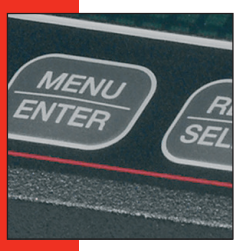
AMETEK®
SENSORS, TEST & CALIBRATION

User manual

Reference Temperature Calibrator

Jofra RTCt-156/157/168 A/B/C





User Manual

Reference Temperature Calibrator

JOFRA RTC^{t} -156/157/168 A/B/C

List of contents

1.0 Introduction

This user manual applies to the following instruments:

- **JOFRA RTC^t -156 A - Temperature calibrator**
- **JOFRA RTC^t -156 B - Temperature calibrator with sensor and reference inputs**
- **JOFRA RTC^t -156 C - Temperature calibrator with reference input**
- **JOFRA RTC^t -157 A - Temperature calibrator**
- **JOFRA RTC^t -157 B - Temperature calibrator with sensor and reference inputs**
- **JOFRA RTC^t -157 C - Temperature calibrator with reference input**
- **JOFRA RTC^t -168 A - Temperature calibrator**
- **JOFRA RTC^t -168 B - Temperature calibrator with sensor and reference inputs**
- **JOFRA RTC^t -168 C - Temperature calibrator with reference input**

These instruments are temperature calibrators designed to calibrate temperature sensors and thermostats.

The RTC^t -156/157 A/B/C instruments are designed as dry-block calibrators, whereas the RTC^t -168 A/B/C instrument is designed to be used both as dry-block calibrator and liquid bath.

Read this manual carefully before using the instrument and ensure that all safety instructions and warnings are observed.

1.1 List of equipment received

When you receive the instrument, the following should be enclosed:

- 1 RTC^t calibrator
- 1 mains cable
- 2 sets of test cables (2 black, 2 red –B models only)
- 1 USB memory stick containing electronic manuals and software package: JOFRACAL, AMETRIM and CON050
- 1 Wifi USB Dongle
- 1 USB cable
- 1 tool for insertion tube
- 1 Accredited Calibration certificate (International traceable, A-models)
- 2 Accredited Calibration certificates (International traceable, B/C-models)
- 1 set of rubber cones for insulation plugs
- 1 insulation collar (RTC^t -156 only)

- RTC^{t} -168 A/B/C only (liquid bath) – **OPTIONAL** :
  - 1 liquid bath kit consisting of :
    - 1 sensor basket with temperature equalizer tube
    - 1 lid for transportation
    - 1 lid for calibration
    - 1 insulating ring for spill tray
    - 3 stirring magnets
    - 1 liquid drainage syringe
    - 1 bottom shield
    - 1 silicone oil
    - 1 oil material safety data sheet

2.0 Safety instructions

Read this manual carefully before using the instrument!

Please follow the instructions and procedures described in this manual. They are designed to allow you to get the most out of your calibrator and avoid any personal injuries and/or damage to the instrument.

The screen menus shown in this manual represent the menus displayed when using a B-model.

Disposal – WEEE Directive

These calibrators contain Electrical and Electronic circuits and must be recycled or disposed of properly (in accordance with the WEEE Directive 2012/19/EU).

Warning

About the use:

- Always supply the calibrator using a power circuit which is separate from essential safety equipment and vital hospital equipment etc., to prevent fatal consequential damage from a potential electrical failure.
- The calibrator **must not** be used for any purposes other than those described in this manual, as it might cause a hazard.
- The calibrator has been designed for **indoor use only** and is not to be used in wet locations.
- The calibrator is **not to be used in hazardous areas**, where vapour or gas leaks, etc. may constitute a danger of explosion.
- The calibrator is **not** designed for operation in altitudes above 2000 meters.
- The calibrator is a CLASS I product and must be connected to a mains outlet with a protective earth connection. Ensure the ground connection of the calibrator is properly connected to the protective earth before switching on the calibrator. Always use a mains power cable with mains plug that connects to the protective earth.
- To ensure the connection to protective earth any extension cord used **must** also have a protective earth conductor.
- Only use a mains power cord with a current rating as specified by the calibrator and which is approved for the voltage and plug configuration in your area.
- Before switching on the calibrator make sure that it is set to the voltage of the mains electricity supply.
- **Always** position the calibrator to enable easy and quick disconnection of the power source (mains inlet socket).
- The calibrator **must** be kept free within an area of 20 cm on all sides and 1 metre above the calibrator due to fire hazard.
- If the calibrator is wet or has been in a wet environment, do not apply power until the moisture has been removed, for example by storage at 50°C in a low humidity environment for at least 4 hours.
- **Never** use heat transfer liquids such as silicone, oil, paste, etc. in the dry-block calibrators. These liquids may penetrate the calibrator and cause electrical hazard, damage or create poisonous fumes.
- The calibrator **must** be switched off before any attempt to service the instrument is made. There are no user serviceable parts inside the calibrator.

- When cleaning the well or the insertion tube, **REMEMBER** to wear goggles when using compressed air in the dry-block calibrator and cleaning oil in the liquid bath calibrator.
- Remember to use appropriate protective equipment or get help when carrying the calibrator (for a longer distance) to prevent injuries from dropping the calibrator.

About the front panel:

- For B and C models only, the sockets on the input module must **NEVER** be connected to voltages exceeding 30V with reference to ground.
- Thermostats connected to the switch test input must **not** be connected to any other voltage source during a test.

About insertion tubes, insulation plugs, well and sensor:

- **Never** leave hot insertion tubes which have been removed from the calibrator unsupervised – they may constitute a fire hazard or personal injury.

  If you intend to store the calibrator in the optional carrying case after use, you **must** ensure that the instrument has cooled down to a temperature **below 50°C/122°F** before placing it in the carrying case.
- **Never** place a hot insertion tube in the optional carrying case.
- Use only insulation plugs supplied by AMETEK Denmark A/S.

About the fuses:

- The fuse box must not be removed from the power control switch until the mains cable has been disconnected.
- The two main fuses must have the specified current and voltage rating and be of the specified type. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited and may cause a hazard.

About the liquid bath (RTC^{t} -168 A/B/C only):

- Product information on the liquid must be carefully investigated before use.
- When using liquids in the calibrator, ensure proper ventilation or local extraction to handle vapor and other airborne particles, as recommended for the particular liquid in accordance with the MSDS (Material Safety Data Sheet) of the liquid and in accordance with the local environmental regulations.
- When handling the liquid, ensure to immediately wipe up and handle spillages in accordance with the MSDS (Material Safety Data Sheet) of the liquid and in accordance with the local environmental regulations.
- For liquid bath ensure that the sensor is absolutely clean and dry as a few drops of water in the well (liquid baths) might cause a steam explosion.
- **Do not pour** cold liquid into a hot well – it might cause an explosion.
- AMETEK Denmark A/S **does not** take any responsibility, if the well is filled with other liquids than those recommended.
- Liquid baths should **only** be operated by trained personal.
- Heat transfer liquids must **only** be used in calibrators prepared as a liquid bath. If these liquids are heated above specified temperature, they will create noxious or toxic fumes. Proper ventilation must be used.
- To avoid hazards from improper handling of liquids, **always** reduce the "Max. SET-temperature allowed" in the CALIBRATOR SETUP MENU according to the specifications of the liquid to be used.
  If using a calibrator outside of the liquids specifications there is a risk of fire hazards, personal Injury, or chemical release.

