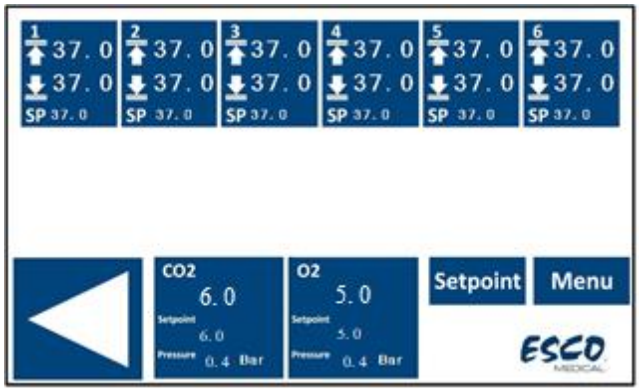


Figure 16.3 Main display view in the MIRI® TL6 multiroom IVF incubator

Figure 16.4 CO_2 Setup sub-menu view in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator

The N_2 pressure value is shown in bar. The external pressure must be between 0.4 – 0.6 bar (5.80 – 8.70 PSI) at all times. It cannot be adjusted on the multiroom IVF incubator; it must be done on the external gas regulator.

Remember that 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.

17 Firmware

The firmware installed on your MIRI® TL6 and MIRI® TL12 multiroom IVF incubator is upgradeable. Whenever an important update is available, it will be provided to our distributors around the world – they will ensure that your incubator runs with the newest available firmware. A service technician can do this during a scheduled annual service.

The current MIRI® TL6 multiroom IVF incubator firmware version is 1.05 for Master PCB and 1.04 for Slave PCB. The current MIRI® TL12 multiroom IVF incubator firmware version is 1.08 for both Master and Slave PCB.

18 pH measuring

Validating the pH of culture media should be a standard procedure.
The MIRI® TL6 and MIRI® TL12 multiroom IVF incubator are equipped with a high-grade pH measuring system.

A standard male BNC connector is located in the back of the device. It can be connected to most standard pH combination probes. Probes that require a separate reference cannot be used. According to the temperature level set in the calibration dialogue window on the screen, the system does temperature correction (ATC) according to the calibration dialogue window's temperature level. An external ATC probe cannot be used with the system.

The temperature level must be set to a correct level in the calibration dialogue window on the screen (corresponding to a measurement done with an external device). Otherwise, the measurement will be incorrect as pH is a temperature-dependent measurement.

All readings from the pH system and calibration dialogue are shown on the main display:

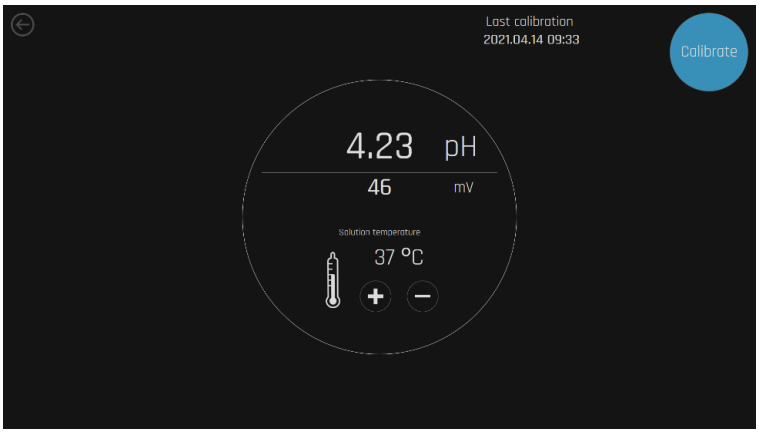


Figure 18.1 pH system and calibration dialogue screen view in the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator

The recommended method to use the system is to fill a CultureCoin® dish with 3 types of buffers in 3 of the wells (one type in each). Leave empty wells in between so there is no contact between the buffers. Fill the pH reservoir of the CultureCoin® dish that is used for incubation with the culture media. Put the PDMS silicone plug in so that evaporation would not occur. Place the dish in one empty chamber and leave it to equilibrate.

For calibration, at least two buffers are needed. However, we recommended using 3 buffers. One of the buffers should have a pH of 7. Any other pH buffer can be used as the user's buffer levels can be set in the calibration dialogue window. If only one or two buffers are available, the system can still be used but with reduced accuracy.

The technique requires the user to be quick, as the pH starts to shift very quickly once the lid is opened. The optimal time to complete the procedure is tested to be 15 seconds, giving the same results as the continuous measurement described below.

Press the "Calibrate" button:

Figure 18.2 pH calibration screen view in the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator

Set the buffer levels with the (+) and (-) keys to correspond to the buffers used.

Before measuring in the culture media, calibrate the probe in 2 or 3 buffers. It is necessary to rinse the probe between each insertion.

After the calibration is performed and saved, quick pH measurement can be done in the CultureCoin® pH reservoir media. Remove the PDMS silicone lid before insertion of the micro probe. The actual pH measured by the probe will be shown in the display.

Conventional pH probes will be affected by protein clogging the sensor, which causes false readings over time (time varies depending on the type of probe).

When choosing an electrode (probe), it is necessary to consider the probe's size, as measurements will be made in a droplet.

19 Cybersecurity

The objectives of the IT security are as follows:

1. To ensure the operational state of the MIRI® TL family's multiroom IVF incubator system.
2. To protect computer and network resources from the cybersecurity breach.
3. To protect the used data from tampering.

MIRI® TL6 and MIRI® TL12 multiroom IVF incubators must be connected to a network using equipment provided by Esco Medical Technologies, UAB. The connection procedure should be completed according to the provided schemes:

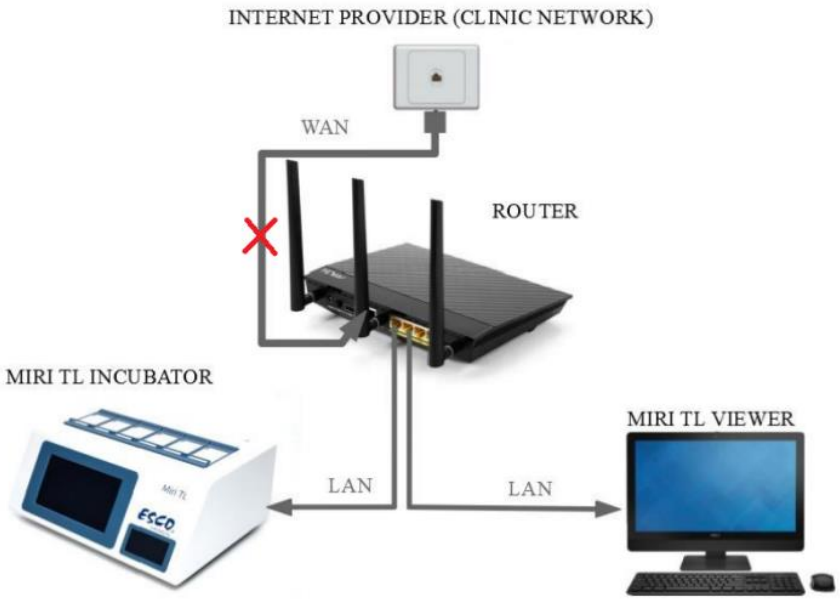


Figure 19.1 MIRI® TL family's multiroom incubator's connection scheme without the incorporated server

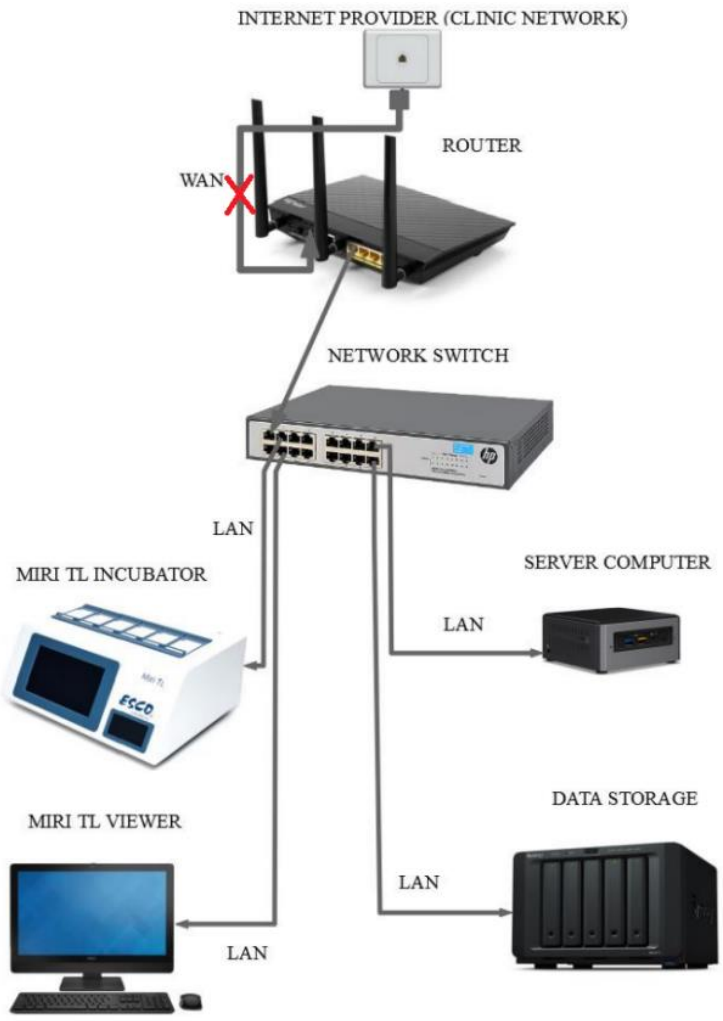


Figure 19.2 MIRI® TL family's multiroom incubator's connection scheme with the incorporated server and its components

Compromised cybersecurity has risks related to the functions of the MIRI® TL family's multiroom IVF incubators:

- Embryo time-lapse function ceasing to work.
- Possible deletion, modification or leaking of the data, entered on the MIRI® TL Viewer's Software.

The system has been designed in a way that the incubator's power control switch is separated from the rest of the Viewer's Software. This ensures that the breach of the Viewer's Software could not impact the power state of the incubator.

☞ **In a critical situation, where the Viewer's Software is disconnected from the network, the incubator can maintain the set parameters and log the necessary information on its own.**

⚠ **If there is a suspicion that the cybersecurity of the system has been compromised, the MIRI® TL family's multiroom incubator should be disconnected from the network and the incident should be reported to the Esco Medical Technical support as soon as possible. Further guidance for diagnosis and troubleshooting should be followed.**

20 Screen functions

The screen works as the user interface for the time-lapse functions, the data-logging functions, alarm overview and the pH measuring function. The interaction with the screen is single-click touch-based principal.

The current MIRI® TL6 and MIRI® TL12 multiroom IVF incubators software version is 1.31.1.0.

Working lines from 1-6 are changed to 7-12 with the button near the screen in the MIRI® TL12 multiroom IVF incubator.

Figure 20.1 The MIRI® TL12 multiroom IVF incubator's front view with marked altering working lines button and indication

☞ **The MIRI® TL12 multiroom IVF incubator user interface images will be used as an example for the line change procedure visualisation.**

2 green lights indicate which line is working:

1. When Line 1 is selected, the according green light lights up. Also, the Line change is indicated on the main screen by an overlay that displays "1" (see Figure 20.3)

Figure 20.2 The MIRI® TL12 multiroom IVF incubator's line altering switch and an active Line 1

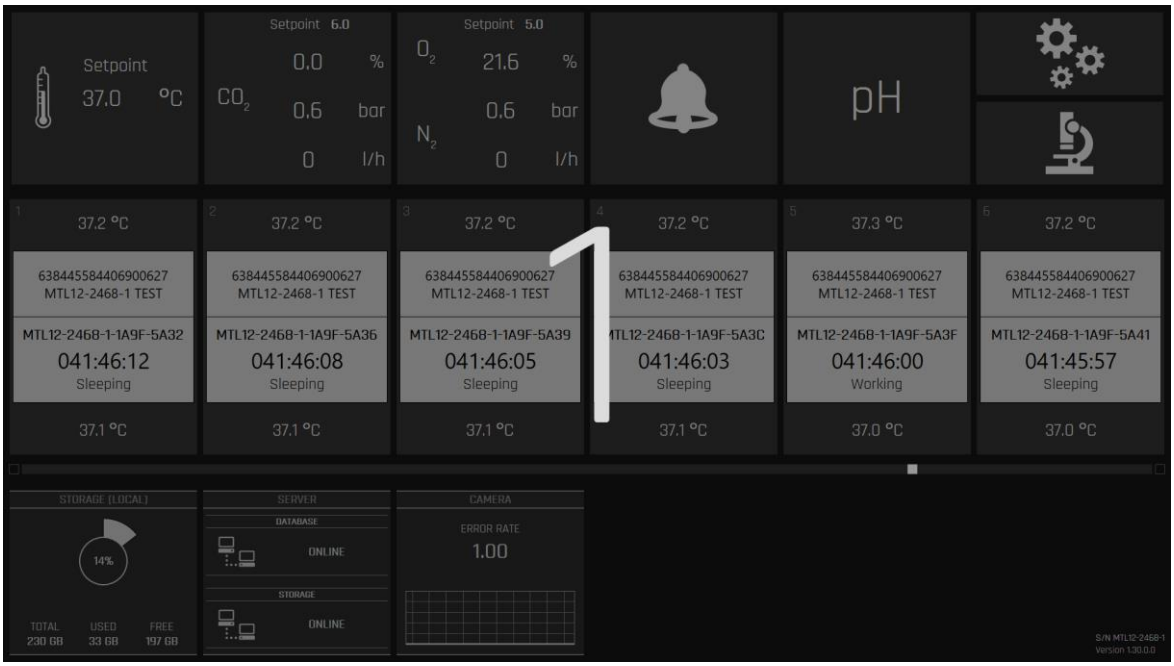


Figure 20.3 Line change indication overlay in the main screen of the MIRI® TL12 multiroom IVF incubator

2. When Line 2 is selected, the according green light lights up. Also, the Line change is indicated on the main screen by an overlay that displays "2" (see Figure 20.5)

Figure 20.4 The MIRI® TL12 multiroom IVF incubator's line altering switch and an active Line 1

Figure 20.5 Line change indication overlay in the main screen of the MIRI® TL12 multiroom IVF incubator

⚠ **Unauthorized access to the laboratory should be controlled!**

20.1 The main screen

The main screen has an overview of the 6 chambers, showing their current bottom temperature and lid temperature. The circle shows the status of a time-lapse: is it active or inactive. If it is active, the time count will run on the screen.

The MIRI® TL6 multiroom IVF incubator user interface images will be used as an example for all the temperature setpoints.