By reducing the "Max. SET-temperature allowed", the calibrator cannot be used outside this temperature range.
Be aware of the flash point, the boiling point and other liquid properties applicable to the usage when setting the Max. SET-temperature. Read the MSDS (Material Safety Data Sheet) of the liquid before use. The Max. SET-temperature must never exceed liquid flash point –50°C.

- **Always** remove the liquid from the calibrator before transportation.
- Product information on the liquid must be carefully investigated before use.
- **Do not** handle hot liquid.
- **Do not pour** water or any other liquids into a bath filled with hot oil, because only a few drops of water might cause a steam explosion, if poured into above 100°C hot oil.
- **Do not** under any circumstances pour water on burning oil. It might cause a dangerous steam explosion.

Warning – Silicone oil

Silicone oil is flammable when heated up to temperatures above its flash point. Always consult the selected heat transfer medium's technical and safety datasheets before use. Set the calibrator's maximum temperature accordingly to ensure a safe margin to the liquid's flash point.

Caution – Hot surface

This symbol is visible on the grid plate. 

- **Do not touch** the grid plate, the well or the insertion tube as the calibrator is heating up – they may be very hot and cause burns.
- **Do not touch** the lid or the spill tray as the calibrator is heating up – they may be very hot and cause burns (RTC^{t} -168 A/B/C only).
- **Do not touch** the tip of the sensor when it is removed from the insertion tube/well – it may be very hot and cause burns.
- **Do not touch** the handle of the calibrator during use – it may be very hot and cause burns.
- **Over 50°C/122°F**

  If the calibrator has been heated up to temperatures above 50°C/122°F, you must wait until the instrument reaches a temperature **below 50°C/122°F** before you switch it off.
- **Do not** remove the insert from the calibrator before the insert has cooled down to less than 50°C/122°F.

Caution – Cold surface

Below 0°C/32°F

- **Do not** touch the well or insertion tube when these are below 0°C/32°F - they might create frostbite.
- If the calibrator has reached a temperature below 0°C/32°F, ice crystals may form on the insertion tube and on the well. This, in turn, may cause the material surfaces to oxidize.

  To prevent this from happening, the insertion tube and the well must be dried. This is done by heating up the calibrator to min. 100°C/212°F until all water left has evaporated.

Remove the insulation plug while heating up.

It is very important that humidity in the well and insertion tube is removed to prevent corrosion and frost expansion damages.

Caution…

About the use:

- **Do not** use the instrument if the internal fan is out of order.
- Before cleaning the calibrator, you **must** switch it off, allow it to cool down and remove all cables.
- Always place power cables and cables for attached accessories, such as sensors, in a safe way to reduce the risk of tripping.
- When transporting (carrying) the calibrator, be extra careful not to drop it on other materials, equipment, and body parts.
- Ensure that the allowed temperature range of the external sensors is not exceeded by the calibrator's temperature range. See section 4.6.1 to set up the calibrator's allowed temperature range.
- Acoustic noise emitted from the calibrator may contribute to the existing noise environment. Be aware of the total noise exposure and act accordingly to maintain a safe, healthy, and pleasant working environment.

About the liquid bath (RTC^{t} -168 A/B/C only):

- Before use, ensure that all external equipment and accessories in contact with the liquid are suited to this exposure.
- Be careful **not to overfill** the well with liquid.
- Avoid getting silicone oil on the clothes. It is impossible to wash off.
- The silicone oil level rises several centimetres when the temperature is rising. Please read instructions in section 3.4.2 in the Reference manual 130787 about oil level. To stop overflow, switch off the main power or set a low temperature and the oil level will decrease when cooled down.
- In the case of liquid spillages into holes, slots, or crevices in the calibrator, attempt to wipe up the liquid as soon as possible. If the liquid is electrically conductive or corrosive, immediately turn off the calibrator and contact the dealer to send in the calibrator for service.
- Carefully wipe off all silicone oil from the sensor under test to avoid spreading of the silicone oil.
- Be careful to select the right oil for the right task. Using other than the recommended oils might cause damage to the calibrator or degrade the performance.
- Remove excess hot liquid with the outmost care, as it might be very hot.
- **Do not** attempt to remove hot liquid with the liquid drainage tube, as it might melt.

About the well, insertion tube and sensor:

- The well and the insertion tube **must** be clean and dry before use.
- **Do not** pour any form of liquids into the well. It might damage the well or cause a hazard.
- **Do not** use any alkali, acid or ionic liquids in the aluminium well as it might be damaged.
- Scratches and other damage to the insertion tubes should be avoided by storing the insertion tubes carefully when not in use
- The insertion tube must **never** be forced into the well.

  The well could be damaged as a result, and the insertion tube may get stuck.

- The insertion tube must **never** be forced into the well. The well could be damaged as a result, and the insertion tube may get stuck.
- The insertion tube must **always** be removed from the calibrator after use.

  The humidity in the air may cause corrosion oxidation on the insertion tube inside the instrument. There is a risk that the insertion tube may get stuck if this is allowed to happen.
- If the calibrator is to be transported, the insertion tube **must** be removed from the well to avoid damage to the instrument.
- The tip of the sensor should rest at the bottom of the sensor basket for optimum results (liquid baths only).
- Be careful **not to** submerge the handle or wire inlet of the sensor-under-test in the liquid, as this might damage the sensor (liquid baths only).

Note…

The product liability **only** applies if the instrument is subject to a manufacturing defect. This liability becomes void if the user fails to follow the instructions set out in this manual or uses unauthorized spare parts.

3.0 Setting up the calibrator

3.1 Before use

The RTC^t -B-models have a precision reference input. To achieve the high precision, a set of sensor coefficients relating to the specific sensor must be present in the RTC^t. Before use of the RTC^t, ensure that the correct coefficients in the RTC^t are equal to those from the sensor's calibration certificate. This is done with the included PC software JOFRACAL. Please read how to do in the chapter "Reference Sensors" in the JOFRACAL user manual.

Warning

- The calibrator **must not** be used for any purposes other than those described in this manual, as it might cause a hazard.
- The calibrator has been designed for **indoor use only** and is not to be used in wet locations.
- The calibrator is **not to be used in hazardous areas**, where vapour or gas leaks, etc. may constitute a danger of explosion.
- The calibrator is **not** designed for operation in altitudes above 2000 meters.
- The calibrator is a CLASS I product and must be connected to a mains outlet with a protective earth connection. Ensure the ground connection of the calibrator is properly connected to the protective earth before switching on the calibrator. Always use a mains power cable with mains plug that connects to the protective earth.
- To ensure the connection to protective earth any extension cord used **must** also have a protective earth conductor.
- Only use a mains power cord with a current rating as specified by the calibrator and which is approved for the voltage and plug configuration in your area.
- Before switching on the calibrator make sure that it is set to the voltage of the mains electricity supply.
- **Always** position the calibrator to enable easy and quick disconnection of the power source (mains inlet socket).

  The calibrator **must** be kept free within an area of 20 cm on all sides and 1 metre above the calibrator due to fire hazard.
- **Never** use heat transfer liquids such as silicone, oil, paste, etc. in the dry-block calibrators. These liquids may penetrate the calibrator and cause electrical hazard, damage or create poisonous fumes.
- If the calibrator is wet or has been in a wet environment, do not apply power until the moisture has been removed, for example by storage at 50°C in a low humidity environment for at least 4 hours.
- Remember to use appropriate protective equipment or get help when carrying the calibrator (for a longer distance) in order to prevent injuries from dropping the calibrator.

About the front panel:

- For B and C models only, the sockets on the input module must **NEVER** be connected to voltages exceeding 30V with reference to ground.
- Thermostats connected to the switch test input must **not** be connected to any other voltage source during a test.

About the liquid bath (RTC^{t} -168 A/B/C only):

- For liquid bath ensure that the sensor is absolutely clean and dry as a few drops of water in the well (liquid baths) might cause a steam explosion.
- **Do not pour** cold liquid into a hot well – it might cause an explosion.
- AMETEK Denmark A/S **does not** take any responsibility, if the well is filled with other liquids than those recommended.
- Liquid baths should **only** be operated by trained personal.
- Heat transfer liquids must **only** be used in calibrators prepared as a liquid bath. If these liquids are heated above specified temperature, they will create noxious or toxic fumes. Proper ventilation must be used.
- To avoid hazards from improper handling of liquids, **always** reduce the "Max. SET-temperature allowed" in the CALIBRATOR SETUP MENU according to the specifications of the liquid to be used.
  If using a calibrator outside of the liquids specifications there is a risk of fire hazards, personal Injury, or chemical release.
  By reducing the "Max. SET-temperature allowed", the calibrator cannot be used outside this temperature range.
  Be aware of the flash point, the boiling point and other liquid properties applicable to the usage when setting the Max. SET-temperature. Read the MSDS (Material Safety Data Sheet) of the liquid before use. The Max. SET-temperature must never exceed liquid flash point –50°C.
- Product information on the liquid must be carefully investigated before use.
- **Do not** handle hot liquid.
- If the oil is heated beyond the flash point, it may constitute a fire hazard.
- **Do not pour** water or any other liquids into a bath filled with hot oil, because only a few drops of water might cause a steam explosion, if poured into above 100°C hot oil.
- **Do not** under any circumstances pour water on burning oil. It might cause a dangerous steam explosion.

Note…

The instrument must **not** be exposed to draughts.

3.1.1 Setting up a dry-block calibrator

Follow the instructions below before using the calibrator:

Warning

Always position the calibrator to enable easy and quick disconnection of the power source (mains inlet socket).

1. Place the calibrator on an even horizontal surface where you intend to use it.

Caution…

- **Do not** use the instrument if the internal fan is out of order.
- The well **must** be clean before use.

2. Ensure a free supply of air to the internal fan located at the bottom of the instrument (pos.②).
   The area around the calibrator should be free of draught, dirt, flammable substances, etc.

3. Check that the fuse size corresponds to the applied voltage on (pos.③). The fuse is contained in the power control switch (on/off switch). To check; follow the procedure in the RTC^t Reference manual, 130787 section 3.1.1.

4. Check that the earth connection for the instrument is present and attach the cable.

5. Select an insertion tube with the correct bore diameter matching the sensor to be calibrated. Ensure that both the well and the insertion tube are clean. Insert the tube into the well as shown in fig 1.

6. Place the sensor under test and the reference/DLC sensors (if available in the insertion tube) as shown in fig. 1.

Fig. 1
Inserting sensors and insertion tube

3.1.2 Setting up a liquid bath calibrator (RTC^t -168 A/B/C only)

Follow the instructions below before using the calibrator.

Warning

Always position the calibrator to enable easy and quick disconnection of the power source (mains inlet socket).

1. Place the calibrator on an even horizontal surface where you intend to use it. Place it in a way that will minimize the risk of tilting.

   It is recommended to cover the surface with a disposable cover to protect the surface against the silicone oil, if spilled.

   It is also recommendable to have a sufficient amount of disposable paper towels within reach.

Caution…

- To reduce the risk of overpressure in the well, ensure that the sealing lid on the spill tray is removed before any use of the calibrator.
- **Do not** use the instrument if the internal fan is out of order.
- The well **must** be clean before use.

2. Ensure a free supply of air to the internal fan located at the bottom of the instrument (pos. ②).
   The area around the calibrator should be free of draught, dirt, flammable substances, etc.

3. Check that the fuse size corresponds to the applied voltage on (pos. ③). The fuse is contained in the power control switch (on/off switch). To check; follow the procedure in the RTC^t Reference manual, 130787 section 3.1.1.

4. Check that the earth connection for the instrument is present and attach the cable.

5. Place the parts from the liquid bath kit in the well in the following order (see Fig 2a):
   - **Insulating ring for spill tray** – The insulating ring is placed in the spill tray making sure that the sensor basket is kept centred in the well.
   - **Sensor basket complete** – Assemble the sensor basket before placing it in the well : Place the stirrer magnet in the sensor basket on the bottom shield and insert the temperature equalizer tube with the integrated grate into the sensor basket (see Fig 2b). It is very important to place the assembled sensor basket in the well before any calibration is attempted, as it ensures that the sensors encounter maximum temperature stability and uniformity while ensuring that the stirring magnet is not blocked.
     - **Bottom shield** – the bottom shield protects the well from being damaged during calibration.
     - **Stirring magnet** – It is very important that the stirring magnet is spinning before any calibration is attempted. The stirring magnet ensures minimum temperature gradient in the liquid. The magnet's Teflon cover will be worn down over time, leaving the magnet flat on one side. This will reduce the spinning ability.

       A magnet with a flat side must therefore be replaced.

- **Silicone oil** – Fill the well with oil according to the tables of recommended oil volume. The recommended volumes must be adjusted to the actual job.
  For oil tables and further oil information – see section 3.4.2 in the Reference manual 130787.

  The sensor basket is marked with an optimum liquid level mark (100%). When filling the well with liquid and placing the sensors, this mark must **never** be exceeded (see Fig 2a)