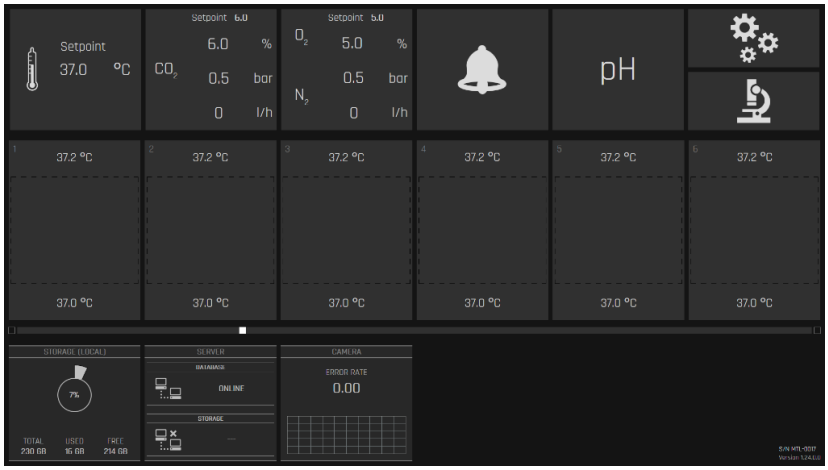


Figure 20.2 No active time-lapses view

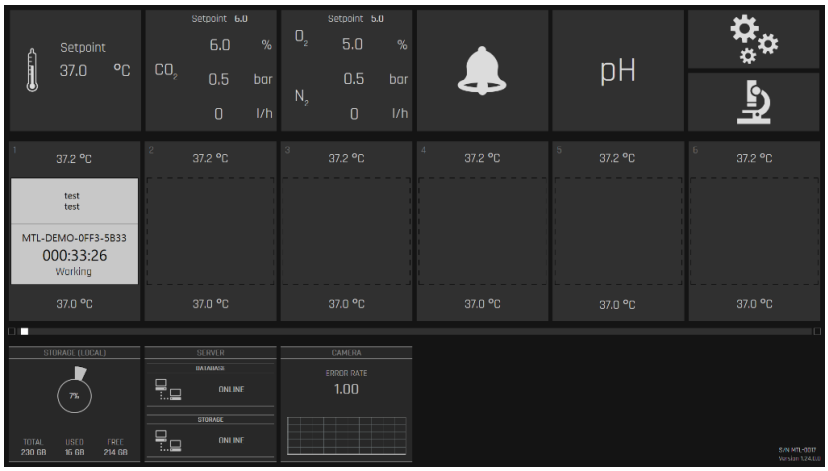


Figure 20.3 One active time-lapse view

When a time-lapse is running normally, a green status indication will appear in the main view.

If the MIRI® TL6 multiroom IVF incubators find the correct positions for the wells, the system will show a status sign which indicates that it is "Calibrating".

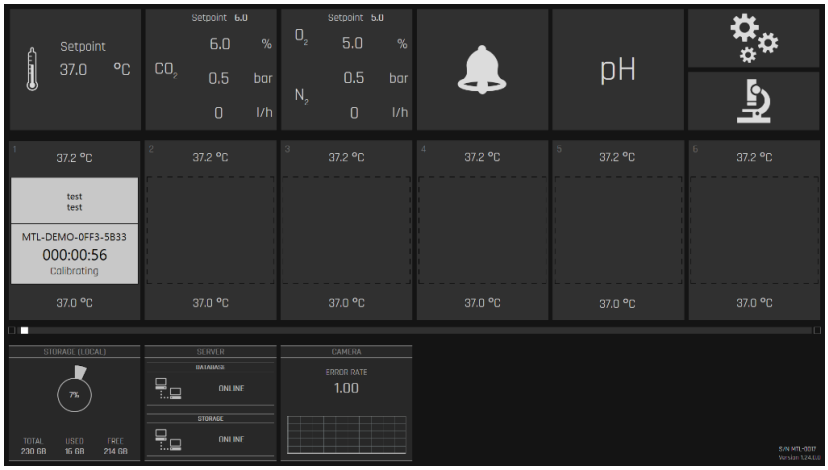


Figure 20.4 Time-lapse calibrating view

If the time-lapse is paused, the system will indicate "Suspended".

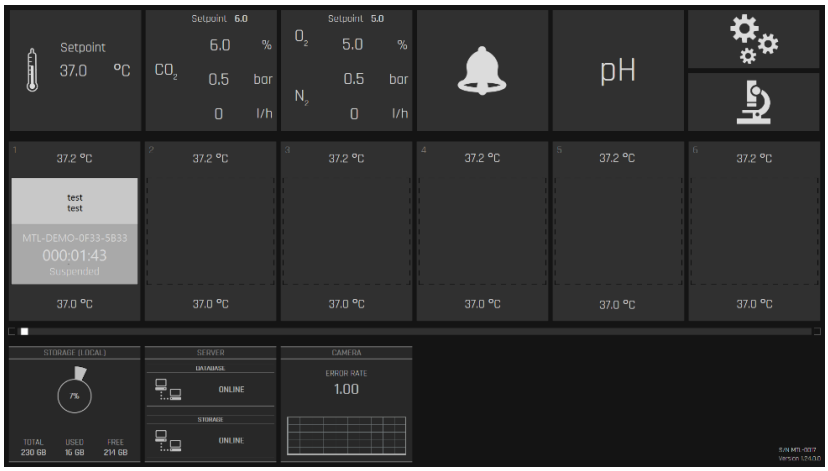


Figure 20.5 Suspended time-lapse view

A time-lapse may be suspended if, for instance, the dish is removed for a culture media change, manual observation or manipulation of the embryo.

20.1.1 Starting a time-lapse

When the rectangle of an empty chamber in the main view is pressed, a time-lapse dialogue window will open. First, select a patient from the list.

Patients can only be created or edited on the MIRI® TL6 or MIRI® TL12 multiroom IVF incubators Viewer's Software. For more information, please read the MIRI® TL multiroom IVF incubator Viewer's Software User Manual. The patient data must be allocated to the MIRI® TL6 or MIRI® TL12 multiroom IVF incubators to appear on the list.

Press the "Refresh" button to update the list.

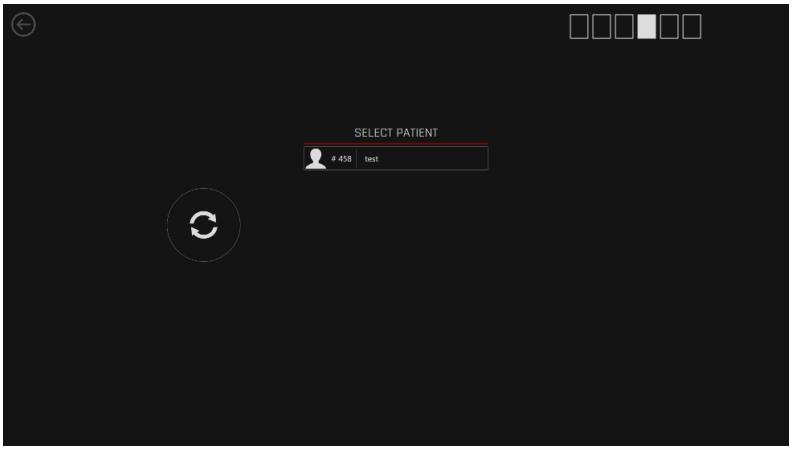


Figure 20.6 Patient selection main window view

The 6 square icons on the top left side in the display indicate chamber number.

Select the correct patient from the list.

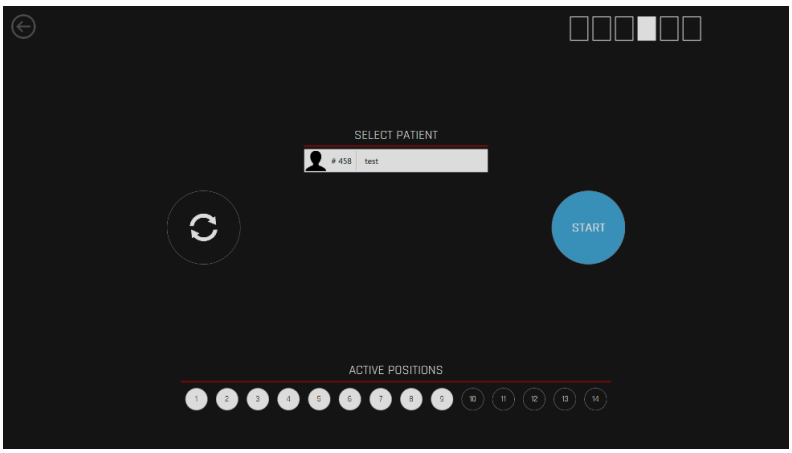


Figure 20.7 Test patient selection view

If no patient is sent from the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator Viewer's Software the incubator, the following screen will appear:

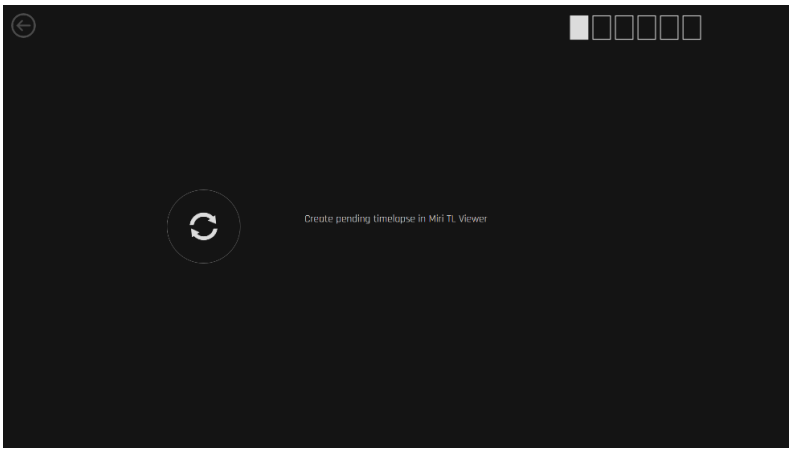


Figure 20.8 No patient from MIRI® TL6 multiroom IVF incubator Viewer is sent to the incubator

If the required network connection is interrupted, the following screen will appear:

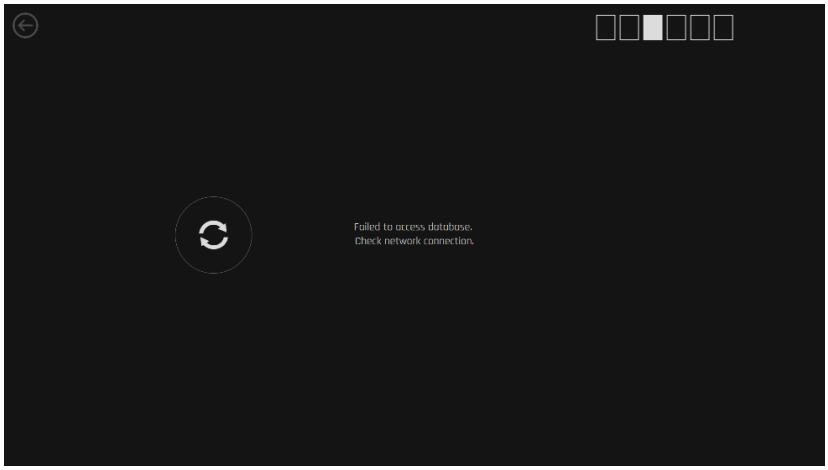


Figure 20.9 Network connection interruption view

When the correct patient has been selected, the active positions in the CultureCoin® (the wells that will contain an embryo) must be selected. Positions 1 – 14 represent the 14 wells on the CultureCoin® dish.

Only the selected positions in the CultureCoin® dish will be used for the time-lapse. Any mistake made here will result in an empty well being photographed or no film made of the well containing the embryo.

The active position buttons can be toggled on/off until the correct pattern is displayed. After that, press the "Start time-lapse" button – it will start an automatic calibration process. In the picture below, positions 1 – 9 are selected as active.

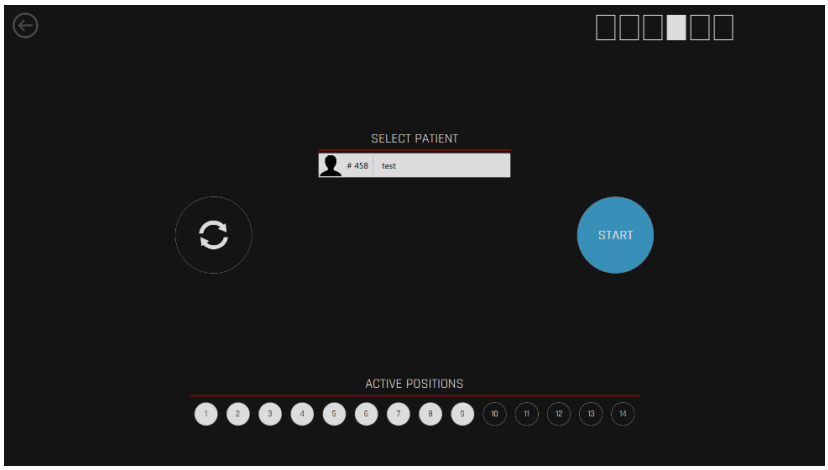


Figure 20.10 Positions 1 – 9 selected as active

Before starting time-lapse, it is essential to place the CultureCoin® in the chamber properly. To ensure the correct position of the CultureCoin® (so that the camera can identify all the wells), place the CultureCoin® in its place and secure its position by pushing it downwards and towards you, then to the left edge.

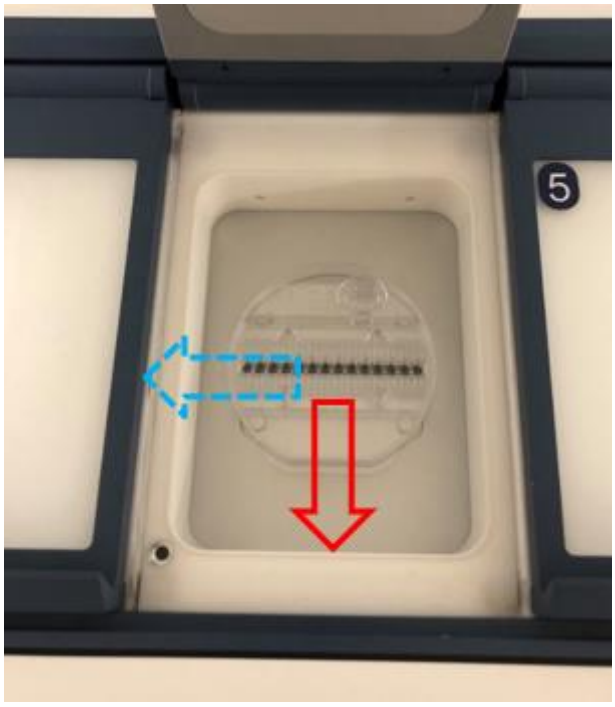


Figure 20.11 Positioning CultureCoin® in the chamber

Press the "Start time-lapse" button. Now, the time-lapse calibration will start.