RTC^t -168 A/B/C
For recommended 10 cSt oil

-30°C - 25°C	100%
25°C - 60°C	95%
60°C - 110°C	90%
110°C - 163°C	85%

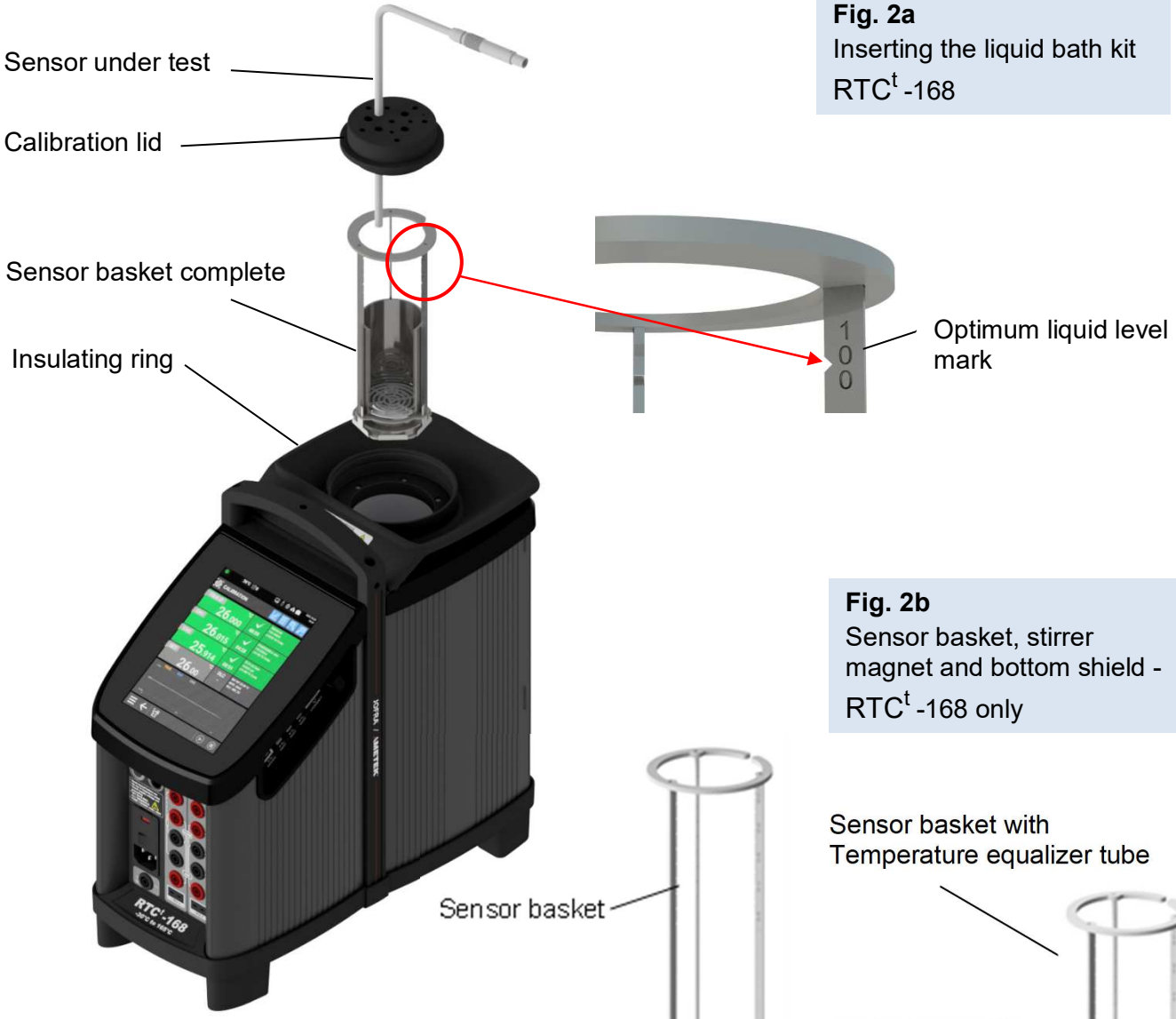


Fig. 2a
Inserting the liquid bath kit RTC^t -168

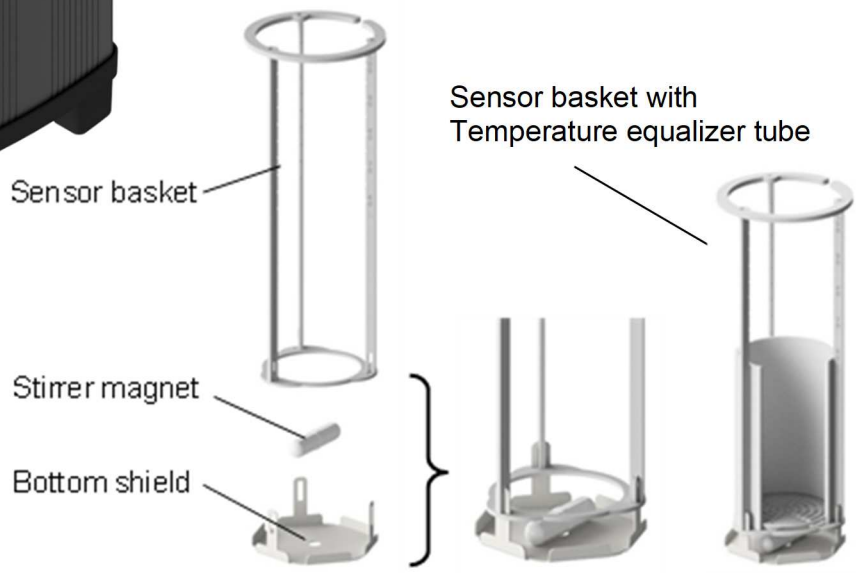


Fig. 2b
Sensor basket, stirrer magnet and bottom shield - RTC^t -168 only

Warning – Silicone oil

Silicone oil is flammable when heated up to temperatures above its flash point. Always consult the selected heat transfer medium's technical and safety datasheets before use. Set the calibrator's maximum temperature accordingly to ensure a safe margin to the liquid's flash point.

Warning

- When using liquids in the calibrator, ensure proper ventilation or local extraction to handle vapor and other airborne particles, as recommended for the particular liquid in accordance with the MSDS (Material Safety Data Sheet) of the liquid and the local environmental regulations.
- **Do not pour** cold liquid into a hot well – it might cause an explosion.
- **Do not pour** water or any other liquids into a bath filled with hot oil, because only a few drops of water might cause a steam explosion, if poured into e.g., above 100°C hot oil.
- **Always** remove the liquid from the calibrator before transportation.
- AMETEK Denmark A/S **does not** take any responsibility, if the well is filled with other liquids than those recommended.

Warning

- **Do not** handle hot liquid.
- If the liquid is heated beyond the flash point, it may constitute a fire hazard

If the liquid has caught fire, switch off the main power to prevent further heating of the liquid. Flames are best extinguished by cowering the well with a non-flammable lid.

Caution…

- In case of liquid spillages into holes, slots or crevices in the calibrator, attempt to wipe up the liquid as soon as possible. If the liquid is electrically conductive or corrosive, immediately power off the calibrator and send in the calibrator for service.
- Do not use any alkali, acid or ionic liquids in the aluminium well as it might be damaged.
- Be careful **not to overfill** the well with liquid.

  The silicone oil level rises several centimetres when the temperature is rising to maximum. To stop the overflow, switch off the mains power or set a low temperature and the oil level will decrease when cooled down.
- **Do not** attempt to remove hot liquid with the liquid drainage syringe, as it might melt.

6. Switch on the calibrator and start the stirring magnet by following the procedure in section 4.7.

7. Place the calibration lid (see fig. 2a) onto the well. Holes with a boring diameter matching the sensors to be calibrated must be drilled into the lid before using it.

   It is strongly recommended to leave the lid on during calibration. Calibration without the lid may affect the temperature stability and uniformity.

Warning

To avoid hazards from improper handling of liquids, **always** reduce the "Max. SET-temperature allowed" in the CALIBRATOR SETUP MENU according to the specifications of the liquid to be used.

If using a calibrator outside of the liquids specifications there is a risk of fire hazards, personal Injury or chemical release.
By reducing the "Max. SET-temperature allowed", the calibrator cannot be used outside this temperature range.

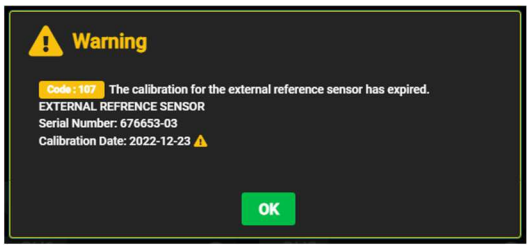
Be aware of the flash point, the boiling point and other liquid properties applicable to the usage when setting the Max. SET-temperature. Read the MSDS (Material Safety Data Sheet) of the liquid before use. The Max. SET-temperature must never exceed liquid flash point –50°C.

8. Select a SET-temperature according to the tables of recommended oil volume by following the procedure in section 4.2.1.

9. Carefully monitor the oil level in the well, as the temperature rises, to prevent overflow.

10. Place the sensor (see fig. 2a) and the reference sensor (if available) to be calibrated vertically into the well. It is recommended to use the optional support rod set for a correct position during calibration (see fig. 1).