20.1.2 Calibration processes

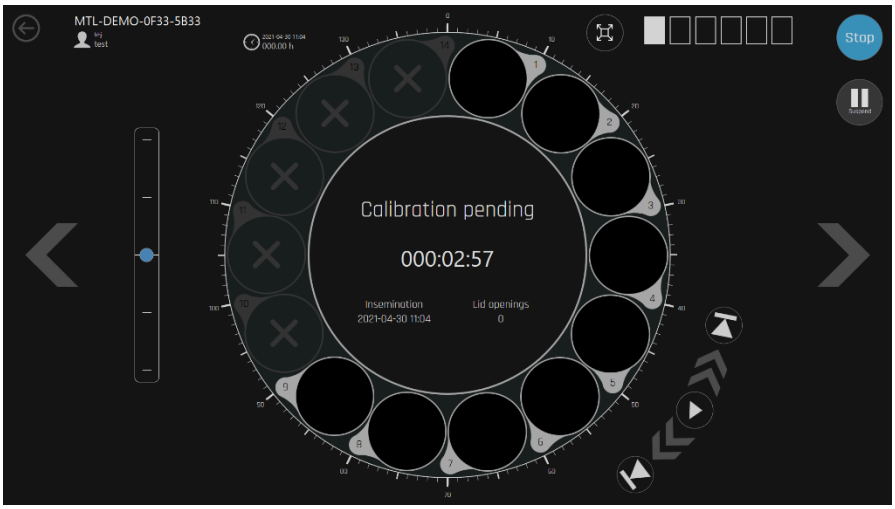


Figure 20.12 Test patient calibration pending

First, the screen will show the chamber view with the "Calibration pending" message. Suppose the CultureCoin® is correctly placed in the chamber, and embryos are placed in the middle of an intended area (for more information, please see the “21 CultureCoin®”

section of the User Manual below). In this case, the MIRI® TL6 or MIRI® TL12 multiroom IVF incubators should find the correct camera positions automatically.

During the calibration process, there will be an indication in the middle area that the calibration process is active.

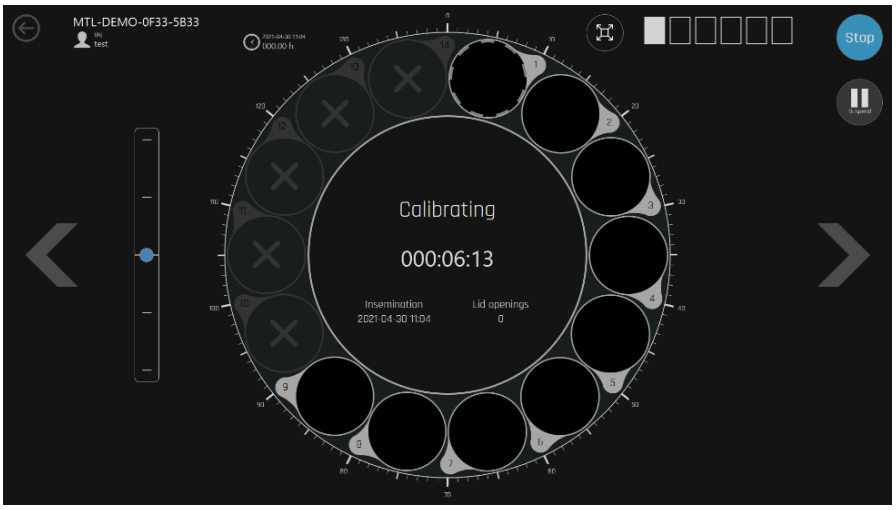


Figure 20.13 Active automatic calibration process indication

After the automatic calibration, it is necessary to consider whether all the wells have been detected correctly. Manual calibration of a particular well must be done on LiveView Mode if not all well positions were detected/focused correctly, and some wells are marked with red/yellow/purple colour (please see section “20.1.5 Manual calibration of well position” of the User Manual below).

Figure 20.14 Example of a failed automatic calibration

Well that is marked in red colour (Failed) means that the camera wasn't able to detect the chamber correctly.

Well that is marked in yellow colour (Interpolated) means that the calibration data of position are calculated based on calibration information around the exact position. For example, if 1st and 3rd wells were calibrated, to calibrate 2nd well, an average of Z (focus) are taken from 1st and 3rd wells.

Well that is marked in purple colour (Image mismatch) means there is image mismatch after the system comparing the last two images. This message could appear if the embryo moved too much than usual or an air bubble formed in the selected well.

20.1.3 Chamber view

The chamber view shows detailed information for the selected chamber. If the chamber has an active time-lapse, the chamber view will show the activity.

The 14 circles in the "revolver" view show 14 wells of the CultureCoin®. They are arranged in this manner (and not in the linear pattern as on the physical dish) to make it easier to see an overview at a glance.

Figure 20.15 14 wells of the selected chamber

The timeline around the large circle shows the elapsed time.

Video player buttons are located on the lower right side of the large circle. They help to navigate back and forth in the generated time-lapse movie. The circle's center holds status information indicating the number of the selected time-lapse, patient name, insemination time, lid openings and the elapsed time. Chamber numbers can be seen from the squares in the top left-hand corner.

The three buttons on the right allow the user to stop the time-lapse, suspend it or start the calibration procedure again.

A time-lapse can be suspended if the dish needs to be removed to make culture media changes or perform a manual observation with a microscope. When the dish is put back, the time-lapse can be resumed so that the final result will be one continuous film. Resuming the time-lapse will initiate automatic calibration as the removal of the dish may cause parameters to shift.

If the stop button is pressed, a confirmation dialogue will be displayed.

Figure 20.16 Sleeping mode confirmation view

To the left of the big circle, the focal planes are located. By tapping on them, it is possible to move up and down in the focal planes. The blue dot indicates the current level displayed. The focal planes in all the images will shift at the same time.

When the system shows the "Sleeping" sign, it means that the camera system generates images in another position. As there is only one camera in the device, it must move around to generate the images of each position.

It is possible to maximize the view of one time-lapse position. By tapping on the small embryo picture, a large version of it will appear in the circle's center. It can be minimized again the same way, i.e. by tapping on the large image. A maximized time-lapse image is shown below.

Figure 20.17 Maximized time-lapse position view

Scrolling through the 6 chambers is possible using the arrow keys "LEFT" and "RIGHT." The circled left arrow in the top left-hand corner will take you back to the main view.

If no time-lapse is running in the chamber, the screen will indicate that the chamber is empty.

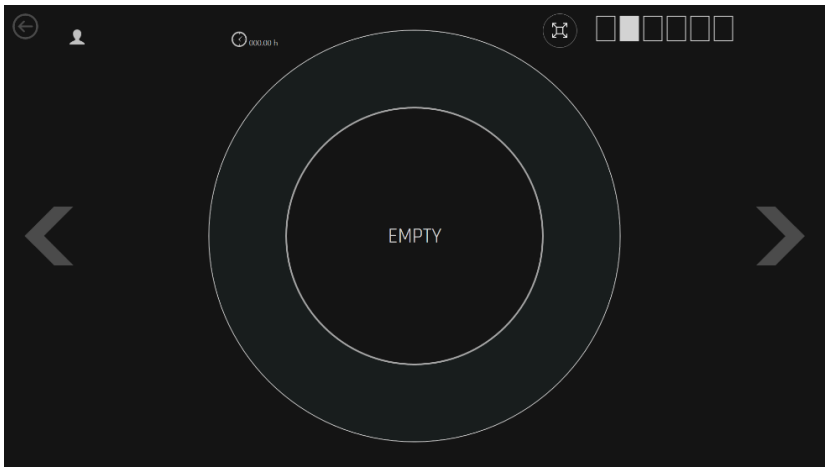


Figure 20.18 Empty time-lapse view

20.1.4 Settings

Pressing the "Settings" button in the main view opens a window where you can set the number of focal planes and the time interval between each image (cycle time).

By default, the cycle times can be set at 5, 10 or 20 minutes. The focal planes can be set at 3, 5 or 7.

Note that 7 focal planes and a cycle time of 5 minutes will result in a large time-lapse file.

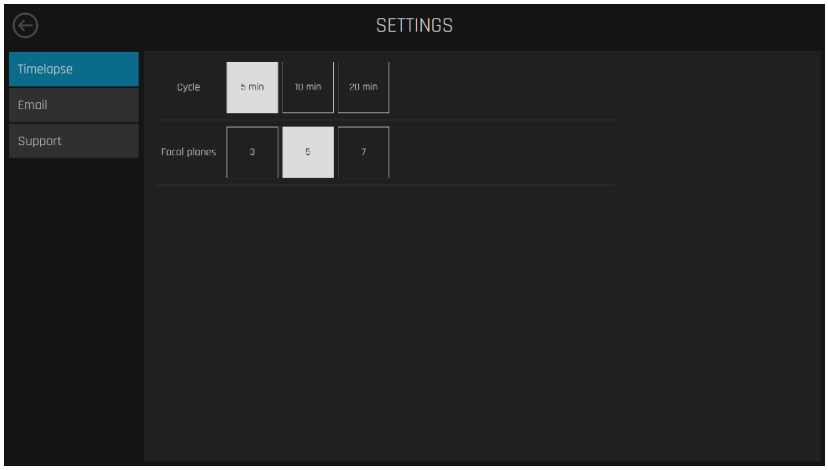


Figure 20.19 Cycle and focal planes settings screen

Press buttons corresponding to the desired choices.

Cycle times cannot be set when a time-lapse has started. End all time-lapses to adjust the cycle time.

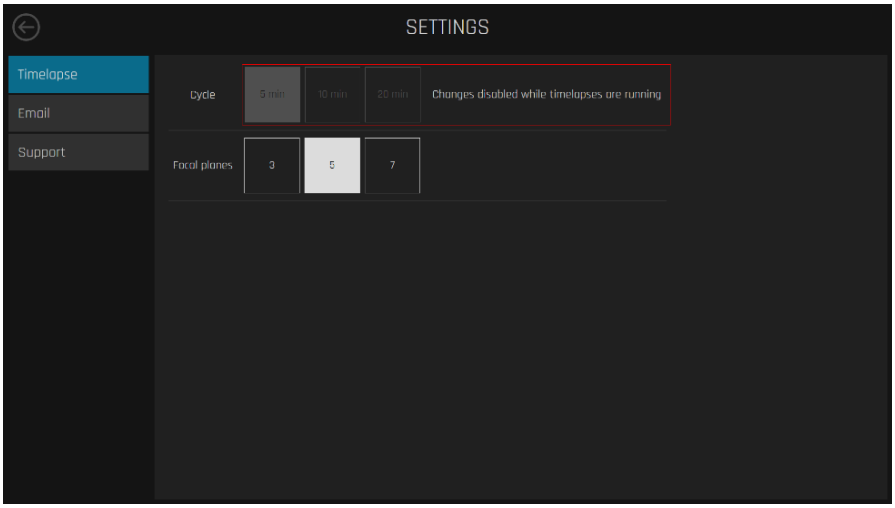


Figure 20.20 Changes are disabled while time-lapses are running

20.1.5 Manual calibration of the well position

If the automatic calibration process fails, the LiveView mode might be used for manual adjustments and calibration.

First, try to adjust the CultureCoin® position and then rerun the automatic calibration.

The automatic search for the correct well is sensitive to errors when the embryo is on the side of the well. Therefore, it is essential to position embryos carefully so they are in the center of the well circle.

As the live view function will allocate the camera system to a specific position, any running time-lapses will be suspended. If a time-lapse is running, a confirmation dialogue will be shown.

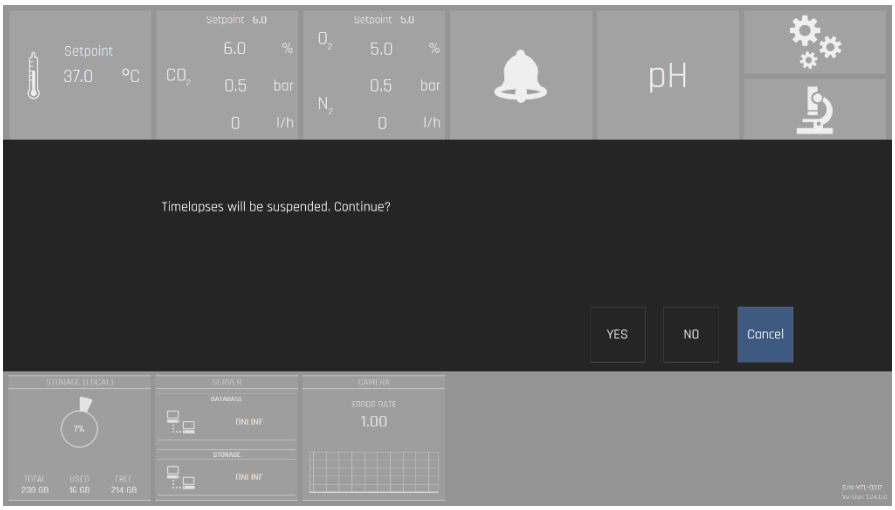


Figure 20.21 Confirmation dialogue view

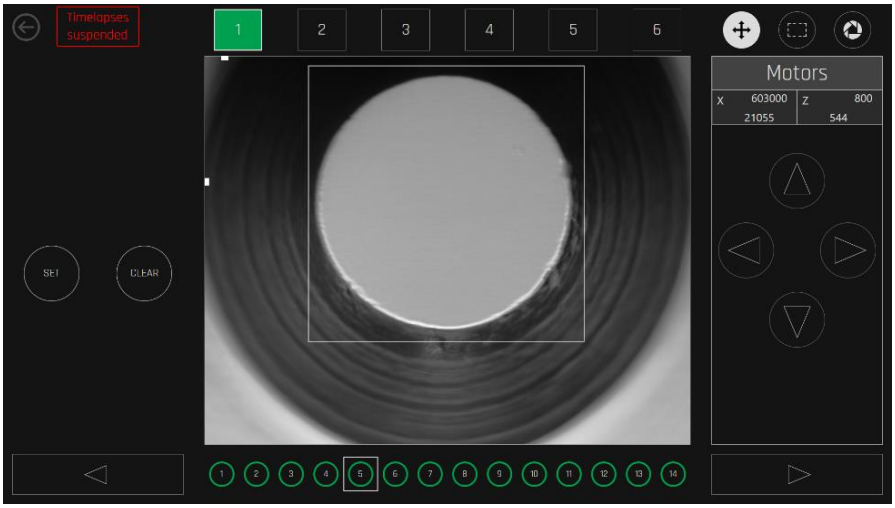


Figure 20.22 Suspended time-lapses view

The black background indicates that there is no active time-lapse running in the chamber. The green background indicates that the time-lapse is running and is in regular operation. The red background indicates that there are calibration failures for some positions.

When a chamber with an active time-lapse is selected, 14 dish positions will be shown at the bottom of the screen.

The white position background indicates that it is not calibrated yet. Black background indicates that the position is not active (not selected when a time-lapse started). Green or red colours indicate that the position is active and that it is or is not calibrated correctly.

It is possible to navigate among the chambers and the 14 positions. The system will indicate such movement.

Buttons in the top right corner offer the selection of the motor control, a square selection tool and an exposure time.

Press the microscope button marked red on the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator screen to enter LiveView mode.

Figure 20.23 LiveView mode button on the main MIRI® TL6 or MIRI® TL12 multiroom IVF incubator screen

In LiveView Mode, select the required chamber from the chamber bar above and the required position from the bar below on the main screen.

Figure 20.24 Chambers bar in the LiveView Mode

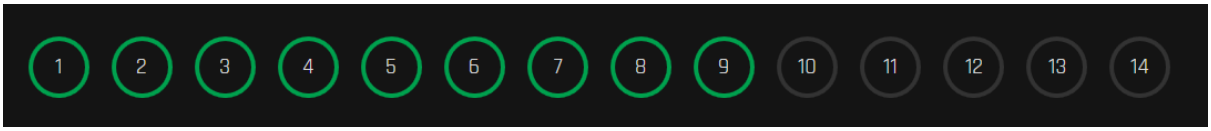


Figure 20.25 Position bar in the LiveView Mode

Once the well position, which must be calibrated, is chosen, please ensure that the well is in the middle of the camera view screen on the X-axis.

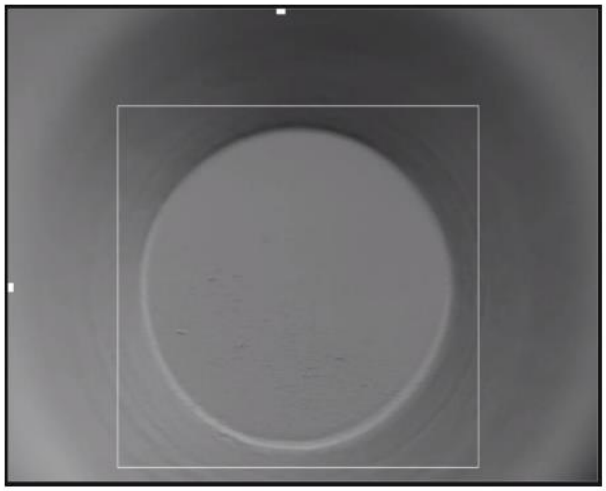


Figure 20.26 Example of a correct well position in the camera view screen

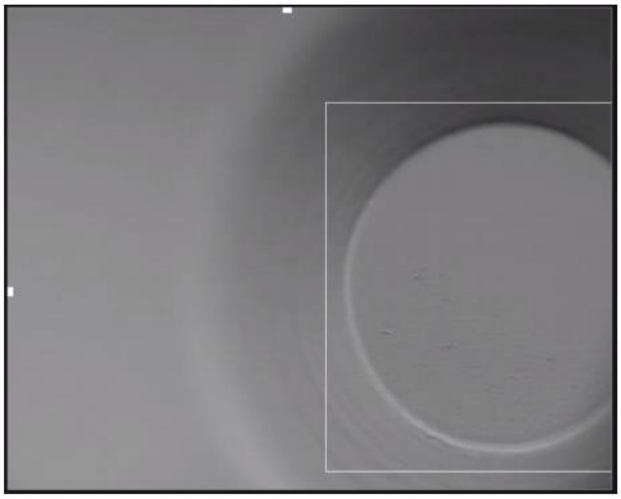


Figure 20.27 Example of an incorrect well position in the camera view screen

If necessary, adjust the X-axis position with the "LEFT" or/and "RIGHT" arrows under the "Motor" icon (located in the upper right corner of the screen).

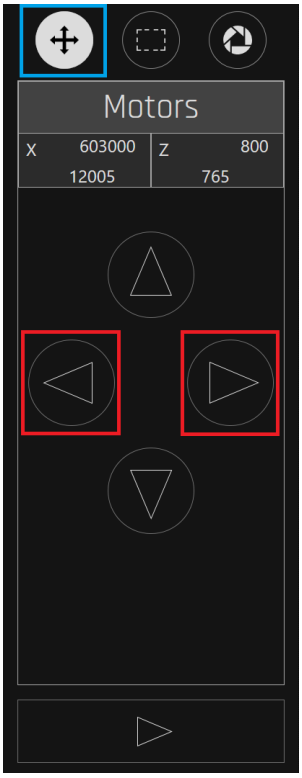


Figure 20.28 Well position adjustment device in the X-axis

Make sure that your well/embryo is well focused (has good focus). If necessary, adjust the Z-axis position with the "UP" or/and "DOWN" arrows under the "Motor" icon (located in the upper right corner of the screen).

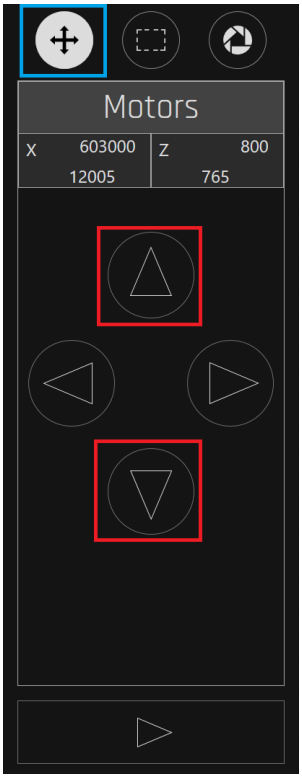


Figure 20.29 Well position adjustment device in the Z-axis

Make sure that the well is inside the marked square limit, as shown below.

Figure 20.30 Well position inside the marked square limit

⚠ **If the well position is out of the limit mark square, it could result in cropped images during the time-lapse. It could cause a system error, and the images of the well would not be taken.**

An inactive position can be activated by pressing the "SET" button ("X-axis", "Z-axis", and square limit must be adjusted as noted above). An active position can be deactivated by pressing the "CLEAR" button.

When a position is activated, it appears in the chamber (time-lapse view). When it is deactivated, it disappears from the chamber (time-lapse view). Any previously taken images will remain, but no new ones will be acquired.

Exposure control can be set according to variations in light conditions.

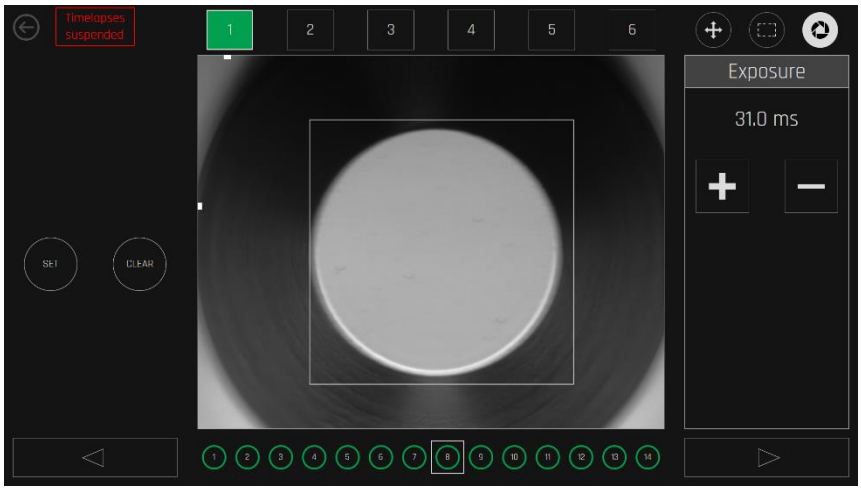


Figure 20.31 Exposure control screen view

When the correct position and the desired focus are found and the set button is pressed, the system confirms the user's calibration.

Figure 20.32 Correctly adjusted well's view

⚠ **Manually overriding automatic system features should be done only when the system repeatedly fails to find the correct calibration. Since the user manually controls the motors in the LiveView, it is possible to move the motors out of bounds and trigger mechanical limit switches.**

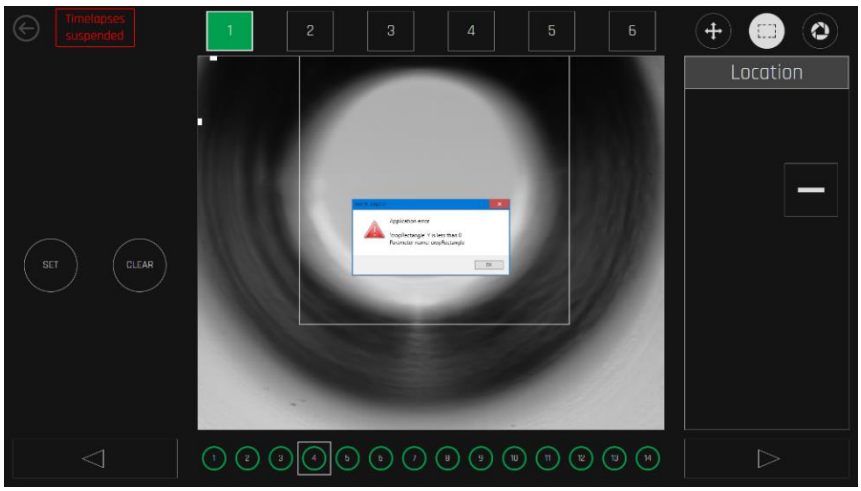


Figure 20.33 Limit switch alarm

Limit switch alarms are shown as a red horizontal indication on the top or at the bottom of the image. In the picture above, the top limit switch for the "Z" has been activated.

20.1.6 Alarms

Alarms regarding lid openings, temperature, CO_2/O_2 status, network connectivity, PC and HDD power status are shown in the main view.

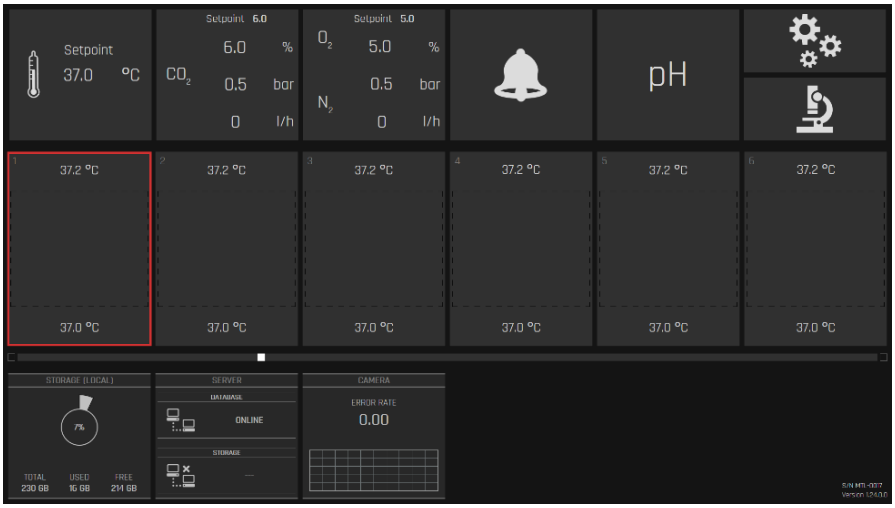


Figure 20.34 Lid opening alarm view

Clear the alarm by pressing on the area – it will take you to the chamber view. Then either end the time-lapse, suspend, recalibrate or just confirm that the patient is still there.

Figure 20.35 Chamber view after opening a lid

⚠ **The system will continue to generate time-lapse images after the lid is opened. If the user changes the dish with another patient without correctly ending the previous patient and starting the new patient, the final time-lapse movie will contain images from two different patients.**

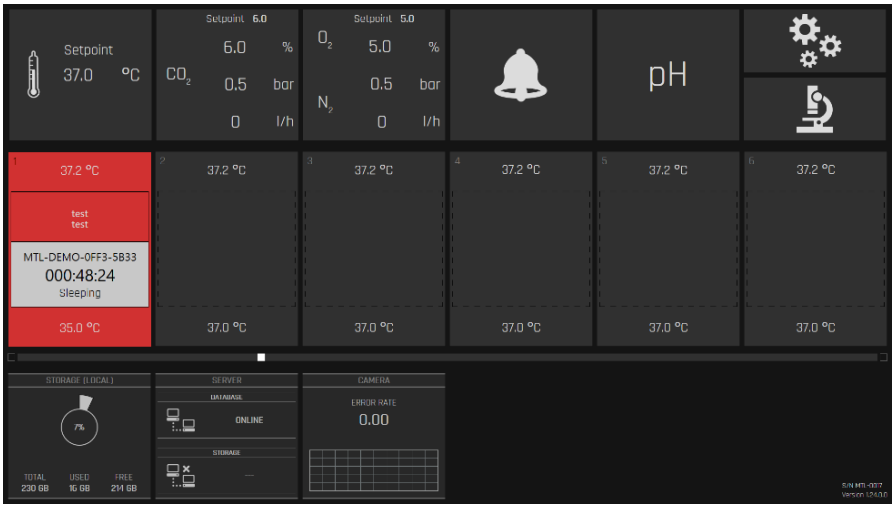


Figure 20.36 Temperature alarm screen view

⚠ **Remove the dish immediately if temperature conditions become dangerous for the embryos. The chambers are entirely separate, so the dish can be safely moved to another position if the temperature in that particular chamber is stable. Remember to end an old time-lapse and start the new at the changed position.**

Loss of server connection is indicated at the bottom. As long as the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators have available storage capacity, time-lapses will continue on the local storage system. Once the network is connected again and running, the system will automatically transfer the data.

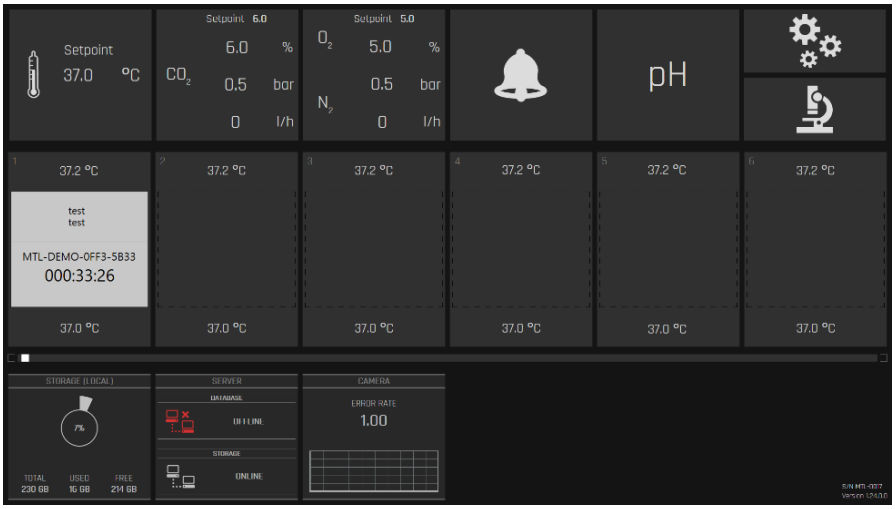


Figure 20.37 Disconnected server alarm view

While the server is disconnected, new time lapses cannot be started as patients cannot be allocated to the device.