    If the sensor has expired a warning will be displayed.



Caution…

- The tip of the sensor should rest at the bottom of the sensor basket for optimum results.
- Be careful **not to** submerge the handle or wire inlet of the sensor-under-test in the liquid, as this might damage the sensor.

11. The calibrator is now ready for use. Please follow the calibration procedure in this manual.

3.2 During use

Caution – Hot surface

This symbol is visible on the grid plate. 

- **Do not touch** the grid plate, the well or the insertion tube while the calibrator is heating up – they may be very hot and cause burns.
- **Do not touch** the lid or the spill tray when the calibrator is heating up – they may be very hot and cause burns (RTC^t -168 A/B/C only).
- **Do not touch** the tip of the sensor when it is removed from the insertion tube – it may be very hot and cause burns.
- **Do not touch** the handle of the calibrator during use – it may be very hot and cause burns.
- **Do not** remove the insert from the calibrator before the insert has cooled down to less than 50°C/122°F.

Caution – Cold surface

- If the calibrator has reached a temperature below 0°C/32°F, ice crystals may form on the insertion tube and on the well. This, in turn, may cause the material surfaces to oxidize.

  To prevent this from happening, the insertion tube and the well must be dried. This is done by heating up the calibrator to min. 100°C/212°F until all water left has evaporated.
  Remove the insulation plug while heating up.

  It is very important that humidity in the well and insertion tube is removed to prevent corrosion and frost expansion damages.
- **Do not touch** the well or insertion tube when these are below 0°C/32°F – they might create frostbite.

Caution…(RTC^t -168 A/B/C only)

- Before use, ensure that all external equipment and accessories in contact with the liquid are suited to this exposure.
- Be careful to select the right oil for the right task. Using other than the recommended oils might cause damage to the calibrator or degrade the performance.
- Be careful **not to overfill** the well with liquid.
- The silicone oil level rises several centimetres when the temperature is rising. Please read instructions in section 3.4.2 in the Reference manual about oil level. To stop overflow, switch off the main power or set a low temperature and the oil level will decrease when cooled down.
- In case of liquid spillages into holes, slots or crevices in the calibrator, attempt to wipe up the liquid as soon as possible. If the liquid is electrically conductive or corrosive, immediately power off the calibrator and contact the dealer to send in the calibrator for service.
- **Do not** attempt to remove hot liquid with the liquid drainage tube, as it might melt.
- It is vital that the stirring magnet is in place and spinning before any calibration attempts. The spinning magnet ensures optimum temperature uniformity in the oil.
- It is strongly recommended to leave the lid on during calibration. Calibration without the lid may affect the temperature stability and uniformity.
- When heated to high temperatures, the liquid bath calibrator should be placed under an exhaust hood to remove any vapors given off by the oil.

3.3 External reference sensor

The following JOFRA STS Reference sensors can be used with the varies models:

RTC^{t} -156: STS-200 A 915, STS-200 B 915
RTC^{t} -157: STS-200 A 915, STS-200 B 915
RTC^{t} -168: STS-200 A 919, STS-200 B 919
RTC^{t} -156: STS-102 A 030
RTC^{t} -157: STS-102 A 030
RTC^{t} -168: STS-102 A 035

Use the configuration software CON050 supplied with RTC^{t} to program and to update calibration information in intelligent sensors.
For instructions read the software manual for CON050 installed on the USB key.
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3.4 Symbol description

3.4.1 Status bar

STATUS indicator WARNING/ERROR symbols


The green symbol indicates that the calibrator is in a proper functional working process.


The yellow symbol indicates a warning.


The red symbol indicates an error. When the error symbol is displayed the calibration results cannot be saved.

See section 7.0 in the Reference manual for details concerning warnings and errors.

True temperature


Shows the temperature of the internal reference sensor


The freeze symbol indicates that the temperature is below 10°C/50°F.


The heat symbol indicates that the temperature has exceeded 40°C/104°F.

Stirrer activated/speed indicator (RTCt-168 only)


Indicates, when lighting up, that the stirrer is activated and the speed setting (0 – 100).

Remote Hosts


Indicates a remote connection is active

USB indicator


Indicates an USB memory stick is connected.

Wifi indicator


Indicates active Wifi connection.

Ethernet indicator


Indicates active Ethernet connection.

Screenshot function

When pressing the Screenshot symbol you can create screenshots. Can be used throughout the operation when a USB memory stick is connected. Screenshots are saved in png-format.

Real time clock and date display

Shows the present time and date

3.4.2 Navigation bar

Open Menu

Go back

Start operation

Stop operation

Pause operation

Previous step

Next step

Delete

Save results

Save as

Test results

External Reference/
DLC information

Open folder/ Open file

Save results on USB drive

Next page/screen

Enter manual readings

3.4.3 Screen Configuration

Graph.
Shows/hides temperature graph.

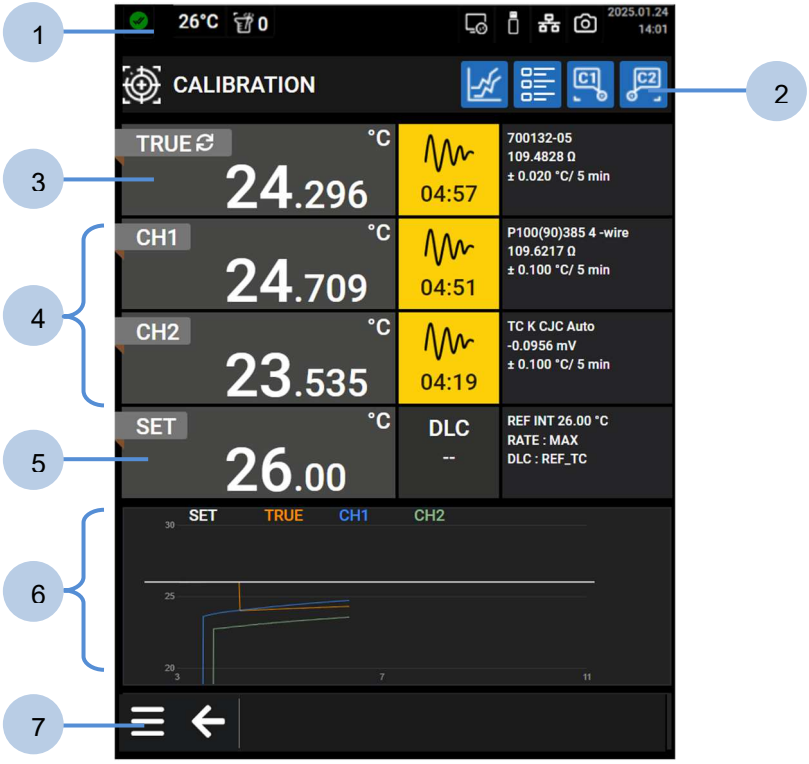
Information fields.
When activated the information fields are not visible

Chanel 1 information field.
When activated the Chanel 1 information field is not visible

Chanel 2 information field.
When activated the Chanel 2 information field is not visible

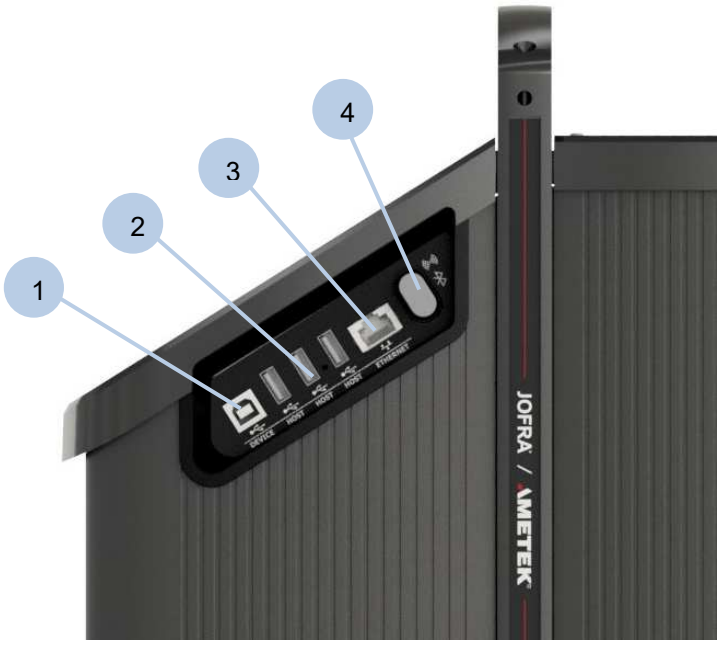
3.5 Calibration screen display

The screen gives an overview of the calibrator status and reads out the most relevant readings.



Pos.	Description
1	**Status bar**: Is always visible and informs you of the current status
2	**Screen Configuration**: The screen layout can be configurated when activated. When activated the symbols appear blue and when deactivated the symbols appear black. See section 3.4.3 for description.
3	**TRUE temperature reading**: Displays the current reading of the internal reference sensor / external reference sensor with stability indicator displaying the status of the TRUE Temperature stability and information about the selected TRUE reference sensor. If the SET follows TRUE function is activated the symbol will be displayed in this field.
4	**Channel 1 / Channel 2**: Displays the temperature measured by the SUT (Sensor Under Test) connected to CH1/CH2 with stability indicator displaying the status of the Sensor Under Test and TRUE sensor stability and information about the CH1/CH2 (type of selected sensor, measured value and stability setting).
5	**SET Temperature and DLC indicator**: Displays the numeric value of the current SET target temperature selected. If active, the measured temperature uniformity in the insert is displayed through the Dynamic Load Compensation (DLC) indicator and the internal reference temperature selected slope rate and DLC serial number are also displayed.
6	**Graph indicator**: Displays the temperature or stability of TRUE, CH1 and CH2. See section 4.3.5 in the Reference manual 130787.
7	**Navigation bar**: The relevant options that can be selected at the present point are displayed in the Navigation bar. See section 3.4.2 for description. Access to the menu can be activated throughout the entire calibration. The menu can be switched on and off in all stages of operating the calibrator.

3.6 Input/Output Connections



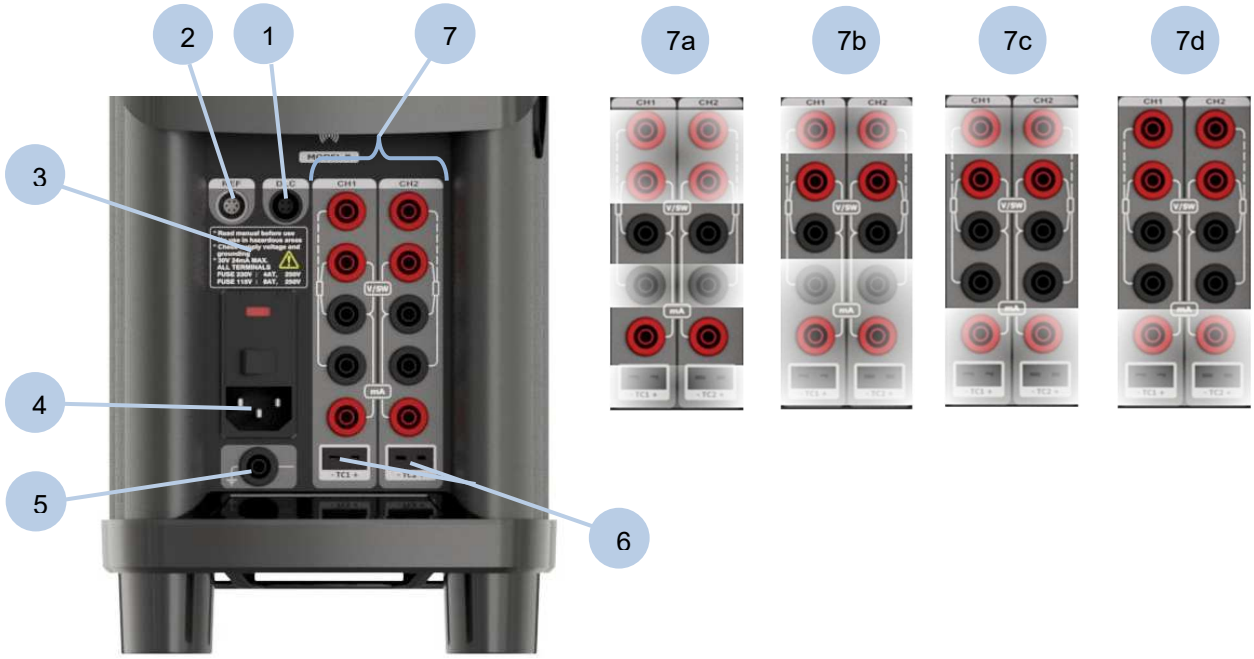
Pos.	Description
1	**Device**: USB 2.0 Device Port, 1 x USB B
2	**Host**: USB 2.0 Host Port, 3 x USB A
3	**Ethernet**: Ethernet port 10/100/1000 base-T, RJ45
4	**Wifi slot**: Connection for optional Wifi module

3.7 Input sections (B and C models only)

Warning

The input terminals must **NEVER** be connected to voltages exceeding 30V with reference to ground.

This image shows the RTC^t – B-model.



Pos.	Description
1	Input for DLC sensor (B and C models)
2	Input for external reference sensor (B and C models)
3	Label indicating fuse value (all models)
4	Power control switch with cable connection and on/off switch. It also contains the main fuse (all models)
5	Connection to chassis (earth/ground) (B-model)
6	TC connection for thermocouples (B-model)
7	Chanel 1 and Chanel 2 - Connection for Sensor Under Test (B-model) **Note** that this connection is for voltage free switches
7a	mA input
7b	Input for Voltage, Switch and RTD sensor (2 wire)
7c	Input for RTD sensor (3-wire)
7d	Input for RTD sensor (4 wire)

One of the inputs, either pos**. 1, 7a, b, c or d** can be selected displaying the “SENSOR” temperature in the Setup and pos. **5** can be displayed as “TRUE” temperature.

Note…

Only the sensor type, which is to be tested, should be connected to the input panel.

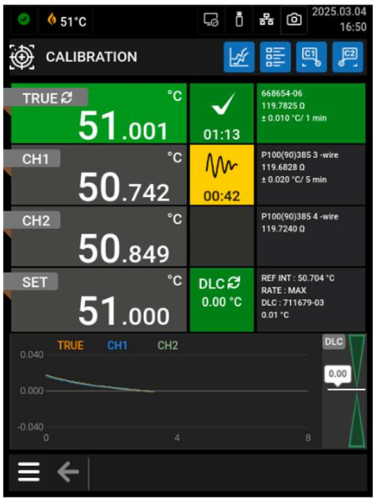
3.8 Stability of temperature values

The stability of the TRUE and SENSOR temperatures is indicated by the following messages:

- 
"No check for stability": If Convert to Temperature or Use Stability Criteria is disabled in Sensor Setup, there will be no check for stability.
- 
"Not stable": Indicates that the measured temperature is not yet within the specified stability criteria.
- 

Indicates "Time to stable": The temperature changes are within the specified stability criteria (see section 10.0 in the Reference manual 130787) and states a time (in minutes and seconds) when the stable situation can be achieved.
- 

Indicates that the “stable” situation is achieved and states the time (in hours, minutes and seconds) for how long the “stable” situation has been achieved.