All incubation functions have level alarms indicated in the image by the relevant button turning red. All of the alarms can be seen in the alarm view, which displays the alarm history.

CO_2 concentration alarm view is shown in the picture below:

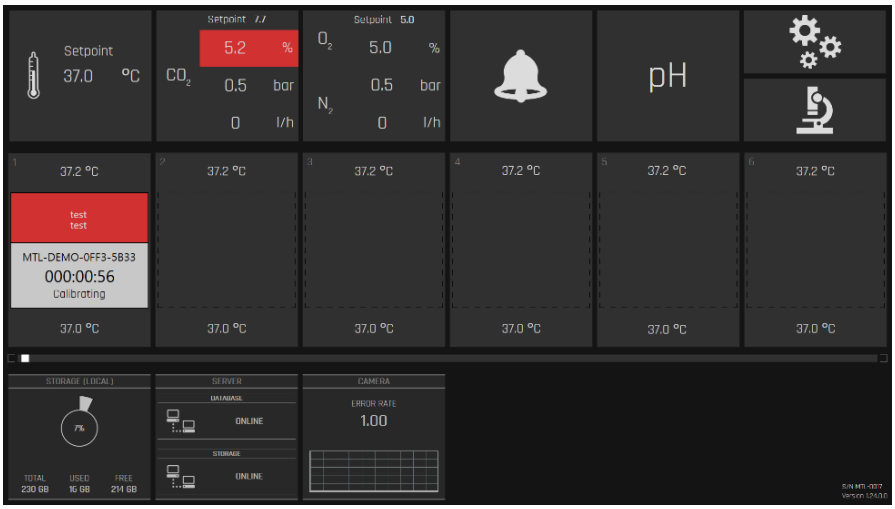


Figure 20.38 CO_2 concentration alarm view

CO_2 pressure alarm view is shown in the picture below:

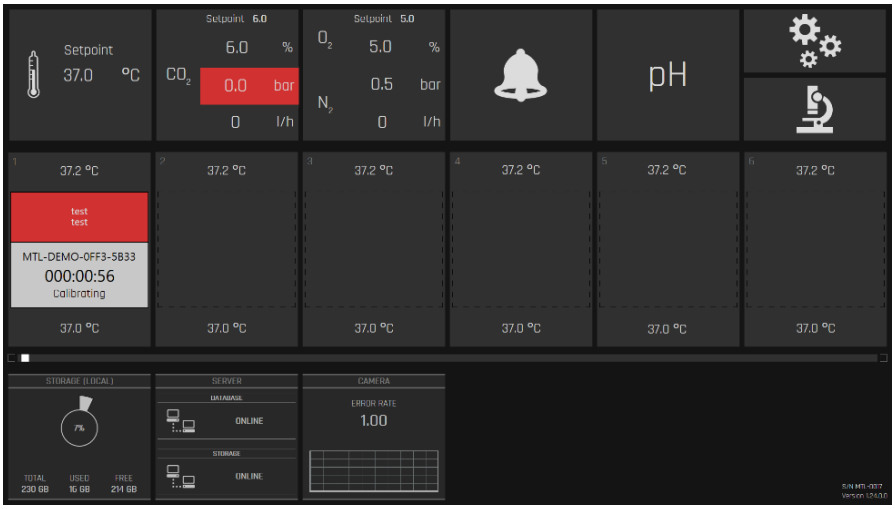


Figure 20.39 CO_2 pressure alarm view

O_2 alarms are shown in the same way – just under O_2 for concentration and N_2 for pressure.

Full HDD (transfer data to an external drive or connect to the server) memory alarm view is shown in the picture below:

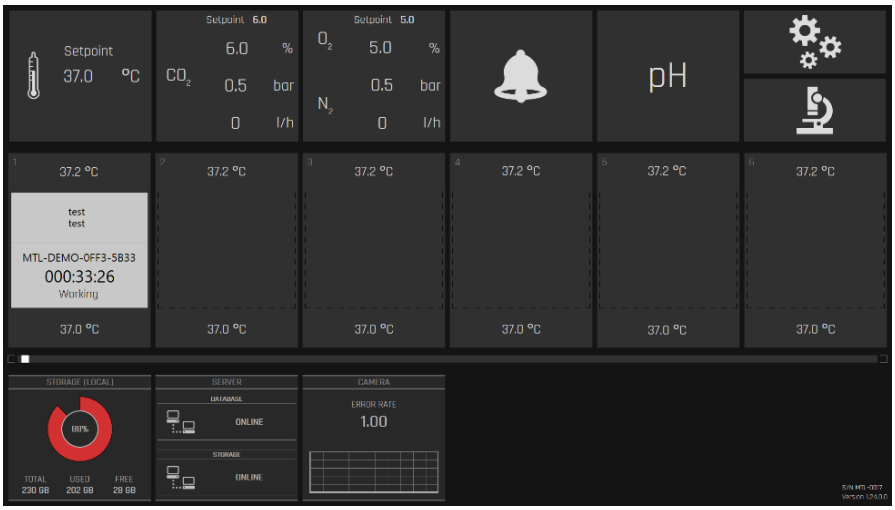


Figure 20.40 HDD full memory alert view

20.1.7 Data-logging temperature view

Pressing the temperature button will change the view to a temperature data graph view.

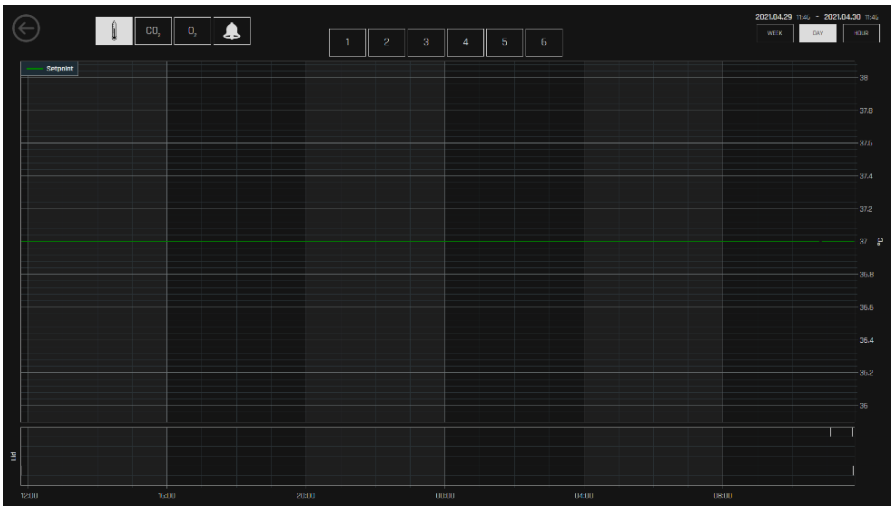


Figure 20.41 Temperature data graph view

The history view allows seeing temperature data graphs. It is possible to toggle on/off chamber graphs 1-6 in the MIRI® TL6 multiroom IVF incubator and graphs 1-12 in the MIRI® TL12 multiroom IVF incubator by pressing the corresponding circled number.

With the time period buttons "Hour", "Day", and "Week", it is possible to change the time period viewed.

It is possible to enlarge a particular area by dragging a finger over it. Zooming can be repeated in steps. To get back to the original size, press the "Reset" button.

20.1.8 Data-logging CO_2 view

By pressing the "CO2" button, the view will change to the CO_2 data graph view.

The CO_2 "Setpoint", "Concentration", "Flow", and "Pressure" graphs can be toggled on/off by pressing on them at the top of the display view. The time period and zoom-in functions are the same as in the temperature view.

Figure 20.42 CO_2 data graph view

20.1.9 Data-logging O_2 view

By pressing the "O2" button, the view will change to the O_2 data graph view.

The O_2 "Setpoint", "Concentration", N_2 "Flow", and "Pressure" graphs can be toggled on/off by pressing on them at the top of the display view. The period and zoom-in functions are the same as in the temperature view.

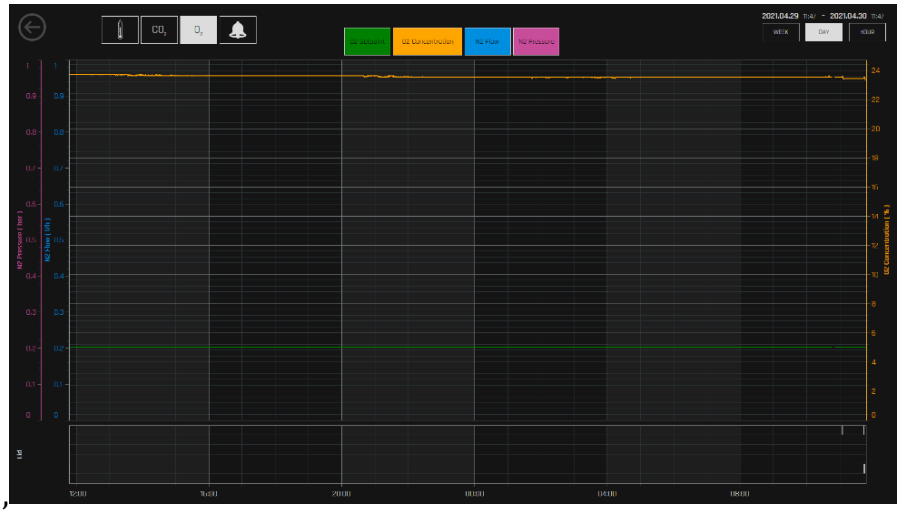


Figure 20.43 O_2 data graph view

20.1.10 Data-logging alarm view

By pressing the alarm bell, the alarm view opens up. The alarm view depicts all the parameters and any alarm statuses in a quick graphical overview. A red block represents each alarm – the longer the alarm lasts, the more that block increases in size.

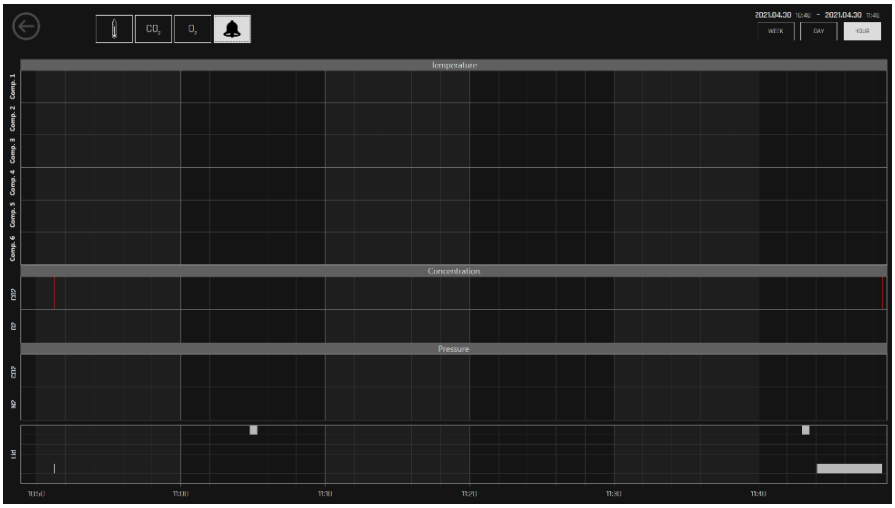


Figure 20.44 Alarm data view

The "Lid" section has six rows in the MIRI® TL6 multiroom IVF incubator, whereas the MIRI® TL12 multiroom IVF incubator has 12. Each row indicates a single lid opening case in a particular chamber, counting from the top. For visualisation purposes white blocks are used. White blocks depend on the lid opening time – the longer the lid was open, the amount of the blocks increases.

21 CultureCoin®

The only dish used with MIRI® TL6 and MIRI® TL12 multiroom IVF incubators is the CultureCoin®. The bottom of MIRI® TL6 and MIRI® TL12 multiroom IVF incubators chambers are shaped to fit the contour of the dish. There is only one way it can be put in the chamber, as the dish is not a perfect circle and has a flat side that makes it impossible to fit the dish in the chamber the wrong way.

CultureCoin® is a single-use sterile class IIa medical device.

Figure 21.1 CultureCoin® overview

⚠ **Never attempt to reuse a single-use device. The device cannot be cleaned or sterilized again. Dangerous contamination will occur.**

The CultureCoin® dish features 14 wells for incubation and four washing wells. The washing wells can be used for embryo handling or if using single-step media.

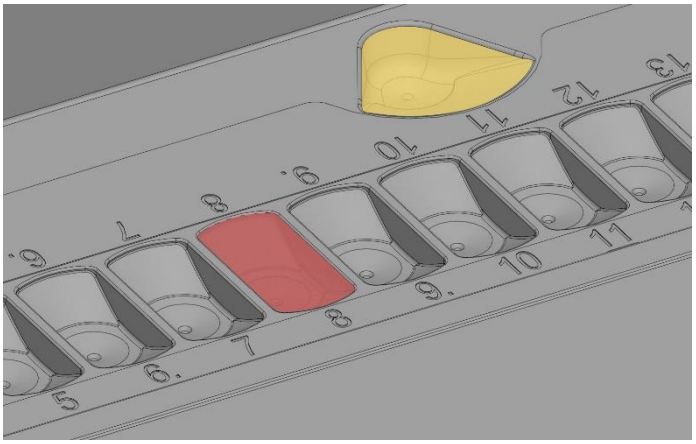


Figure 21.2 The culture well (marked red) and washing well (marked yellow)

Each of the 14 wells is filled with approximately 25 µl culture medium. The washing wells can also be filled (approximately with 23 µl of liquid), but it is not a requirement. The embryo is placed at the bottom of the culturing area.

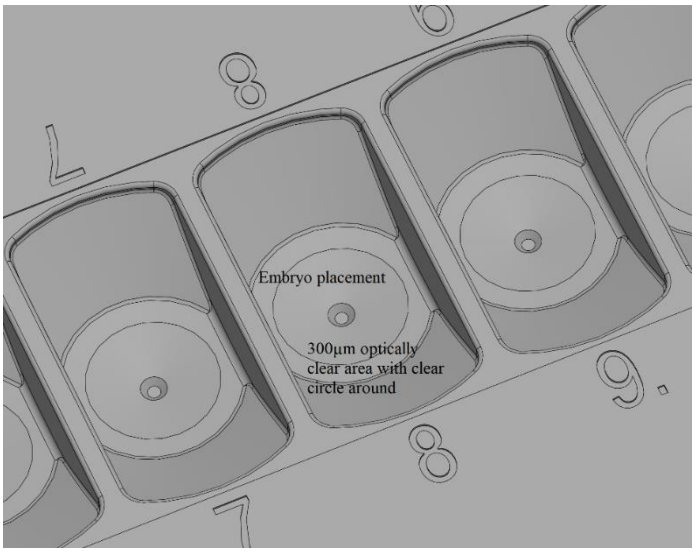


Figure 21.3 Embryo Placement in detail on the 300µm optically clear area

The process of locating the correct well is sensitive to errors. When the embryo is positioned at the side of the well, it rests against the side. Positioning embryos carefully to be in the center of the well circle can avoid this problem.

The identification process is easy because the wells are numbered.

Media and embryo handling are ergonomically optimized as it is possible to angle the pipette when loading the well.

Air bubbles in the media can be easily removed by pushing them up with the pipette tip. Air bubbles in the media will push the embryo out from the correct position, and no time-lapse images will be generated. Usually, when air bubbles are present, a black cloud can be seen to move around the images or cover the whole view.

Mark the lid and the dish with the patient's name and unique identifier. It is possible to write directly on the dish or put it on a label.

Once filled with the culture media, the culture wells must be covered by a confluent oil layer. It is impossible to use an open culture (any culture media where a layer of oil does not cover the culture media).

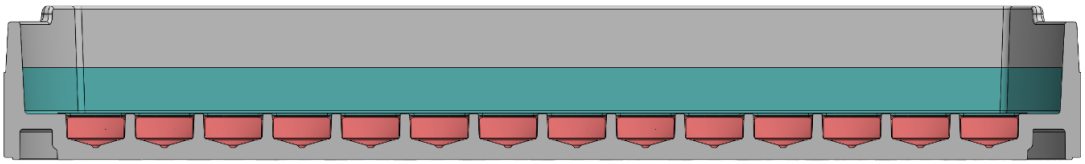


Figure 21.4 The culture wells are covered with a mineral oil layer, and the lid is put on

A large reservoir outside the culturing area can be used for pH validation (please look at Figure 21.1). The reservoir can be closed with a gas permeable silicone plug which will stop evaporation. In this way, no oil layer is necessary, as it would cause problems for most pH probes while measuring pH anyway. Fill the reservoir and measure pH with a combination probe and the pH measuring system built into the MIRI® TL TL6 and MIRI® TL12 multiroom IVF incubators.

For more information about CultureCoin®, please refer to the "User Manual of CultureCoin®". It can be accessed on our website www.esco-medical.com or contact us at support-medical@escolifesciences.com.

22 The MIRI® TL multiroom IVF incubators Viewer's Software

The MIRI® TL multiroom IVF incubators viewer and server is a graphical software system operated by touch, which is used for storing time-lapse images and working with them.

The current MIRI® TL Viewer's Software version is 1.21.0.0.

For more information, please see User Manual of MIRI® TL family`s multiroom IVF incubators Viewer's Software.

Unauthorized access to the laboratory should be controlled!

For MIRI® TL family's multiroom IVF incubators to achieve full time-lapse functionality (i.e., create new patients, treatments and start the time-lapse), it must be connected to the MIRI® TL Viewer's Software.

23 Cleaning instructions

23.1 Consideration about a sterile device

The MIRI® TL6 and MIRI® TL12 multiroom IVF incubator is not a sterile device. It is not delivered in a sterile state and it will not be possible to keep it sterile while in use.

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

The design features intended to provide cleanliness include:

- A circulated air system.
- External 0.22µm and internal 0.2µm HEPA filters which clean the incoming gas.
- A VOC/HEPA filter, which continually cleans the air inside the system.
- A chamber with sealed edges that can be cleaned.
- The use of aluminum and PET parts that withstand cleaning well.

23.2 Cleaning procedure recommended by the manufacturer

Always validate cleaning procedures locally; for more guidance, consult either 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 using alcohol-free detergents 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 the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator immediately after any media spills.

Periodic cleaning of the device (with no embryos inside)

Wearing gloves and GLP (good laboratory practice) techniques are essential to the successful cleaning of the device.

1. Clean the incubator with a suitable detergent that does not contain alcohol, i.e. benzyl-alkyldimethyl chloride. Wipe external device surfaces with wipes and repeat the process until the wipes are no longer discolored.
2. After cleaning leave the device for some time to ensure that all detergent fumes have evaporated.
3. Change your gloves and after 10 minutes of contact time, spray sterile or purified water on the surfaces and wipe them with a sterile wipe.
4. Once it is visually clean, it is ready to be used again.

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

23.3 Cleaning procedure recommended by the manufacturer

Disinfection of the device (with no embryos inside)

Wearing gloves and GLP (good laboratory practice) techniques are essential to the successful disinfection of the device.

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 the MIRI® TL6 or MIRI TL12 multiroom IVF incubator (rear panel).
2. Open the lids.
3. Use the required disinfectant that does not contain alcohol, i.e. benzyl-alkyldimethyl chloride, 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 wipes and repeat the process until the wipes are no longer 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 the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator (rear panel).

24 Humidification

The MIRI® TL family's multiroom IVF incubators have been primarily developed and designed for the incubation of gametes and embryos with an overlay of either Paraffin or mineral oil.

The MIRI® TL family's multiroom IVF incubators **must not be irrigated**. Humidification of the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators will damage the devices – condensation will block internal pipes and damage electronic parts.

⚠ **MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are not created to work with a water container inside. Otherwise, the devices will be damaged. The safety and performance of the device will be affected.**

25 Temperature validation

The MIRI® TL6 multiroom IVF incubator is equipped with 6 PT-1000 Class B sensors, whereas the MIRI® TL12 multiroom IVF incubator has 12. They are located in the center of the bottom of each chamber.

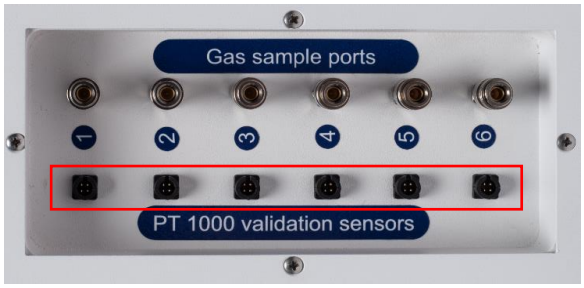


Figure 25.1 PT-1000 Class B sensors in the MIRI® TL6 multiroom IVF incubator

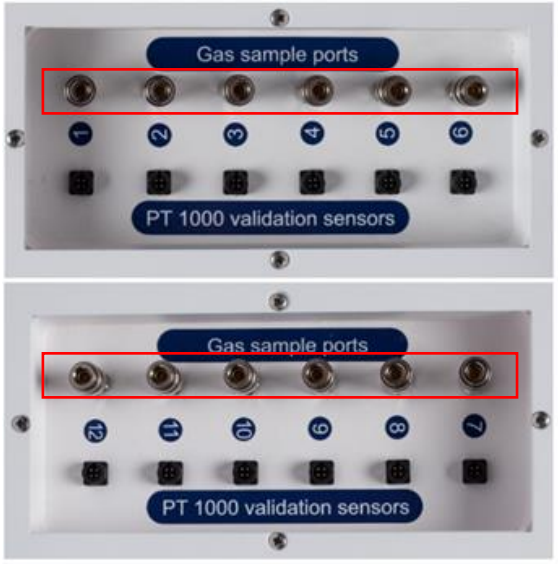


Figure 25.2 PT-1000 Class B sensors in the MIRI® TL12 multiroom IVF incubator

These sensors serve external validation purposes. They are completely separated from the circuit of the device.

Temperature conditions in the chambers can be continuously logged through the external connectors on the device's side without compromising its performance.

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

Esco Medical Technologies, UAB can supply an external logging system (MIRI®-GA) for the sensors.

26 Gas concentration validation

Gas concentration in each chamber of the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator may be validated by taking a gas sample from one of the 6 (MIRI® TL6 model) or 12 (MIRI® TL12 model) gas sample ports on the device's side, using a suitable gas analyzer.

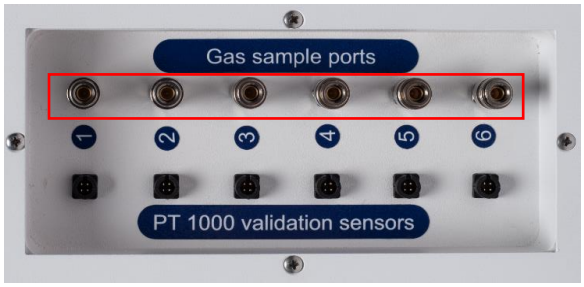


Figure 26.1 PT-1000 Class B sensors in the MIRI® TL6 multiroom IVF incubator

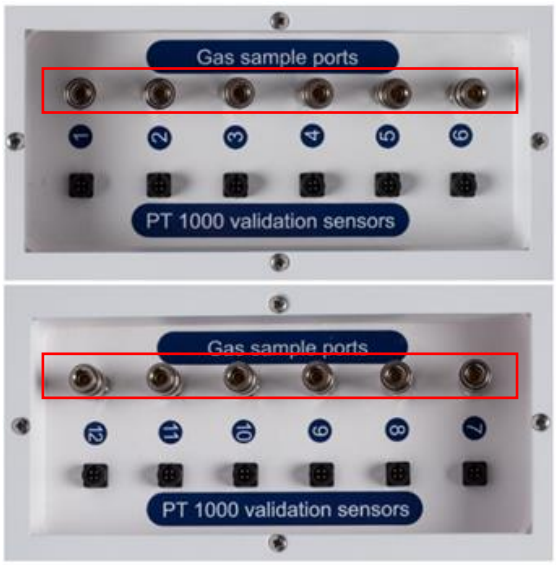


Figure 26.2 PT-1000 Class B sensors in the MIRI® TL12 multiroom IVF incubator

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

An external automatic gas sampler can be connected to the ports for continuous validation. The gas analyzer must have the possibility to return the gas sample to the incubator. Otherwise, sampling can affect gas regulation and also gas analyzer reading.

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

⚠ **Taking out a large sample volume may affect gas concentration.**

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

27 Alarm switch for an external system

The MIRI® TL6 or MIRI® TL12 multiroom IVF incubator is equipped with a 3.5 mm jack connector on the back, which can be connected to an external monitoring device, to ensure maximum safety, especially at night and on weekends.

Whenever an alarm goes off (that could be the temperature alarm, gas alarms for CO_2 or O_2 concentrations, low-pressure or high-pressure alarms for CO_2 or N_2 gases) or if the power supply to the device is suddenly lost, the switch indicates that the device 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 device will be in the "ON" position, as illustrated below.

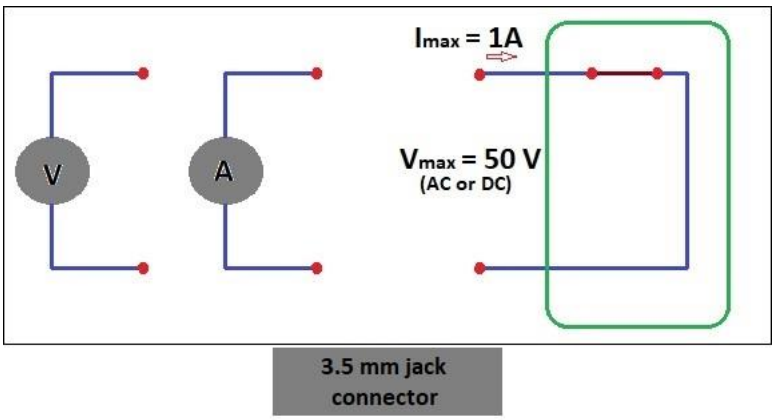


Figure 27.1 No alarm mode

Whenever the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator goes into an alarm mode, the switch status will change into "open circuit". It means that no current can run

through the system anymore.

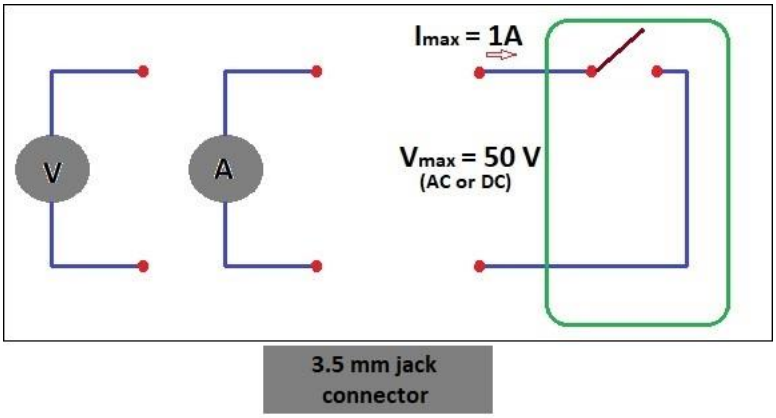


Figure 27.2 "Open circuit" alarm mode

Whenever the MIRI® TL family's 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.

28 Writing area on the chamber lids

Each chamber's lid on the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator is made from white glass, optimized for writing text. The patient data or the chamber's content can be noted 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 28.1 Area for patient information

29 Maintenance

The MIRI® TL6 and MIRI TL12 multiroom IVF incubator 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 concentration, using high-precision equipment in the intervals prescribed based on clinical practice at the laboratory,

where the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator is used. The manufacturer recommends that the period between validations should be no longer than 14 days.

2. VOC/HEPA filters must be replaced every 3 months.
3. External and internal HEPA filters must be replaced yearly during annual maintenance.
4. According to the clinical practice intervals, suitable cleaning procedures must be employed in the laboratory where the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 "38 The Maintenance guide" section of the User Manual. Failure to do so can have a severe adverse outcome, causing the device to stop performing as expected and causing damage to samples, patients or users.**

⚠ **Warranty is void if service and maintenance procedures are not followed.**

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

30 Emergency procedures

Total loss of power to or inside the device:

- 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 the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator will drop below 35 °C after being 10 minutes in an ambient environment of 20 °C;
- The CO_2 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 device with insulating blankets to slow the temperature drop.

If a single temperature alarm goes off:

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

If multiple temperature alarms go off:

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

If the CO_2 concentration 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 CO_2 concentration is low, keep the lids shut. If the state is temporary and the CO_2 concentration is high, open a few lids to vent out some CO_2.

If the O_2 concentration 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 O_2 regulation in the menu.

If the CO_2 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 section "CO_2 pressure alarm".

If the N_2 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 "O_2 pressure alarm" section.