The tolerance of the DLC temperature reading is indicated by the following messages:

- 

"No check for DLC Tolerance": Indicates that stability check for DLC is not enabled.
- 

"Outside DLC Tolerance": Indicates that the reading from DLC is not yet within the specified tolerance.
- 

Indicates that reading from DLC is within the specified DLC Tolerance and “stable” situation is achieved.

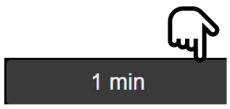
4.0 Operating the Calibrator

Warning **Caution…**

Please inspect the Safety Instructions in section 2.0 before using the instrument.

You can carry out, monitor and analyze your calibrations operating directly on the instrument or through a web browser interface from anywhere in your facility or remotely.

All the operational functions can be easily accessed through the Menu screen.

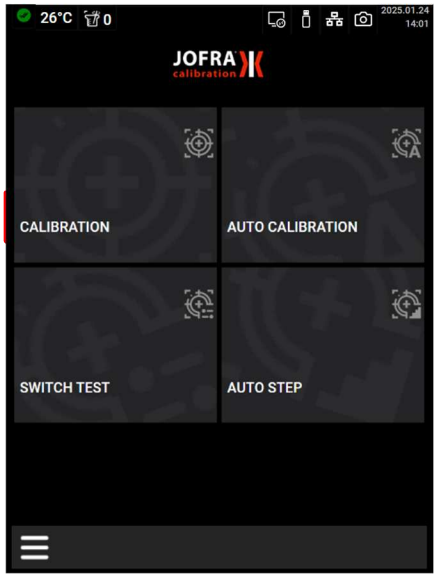
All editable fields are accessed by pressing the actual field 

When operating – no matter where you are – the “Open Menu” key and the “Back” key will always be available to you.

At some points, when operating the calibrator, some choices are not relevant and will therefore be shaded.

4.1 Starting the calibrator

Switch on the calibrator using the power control switch (pos. 4, page 23). A start up screen is displayed and then replaced with the Welcome menu screen:



Select the function of your choice by pressing the image of the function on the screen.
For example, for calibration press the function “Calibration”.

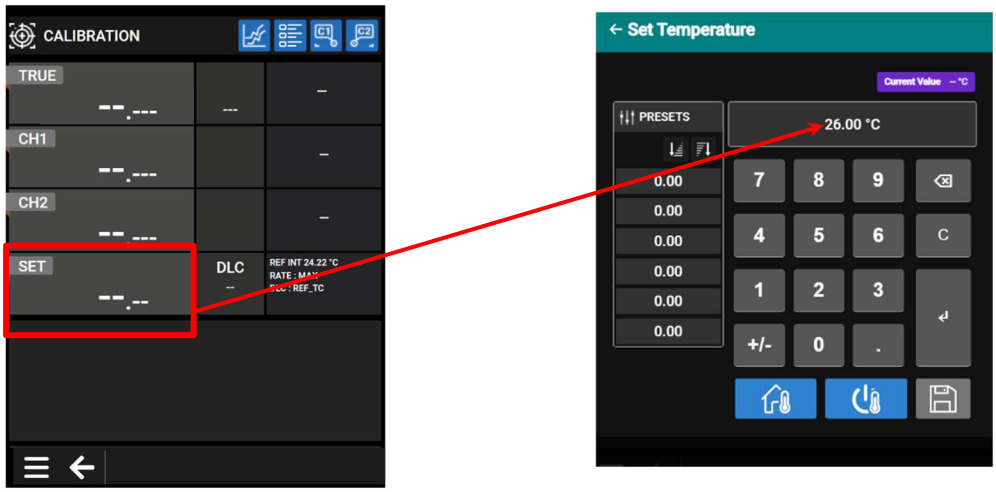
Once activated the Welcome Screen will not be displayed again, and all operational options are selected using the Menu Screen.

4.2 CALIBRATION

This function enables you to perform manual calibrations of different temperature sensors.

4.2.1 Setting the temperature

1. Press the SET field on the Calibration screen and a Set Temperature function is displayed.



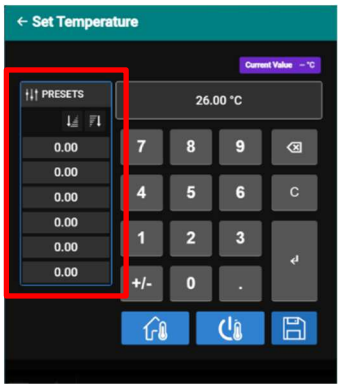
2. Use the numeric keys to enter a new value or choose one of the preset values from the PRESETS list. Press ↵ to accept the value and the calibrator returns to the CALIBRATION screen.
3. Press to start the Prepare for Storage function. When started, the calibrator will continue to the storage temperature defined in the Temperature Setup menu and switch off temperature control. If Dehumidify has been enabled, the calibrator will heat to 105°C/221°F before going to the storage temperature.
4. Press to switch off the temperature controller. The temperature controller will remain off until a new SET-temperature is entered or Auto Step/Switch Test/Auto Calibration is started.

   Through this Calibration screen, a new set point value can be entered at any stage of the operation **except when one of the automatic functions are active.**

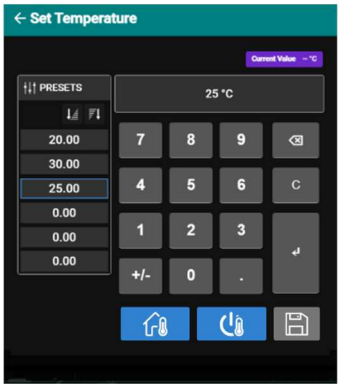
4.2.1.1 Saving the temperature as a Preset temperature

The temperature can be saved as a Preset temperature making it available through a PRESETS list for your later choice.

1. Use the numeric keys to enter a new value.
2. Press the “Save” key . The key and the box around the PRESETS list will turn blue making the PRESETS list editable for storage of the new temperature.



3. Press one of the fields in the list to store your new temperature. The  "Save" key will turn grey.
You can choose any field in the PRESETS list also the ones with already predefined temperatures. The existing predefined temperature will be replaced by the new temperature, and this is now saved for future use.



It is not possible to delete the temperatures from the PRESETS list.
You can only define up to 6 Preset temperatures.

The temperatures can be sorted on the PRESETS list placing either the lowest temperature or the highest temperature at the top of the list.

Press  for Low ➔ High.

Press  for High ➔ Low.