31 User troubleshooting

Table 31.1 Heating system

Symptom	Cause	Action
No heating, the display is off	The device is switched off at the back or not connected to the power source	Switch on the device or connect to the power source
Temperature alarm is on	The heating is off, because, temperature deviated more than 0.5 °C from the set temperature	Contact your Esco Medical distributor for details
No heating	The temperature setpoint is incorrect	Check the desired temperature setpoint
Heating is uneven	The system is not calibrated	Calibrate each zone according to the User manual, using a high-precision thermometer

Table 31.2 CO_2 gas regulator

Symptom	Cause	Action
No CO_2 gas regulation	The system is not powered	Check the power mains
	The system is switched off	Switch the system on
	CO_2 gas regulator is off	Activate CO_2 gas regulator by setting “CO2” to “ON” in the menu
	No CO_2 gas or wrong gas attached to CO_2 gas input	Check gas supply, make sure that gas pressure of 0.6 bar (8.70 PSI) is supplied
	The actual gas concentration is higher than the setpoint	Check the CO_2 setpoint. If the issue persists, contact Esco Medical support
Poor CO_2 gas regulation	Lid(s) are left open	Close the lid(s)
	Seals are missing on the lid(s)	Replace the seals on the lid(s)
CO_2 gas concentration indicated red on the display	CO_2 gas concentration deviates more than ±1 from the setpoint	Allow the system to stabilize by closing all the lids
CO_2 gas pressure indicated red on the display	No/wrong CO_2 gas pressure in the system	Check CO_2 gas supply; make sure that the pressure is kept stable at 0.6 bar (8.70 PSI)

Table 31.3 O_2 gas regulator

Symptom	Cause	Action
No O_2 gas regulation	The system is not powered	Check the power mains
	The system is on standby or switched off	Switch the system on
	O_2 gas regulator is off	Activate the O_2 gas regulator by setting "O2" to "ON" in the menu
	No N_2 or wrong gas type attached to N2 gas input	Check gas supply; make sure that 0.6 bar of N_2 gas is applied
	The actual gas concentration is higher than the setpoint	Check the O_2 setpoint. If the issue persists, contact Esco Medical support
Poor O_2 gas regulation	Lid(s) are left open	Close the lid(s)
	Seals are missing on the lid(s)	Replace the seals on the lid(s)
O_2 gas concentration indicated red on the display	O_2 gas concentration deviates more than ±1 from the setpoint	Allow the system to stabilize by closing all the lids
N_2 gas pressure indicated red on the display	No/wrong N_2 gas pressure in the system	Check the N_2 gas supply; ensure that the pressure is stable at 0.6 bar (8.70 PSI). If O_2 regulation is not needed, set the O_2. to "OFF" in the menu to deactivate oxygen regulation and abort the N_2 alarm

Table 31.4 Viewer communication

Symptom	Cause	Action
No data is sent to PC	The system is not powered	Check the power mains
	The system is on standby or switched off	Switch the system on
	The data cable between incubator and PC is not properly attached	Check the connection. Use only the cable supplied with the device
	Viewer's Software/USB driver is not installed correctly	Please refer to the software installation guide

Table 31.5 Display

Symptom	Cause	Action
Missing segment(s) in display	Failure in the PCB	Contact your Esco Medical distributor for PCB replacement

Table 31.6 Keyboard

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

32 Specifications

Table 32.1 MIRI® TL6 multiroom IVF incubator's specifications

Technical specifications	MIRI® TL6
Overall dimensions (W x D x H)	805 x 590 x 375 mm
Weight	60 kg
Material	Mild steel/Aluminum/PET/Stainless steel
Dish type	CultureCoin®
Power supply	115V 60Hz OR 230V 50Hz
Power consumption	330 W
Temperature range	28.7 – 41.0 °C
Temperature deviation from the setpoint	± 0.1 °C
Gas consumptions (CO_2)[1]	< 2 liters per hour
Gas consumption (N_2)[2]	< 5 liters per hour
CO_2 range	2.9% – 9.9%
O_2 range	2.0% – 20.0%
CO_2 and O_2 concentration deviation from the setpoint	± 0.2 %
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, gas pressure
Operating altitude	Up to 2000 meters (6560 feet or 80kPa – 106kPa)
Shelf life	1 year

Table 32.2 MIRI® TL12 multiroom IVF incubator's specifications

Technical specifications	MIRI® TL12
Overall dimensions (W x D x H)	950 x 685 x 375 mm
Weight	93 kg
Material	Mild steel/Aluminum/PET/Stainless steel
Dish type	CultureCoin®
Power supply	115V 60Hz OR 230V 50Hz
Power consumption	650 W
Temperature range	28.7 – 41.0 °C
Temperature deviation from the setpoint	± 0.1 °C
Gas consumptions (CO_2)[1]	< 2 liters per hour
Gas consumption (N_2)[2]	< 5 liters per hour
CO_2 range	2.9% – 9.9%
O_2 range	5.0% – 20.0%
CO_2 and O_2 concentration deviation from the setpoint	± 0.2 %
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, gas pressure
Operating altitude	Up to 2000 meters (6560 feet or 80kPa – 106kPa)
Shelf life	1 year

[1] Under normal conditions (CO_2 setpoint reached at 6.0%, all lids closed)

[2] Under normal conditions (O_2 setpoint reached at 5.0%, all lids closed)

33 Electromagnetic compatibility

Table 33.1 Electromagnetic emissions

Guidance and manufacturer's declaration – electromagnetic emissions		
The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are intended for use in the electromagnetic environment specified below. The customer or the user of the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator should ensure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment – guidance**
RF emissions CISPR 11	Group 1	The MIRI® TL6 or MIRI® TL12 multiroom IVF 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	The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are suitable for use in a hospital environment. It is not suited for domestic establishments.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Class A	

Table 33.2 Electromagnetic immunity

Guidance and manufacturer's declaration – electromagnetic immdevicey			
The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are intended for use in the electromagnetic environment specified below. The customer or the user of the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator 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	±8 kV contact discharge ±8 kV, ±4 kV, ±8 kV, ±15 kV air discharge	Level 4	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	Level 3	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode	Class 2	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5% UT (95% dip in UT for 0.5 cycles) < 40% UT (60% dip in UT for 5 cycles) < 70% UT (30% dip in UT for 25 cycles) NOTE UT is the a.c. mains voltage prior to application of the test level	N/A	Mains power quality should be that of a typical commercial or hospital environment. If the user of the product requires continued operation during mains interruptions, it is recommended that the product be powered from an uninterruptible power supply or a battery.

Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	N/A	N/A	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Guidance and manufacturer's declaration – electromagnetic immdevicey

The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are intended for use in the electromagnetic environment specified below. The customer or the user of the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator should ensure that it is used in such an environment.

Immunity test	**IEC 60601 Test level**	**Compliance level**	**Electromagnetic environment-guidance**
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	6 Vrms 150kHz to 80 MHz in ISM bands 30 V/m 80 MHz to 2.7 GHz	Level 4	Portable and mobile RF communications equipment should be used no closer to any part of the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators, including cables, than the recommended separation distance calculated according to the equation, applicable to the transmitter's frequency. Recommended separation distance d = 0.35 P d = 0.35 P 80MHz to 800MHz d = 0.7 P 800MHz to 2.5GHz Where *P* is the maximum the power output rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be lower than the compliance level in each frequency range Interference may occur in the vicinity of the equipment.

Table 33.3 Recommended separation distances

Recommended separation distances between portable and mobile RF communication equipment and the MIRI® TL6 or MIRI® TL12 multiroom IVF incubators			
The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are intended to be used in an electromagnetic environment in which radiated RF disturbances are controlled. The customer, or the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator user, can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters). The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators are recommended below, according to the communications equipment's maximum output power.			
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√P	**80 MHz to 800 MHz d = 1.2√P**	**800 MHz to 2.5GHz d = 2.3√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 *d* in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* 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 that all equipment used near the MIRI® TL6 and MIRI® TL12 multiroom IVF incubators comply with the medical electromagnetic compatibility standard and checks before use that no interference is evident or possible. If the interference is suspected or potential, switching off the offending device is the standard solution as it is the usual practice in aircraft and medical facilities.

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

34 The Validation guide

34.1 Product release criteria

The Esco Medical MIRI® TL6 and MIRI® TL12 multiroom IVF incubators undergo strict quality and performance testing before being released for sale.

34.1.1 Performance

Each component used in the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator is tested during the manufacturing process to ensure a defect-free device.

Before release, the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator is tested per a release test which has a duration of at least 24 hours and is performed using high-performance thermometers and gas analyzers, along with real-time data logging to ensure that the device lives up to expected performance standards.

Pass I: Internal sensor temperature variation from setpoint within ± 0.1 °C absolute.
Pass II: Internal sensor CO_2 concentration variation from setpoint within ± 0.2% absolute.
Pass III: Internal sensor N_2 concentration variation from setpoint within ± 0.2% absolute.
Pass IV: Gas flow of CO_2 is less than 2 l/h.
Pass V: Gas flow of N_2 is less than 5 l/h.

34.1.2 Electrical safety

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

34.1.3 Communication & data logging

Each device is connected to a computer running the MIRI® TL6 or MIRI® TL12 data logging software. Gas is supplied to the device, and the system is activated. The data received by the PC program is analyzed to ensure communication between the incubator and the PC.

34.1.4 Gas concentration levels and consumption

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

The average CO_2 gas variation must stay within SP ± 0.2% absolute on all external sampling and internal sensor readings.

The gas flow under regular operation is less than 2 liters per hour, and thus, the average should be below 2 liters for both MIRI® TL6 and MIRI® TL12 multiroom IVF incubators.

The average N_2 gas variation must stay within SP ± 0.2% absolute on all external sampling and internal sensor readings.

The gas flow under regular operation is less than 5 liters per hour, and thus, the average should be below 5 liters for both MIRI® TL6 and MIRI® TL12 multiroom IVF incubators.

34.1.5 Visual inspection

Make sure, that:

- There is no misalignment in the lids.
- Each lid opens and closes easily.
- The seals for the lids are appropriately attached and aligned.
- There aren't any scratches or missing paint on the device.
- Overall, the device is presentable as a high-quality item.
- The bottom of the chambers is checked for misalignment and shape.
- CultureCoin® is placed into the chambers to check for mismatches due to the sizes of the chamber and aluminum cut-outs.

35 Validation on-site

Even though at Esco Medical Technologies, UAB, 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 Technologies, UAB for internal device tracking and device history record.

35.1 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 minimum resolution of 0.1 °C.
- A thermometer with a suitable sensor for measuring on an aluminum surface with a minimum resolution of 0.1 °C.
- A CO_2 analyzer with a minimum range of 0.0 – 10.0%.
- An O_2 analyzer with a minimum range of 0.0 – 20.0%.
- A Pressure tester with a minimum range of 0.0 – 1.0 bar.
- A Multimeter.

35.2 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;
- With the laser particle counter, a sample should be taken just above the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator. 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.

36 Testing

36.1 Gas supply CO_2

For the regulation system to maintain the correct CO_2 concentration level in the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator chambers, the device must be connected to a stable source of 100% CO_2 at 0.4 – 0.6 bar (5.80 – 8.70 PSI) of pressure.

Measure the CO_2 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 CO_2 concentration, as CO_2 concentration is pressure dependent.**

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

PASS: CO_2 concentration measured must be between 98.0% – 100%.

⚠ **Use of CO_2 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.**

36.1.1 About CO_2

Carbon dioxide (CO_2) is a colourless, odourless, 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) in the surrounding atmosphere can cause rapid asphyxiation.**

The User should make sure the CO_2 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:

- 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/NO_2) 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.

36.2 Gas supply N_2

For the regulation and maintenance of the correct O_2 concentration levels in the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator chambers, the device must be connected to a stable source of 100% N_2 at 0.4 – 0.6 bar (5.80 – 8.70 PSI) of pressure.

Measure the N_2 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% O_2 accurately can be used.**

PASS: N_2 concentration measured must be between 95.0%– 100%.

⚠ **The use of N_2 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.**

36.2.1 About N_2

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

⚠ **N_2 gas can act as a simple asphyxiant by displacing air.**

The User should make sure the N_2 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 (CO_2) 1.0 ppm.
- Carbon Monoxide (CO) 1.0 ppm.
- Hydrogen (H_2) 0.5 ppm.
- Methane 0.5 ppm.

- Oxygen (O_2) 0.5 ppm.
- Water (H_2O) 0.5 ppm.

36.3 CO_2 gas pressure check

The MIRI® TL6 and MIRI® TL12 multiroom IVF incubator require a pressure of 0.4 – 0.6 bar (5.80 – 8.70 PSI) on the input CO_2 gas line. This gas pressure must be held stable at all times.

For safety, this device has a built-in digital gas pressure sensor that monitors the incoming gas pressure and alerts the user if the pressure drops below 0.3 bar.

Remove the inlet gas line for the CO_2 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 User manual sections for more information.

36.4 N_2 gas pressure check

The MIRI® TL6 and MIRI® TL12 multiroom IVF incubator require a pressure of 0.4 – 0.6 bar (5.80 – 8.70 PSI) on the input N_2 gas line. This gas pressure must be held stable at all times.

For safety, this device has a built-in digital gas pressure sensor that monitors the incoming gas pressure and alerts the user if the pressure drops below 0.3 bar.

Remove the inlet gas line for the N_2 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 User manual sections for more information.

36.5 Voltage supply

The voltage on-site must be verified.

Measure the output plug on the UPS that the MIRI® TL6 and MIRI® TL12 multiroom IVF 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%

36.6 CO_2 gas concentration check

The CO_2 gas concentration is checked for deviation. The gas sample port on the side of the device is used. Use sample port-6 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 multiroom IVF incubator (i.e., another chamber). Only measure while the value on the gas analyzer stabilizes.

Please refer to the "13.5.1.2 CO_2/O_2 calibration" section for more information on how to perform the CO_2 gas calibration.

PASS: CO_2 concentration measured must not deviate more than ± 0.2% from the setpoint.

36.7 O_2 gas concentration check

The O_2 gas concentration is checked for deviation. The gas sample port on the side of the device is used. Use sample port-6 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 multiroom IVF incubator (i.e., another chamber). Only measure while the value on the gas analyzer stabilizes.

Please refer to the "13.5.1.2 CO_2/O_2 calibration" section for more information on how to perform the CO_2 gas calibration.

PASS: O_2 concentration measured must not deviate more than ± 0.2% from the setpoint.

36.8 Temperature check: Chamber 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 are prepared for MIRI® TL6 and 12 for MIRI® TL12 multiroom IVF incubator 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 do not need to be equilibrated, as the pH will not be measured during the validation tests.

The dishes are placed with at least one dish in each chamber.

1-hour stabilization time is required to complete this test after all previous steps have been completed.

Open the chamber's 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 to a spot inside the chamber's 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 "13.5.1.1 Temperature calibration " section for more information on how to perform the temperature calibration.

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

36.9 Temperature check: Chamber 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 chambers' lid must not deviate more than ± 0.5 °C from the setpoint.

If calibration is needed, please refer to the "13.5.1.1 Temperature calibration" 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 chambers.**

36.10 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 CO_2 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 O_2 regulation activated, but there is N_2 gas available, the test should be conducted with O_2 regulation switched on and with N_2 gas supply.

If the N_2 is not available, the test can be done without it.

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

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

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

Pass II Internal sensor CO_2 concentration variation from setpoint within ± 0.2% absolute.
Pass III: Internal sensor N_2 concentration variation from setpoint within ± 0.2% absolute.
Pass IV: Gas flow of CO_2 is less than 2 l/h.
Pass V: Gas flow of N_2 is less than 5 l/h.

36.11 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.

After the testing has been conducted successfully, it should be cleaned again before the device is taken into clinical use (for cleaning instructions refer to the "23 Cleaning instructions" section of the User Manual).

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

36.12 Test documentation form

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

36.13 Recommended additional testing

36.13.1 A VOC meter

With the VOC meter, a sample should be taken just above the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator. The reading should be noted down as the background VOC level. Then a sample is taken from the gas sample port number 6 (in the MIRI® TL6 model) or 12 (in the MIRI® TL12 model).

Pass: 0.0 ppm VOC.

☞ Ensure that the sample lines do not contain any VOC.

36.13.2 A laser particle counter

A sample should be taken just above the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 6 (in the MIRI® TL6 model) or 12 (in the MIRI® TL12 model).

Pass: 0.3-micron < 100 ppm.

Ensure that the sample lines do not contain any particles.

37 Clinical use

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

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 MIRI® TL6 and MIRI® TL12 multiroom IVF incubator for clinical purposes without access to high-grade quality control validation equipment.

Table 37.1 Validation intervals

Task	Every day	Every week
Temperature check		×
CO_2 gas concentration check	×	
O_2 gas concentration check	×	
Check log for anomalies		×
CO_2 gas pressure check	×	
N_2 gas pressure check	×	
pH check		×

37.1 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 "13.5.1.1 Temperature calibration" section for more information on how to perform the temperature calibration.

PASS:

- **All temperatures measured on the bottom of the chamber in the locations where the dishes would be placed must not deviate more than ± 0.1 °C from the setpoint.**
- **All temperatures measured on the lid must not deviate more than ± 0.5 °C from the setpoint.**

37.2 CO_2 gas concentration check

The CO_2 gas concentration is checked for deviations. The gas sample port on the side of the device is used for this. Use sample port-6 for validation. It is essential to have a high-precision gas analyzer for CO_2 and O_2 available to do the test.

Please follow these simple rules while testing gas concentration:

- Check the CO_2 gas setpoint.
- Check the actual CO_2 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 "13.5.1.2 CO_2/O_2 calibration" section for more information on how to perform the CO_2 gas calibration.

PASS: CO_2 concentration measured must not deviate more than ± 0.2% from the setpoint.

37.3 O_2 gas concentration check

The O_2 gas concentration is checked for deviations. The gas sample port on the side of the device is used for this. Use sample port-6 for validation. It is essential to have a high-precision gas analyzer for CO_2 and O_2 available to do the test.

Please follow these simple rules while testing gas concentration:

- Check the O_2 gas setpoint.
- Check the actual O_2 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 "13.5.1.2 CO_2/O_2 calibration" section for more information on how to perform the CO_2 gas calibration.

PASS: O_2 concentration measured must not deviate more than ± 0.2% from the setpoint.

☞ **Gas analyzers use a small pump to draw out gas 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. The performance of the MIRI® TL6 and MIRI® TL12 multiroom IVF incubator will not be affected, as the gas in the chamber is not under pressure, and the reading is just an artifact based on unsuitable measuring equipment. Contact Esco Medical Technologies, UAB or the local distributor for further guidance.

37.4 CO_2 gas pressure check

The MIRI® TL6 or MIRI® TL12 multiroom IVF incubator requires a pressure of 0.4 – 0.6 bar on the input CO_2 gas line. This gas pressure must be held stable at any time.

For safety, both medical devices have built-in digital gas pressure sensor that monitors the incoming gas pressure and alerts the user if the pressure drops below 0.3 bar.

It is recommended to check the CO_2 gas pressure in the menu by inspecting the value for an item called 'CO2 P' (CO_2 pressure).

PASS: The value must be 0.4 – 0.6 bar.

Please refer to the "16.1 CO_2 gas pressure" section for more information.

37.5 N_2 gas pressure check

The MIRI® TL6 or MIRI® TL12 multiroom IVF incubator requires a pressure of 0.4 – 0.6 bar on the input N_2 gas line. This gas pressure must be held stable at any time.

For safety, both medical devices have built-in digital gas pressure sensor that monitors the incoming gas pressure and alerts the user if the pressure drops below 0.3 bar.

It is recommended to check the N_2 gas pressure in the menu by inspecting the value for an item called 'N2 P' (N_2 pressure).

PASS: The value must be 0.4 – 0.6 bar.

Please refer to the "16.2 N_2 gas pressure" section for more information.

37.6 pH check

Validating the pH of the culture media should be a standard procedure. It can never be accurately predicted what will be the media pH at a certain CO_2 concentration.

CO_2 is pressure-dependent, and thus, at different altitudes, higher concentrations of CO_2 are needed to maintain the same pH. Even changes in barometric pressure under standard weather systems will affect CO_2 concentrations.

The MIRI® TL6 and MIRI® TL12 multiroom IVF incubator are equipped with a high-grade pH measuring system.

Please refer to the "18 pH measuring" section for more information on performing pH calibration.

38 The Maintenance guide

Your MIRI® TL6 or MIRI® TL12 multiroom IVF incubator from Esco Medical Technologies, UAB 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 "34 The Validation guide" section.

If problems are encountered, contact Esco Medical Technologies, UAB 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 38.1.

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 38.1.**

⚠ **Warranty is 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 38.1 Service interval plan

Component name	Every 3 months	Every year	Every 2 years	Every 3 years	Every 4 years
VOC/HEPA filter capsule	×				
External 0.22µm HEPA filter for incoming CO_2 and N_2 gas		×			
Internal in-line 0.2µm HEPA filter for incoming CO_2 and N_2 gas		×			
O_2 sensor		×			
CO_2 sensor					×
UV light		×			
Cooling fan				×	
Internal gas pump			×		
Proportional valves				×	
Flow sensors			×		
Pressure regulators					×
A firmware update (if a new version has been released)		×			

38.1 VOC/HEPA filter capsule

The VOC/HEPA filter capsule is placed on the incubator device'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 that is being re-circulated to the chambers. Because of the carbon component's lifespan, all VOC filters' lifetimes are limited, and they must be replaced often. According to table 38.1, the VOC filter installed in the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 Technologies, UAB 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 of the User Manual for the replacement instructions.

38.2 External 0.22µm HEPA filter for incoming CO_2 and N_2 gas

The bigger 64mm round-shape external 0.22µm HEPA filter for CO_2 and N_2 gas removes

any particles found in the incoming gas. Failure to use the external HEPA filter may cause damage to the high precision flow sensor or compromise the CO_2/N_2 regulation system.

Please follow these safety precautions when changing the filter:

- Always use the original filter (contact Esco Medical Technologies, UAB 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 CO_2/N_2 gas.
- Warranty void if wrong/non-original filter is used.

Please refer to the service manual for replacement instructions.

38.3 Internal in-line 0.2µm HEPA filter for incoming CO_2 and N_2 gas

The smaller 33mm round-shape internal in-line 0.2µm HEPA filter for CO_2 and N_2 gas further acts to remove any particles left in the incoming gas that have passed through the external HEPA filter. Failure to use the internal HEPA filter may cause damage to the high precision flow sensor or compromise the CO_2/N_2 regulation system.

Please follow these safety precautions when changing the filter:

- Always use the original filter (contact Esco Medical Technologies, UAB 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 CO_2/N_2 gas.
- Warranty void if wrong/non-original filter is used.

Please refer to the service manual for replacement instructions.

38.4 O_2 sensor

The oxygen regulation uses the Oxygen sensor to keep the O_2 gas concentration at a desired concentration 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, but it is necessary for measuring the amount of oxygen with a very high precision that is needed in the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 device, irrespective of the incubator being used or not.

In the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 O_2 sensor change.

Please follow these safety precautions when changing sensor:

- Always use an original O_2 sensor (contact Esco Medical Technologies, UAB or your local distributor for more details or ordering).
- Change the O_2 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 O_2 concentration.
- Warranty void if wrong/ non-original sensor is used.

Please refer to the service manual for replacement instructions.

38.5 CO_2 sensor

The CO_2 regulation uses the CO_2 sensor to keep the gas concentration at the chambers' desired concentration.

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

Please follow these safety precautions when changing the sensor:

- Always use an original CO_2 sensor (contact Esco Medical Technologies, UAB or your local distributor for more details or ordering).
- Change the CO_2 sensor within 4 years from the date of installation.
- Failure to change the CO_2 sensor on time can result in low/no CO_2 gas concentration regulation.
- Warranty void if wrong/non-original sensor is used.

Please refer to the service manual for replacement instructions.

38.6 UV light

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 38.1.

Figure 38.1 UV light warning

⚠ **Exposure to UV-C radiation may cause severe damage to your skin and eyes. Always power the device 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 Technologies, UAB 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.

38.7 Cooling fan

The cooling fan is responsible for cooling down the electronics installed in the device. 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 Technologies, UAB 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 Technologies, UAB 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.

38.8 Internal gas pump

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 Technologies, UAB 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.

38.9 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 Technologies, UAB 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.

38.10 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.

⚠ **All gas lines/hoses must be visually checked during the annual maintenance service visit.**

☞ **All service engineers must have extra internal gas lines/hoses in order to be able to replace them during a maintenance service visit.**

Please follow these safety precautions when changing gas lines:

- Always use original gas lines (contact Esco Medical Technologies, UAB or your local distributor for more details or ordering).
- 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.

38.11 Flow sensors

The flow sensors are used by the CO_2/N_2 regulations and for logging the device's gas consumption.

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

Please follow these safety precautions when changing sensors:

- Always use an original flow sensor (contact Esco Medical Technologies, UAB 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 CO_2 and O_2 gas concentration regulation.
- Warranty void if wrong/non-original sensors are used.

Please refer to the service manual for replacement instructions.

38.12 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 4 years to maintain the system safe and stable.

Please follow these safety precautions when changing regulators:

- Always use original pressure regulators (contact Esco Medical Technologies, UAB 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.

38.13 Firmware update

If Esco Medical Technologies, UAB has released a newer version of the firmware, this should be installed on the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator during the yearly scheduled service.

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

38.14 Software update

If Esco Medical Technologies, UAB has released a newer version of the software, it should be installed on the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator during the yearly scheduled service.

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

39 The Installation guide

This section describes when and how to install the MIRI® TL6 or MIRI TL12 multiroom IVF incubator in the IVF clinic.

39.1 Responsibilities

All technicians or embryologists installing the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 device, calibration and testing procedures, and devices used in the device'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 device must be trained by Esco Medical Technologies, UAB or at a qualified training center.

Experienced service technicians or embryologists conduct training to ensure that the installation personnel clearly understand the device's functions, performance, testing, and maintenance.

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

39.2 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 the MIRI® TL6 and MIRI® TL12 multiroom IVF 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 MIRI® TL6 multiroom IVF incubator weight is approximately 60 kg and MIRI® TL12 multiroom IVF incubator weight is approximately 93 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. Uninterrupted power supply (UPS) with 115 or 230 V, minimum 120 W.
6. Proper grounding.
7. CO_2 gas outlet with 0.6 – 1.0 atm above ambient.
8. N_2 gas outlet with 0.6 – 1.0 atm above ambient if the clinic uses reduced oxygen concentrations.
9. Tubes that fit 4 mm hose nipple and HEPA filter.

39.3 Preparing for installation

- Bring the "Installation report" form. Make sure it is the latest and current version only;
- Fill out the following blank boxes in the form: the MIRI® TL6 and MIRI® TL12 multiroom IVF 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 software. Bring these files on a labeled memory stick to the service site.

39.4 Bring the following to the installation site

- "Installation report" form;
- Service manual for the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator;
- 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 CO_2 and O_2 and the possibility of returning gas samples to the incubator;
- Extension cable for USB connection.

39.5 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 the MIRI® TL6 or MIRI® TL12 multiroom IVF 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 MIRI® TL6 or MIRI® TL12 multiroom IVF incubator on the back.
7. Observe for standard functionality.
8. Let the device warm up and stabilize for 30 min.
9. Follow the guidelines in the “34 The Validation guide” section of the User Manual.
10. Complete user training and finish reading instructions.
11. After a burn-in phase of 24-hours, the device is ready for use IF the testing is successful.

39.6 User training

1. Mains switch on/off.
2. Explain the MIRI® TL6 or MIRI® TL12 multiroom IVF incubators essential function and incubation with a multi-room facility to store the samples.
3. Explain temperature control in the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator (direct heat transfer with heated lids).
4. Gas regulation on/off.
5. Setpoint for temperature, CO_2 and O_2.
6. Explain how N_2 is used to suppress the O_2 concentration.
7. Alarm turn off procedure (temperature, CO_2, O_2) and revert times.
8. Emergency procedures (can be found in the "30 Emergency Procedures" section).
9. Explain how to clean the device.
10. External measurement and calibration of temperature.
11. External measurement and calibration of gas concentration.

12. How to add and remove a CultureCoin®.
13. The MIRI® TL6 and MIRI® TL12 multiroom IVF incubators screen functionality and how the connection to the MIRI® TL Viewer works.
14. Loading a CultureCoin® with media and oil.
15. pH measuring in the CultureCoin®.
16. Demonstrate how to replace the VOC-HEPA filter (can be found in the "12.1 Installation of new filter capsule" section).
17. Data logger functionality, how to establish a connection and re-connection.

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

39.7 After the installation

When the installation trip is finished, a copy of the original "Installation report" form must be sent to Esco Medical Technologies, UAB. 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 device overview file. The date of installation is also written in the service schedule.

Suppose the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator user or owner make inquiries about a written "Installation report". The completed and signed "Installation report" 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 the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator fails any of the "Installation report" form acceptance criteria, or it in any way suffer from a severe error and incubation parameters are compromised, the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator must be taken out of service until it is repaired/ exchanged, or a new test approves the MIRI® TL6 or MIRI® TL12 multiroom IVF incubator. The User and owner must be informed about this and arrangements to solve the problems must be initiated.**

40 Other countries

40.1 Switzerland

The Swiss Authorised Representative CH-REP symbol is placed on each medical device.

Figure 40.1 Swiss Authorised Representative

Swiss Authorised Representative's contact e-mail is “Vigilance@medenvoyglobal.com”.

41 Reporting on serious incidents

In case of any serious incidents that have occurred in relation to the device should be reported to Esco Medical Technologies, UAB by contacts, written on the contact information page, and the Authorised Representative in which the user and/or patient is established.

For contacting Authorised Representative, please refer to the “Other countries” section according to your country.