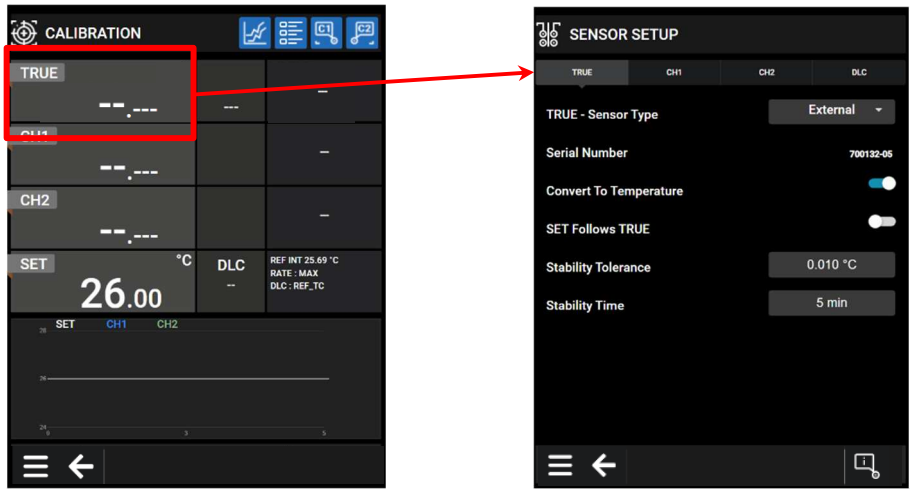
4. Press  to accept the value and the calibrator returns to the CALIBRATION screen.

4.2.2 Setting the TRUE parameters

Internal reference source.
The calibrator has a set of internal stability criteria it shall meet before stability is indicated. Additional stability time may be set beyond the internal stability criteria.

External reference source
The TRUE value on the Calibration screen will be read from the Intelligent Reference Sensor connected to the REF. INPUT on the front panel (see section 3.7 pos. 2, page 23). The calibrator automatically reads the calibration data and serial number of the Sensor.

1. Press TRUE to access the SENSOR SETUP menu. The sensor setup can also be edited immediately before running the Auto Step or the Switch Test.



2. Choose your sensor type – External or Internal – from the dropdown list.
3. **Internal** : Set the additional stability time by touching the “0 min” field and type the requested stability time using the numeric keys.

   Stability time is set (in minutes) using integers from 1 – 99.

   External : Slide the Convert To Temperature button to the right making the stability fields visible.

   - When activated the readout of the external reference is set as a temperature.
   - When not activated the readout of the external reference is set in Ω values.

4. The SET Follows TRUE function enables you to reach the TRUE temperature measured by the External reference sensor. Activate the function by sliding the button to the right.

Note...

that when the function is active, the calibrator will control the temperature to the TRUE temperature. This means that it could take longer time before the calibrator indicates stability.

The SET follows TRUE function is indicated with the symbol at the TRUE reading on the Calibration screen. TRUE

Note...

SET follows TRUE is only available when the External reference sensor is displayed in temperature units.

5. Set the stability tolerance and the stability time using the numeric keys.

   Stability tolerance can be set down to ±0.001°. The tolerance should be set low enough to utilize the good temperature stability of the calibrator – however a low value also gives a longer time to be stable.

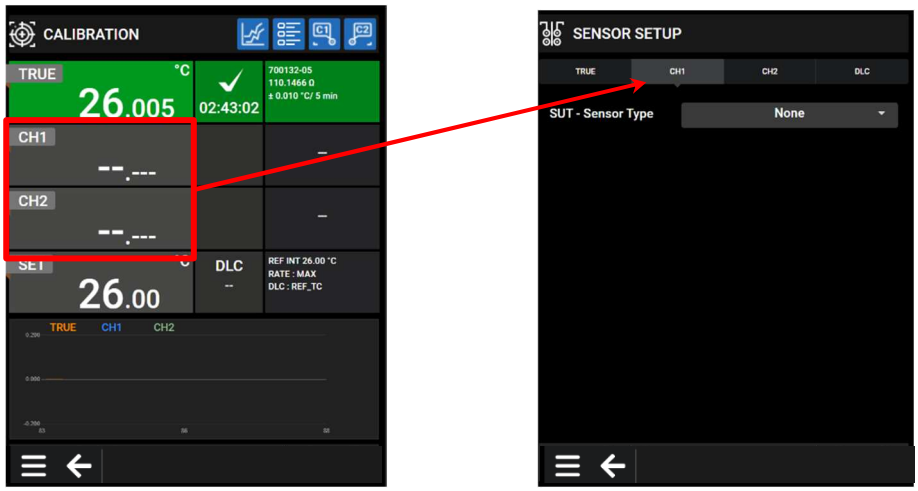
   Stability time is set (in minutes) using integers from 1 – 99.

   When the TRUE temperature has reached the specified Stability tolerance during the specified Stability time, then the stability indicator on the Calibration screen will turn green.

6. Press “Information” in the Navigation bar to get access to a Reference Information screen showing the calibration data of the Intelligent Reference sensor.

4.2.3 Setting the CH1 and CH2 (Channel 1 and 2) parameters

1. Press CH1 or CH2 either on the CALIBRATION screen or in the SENSOR SETUP menu.



SUT - Sensor type:

2. Choose between :
   - Thermocouple Sensors (μV)
   - Voltage Sensors (V)
   - Current Sensors (ma)
   - RTD Sensors (resistance temp. detector (Ω))
   - None (no sensor connected)
3. Select a sensor.

   The selected sensor and its list of parameters are now displayed. The various settings can be edited as described in the following :

4. **Convert to temperature:**
   (using thermocouple, voltage, current and RTD)
   - When activated – the inputs are converted to temperatures.
   - When not activated – no conversion is made.
     When the function is not activated the type of model is the only other parameter which can be altered.

5. **Model:**
   (using thermocouple and RTD)

   Toggle between the models; K, N, R, S, T, U, B, L, E and J (thermocouple) or P10(90)385, P100(90)385, P100(90)392, P1000(90)385, P200(90)385, P50(90)385, P500(90)385, Pt-100 MILL, P100(90)391, P50(90)391, YSI-400, H120(90)672, M100(90)428, M50(90)428-06, M100(90)428 and M50(90)428 (RTD).

6. **Cold junction compensation:**
   (using thermocouple)
   - “Auto” – when the automatic mode is selected, the calibrator measures the temperature in the TC connector and uses this for the cold junction compensation of the thermocouple.
   - “Manual” – to define a manual temperature for cold junction compensation. Can be used when an external cold junction temperature can be established.

7. **Cold junction temperature:**
   (using thermocouple)

   When “Manual” Cold junction compensation has been selected, the temperature for cold junction can be set using the NUMERIC keys.

8. **Voltage (V) and temperature (T) span:**
   (using voltage)

   The minimum and the maximum of the voltage and the corresponding temperature span can be set here.

   Use the NUMERIC keys to set the value of the voltage and/or the temperature.

9. **Current (I) and temperature (T) span:**
   (using current)

   The minimum and the maximum of the current and the corresponding temperature span can be set here.

   Use the NUMERIC keys to set the value of the current and/or the temperature.

10. **Number of wires:**
    (using RTD)

    The number of wires used for the sensor under test can be selected here.

    Choose between 2, 3 or 4 wires.

11. **Use stability criteria:**
    (using thermocouple, voltage, current and RTD)

    Beside the stability check on the Reference sensor, it is also possible to ensure that the Sensor Under Test (SUT Sensor) is stable before the temperature is indicated as stable.

    - When activated – Stability will be checked on both Reference sensor (TRUE) temperature and Sensor Under Test (SUT Sensor) temperature.
    - When not activated – Stability will be checked on Reference sensor (TRUE) temperature only.

12. **Stability tolerance:**
    (using thermocouple, voltage, current and RTD)

    Enter the Stability tolerance (temperature) by pressing the NUMERIC keys.

    The Stability tolerance can be set down to ±0.001° however the expected performance of the Sensor Under Test should be considered before setting the tolerance.

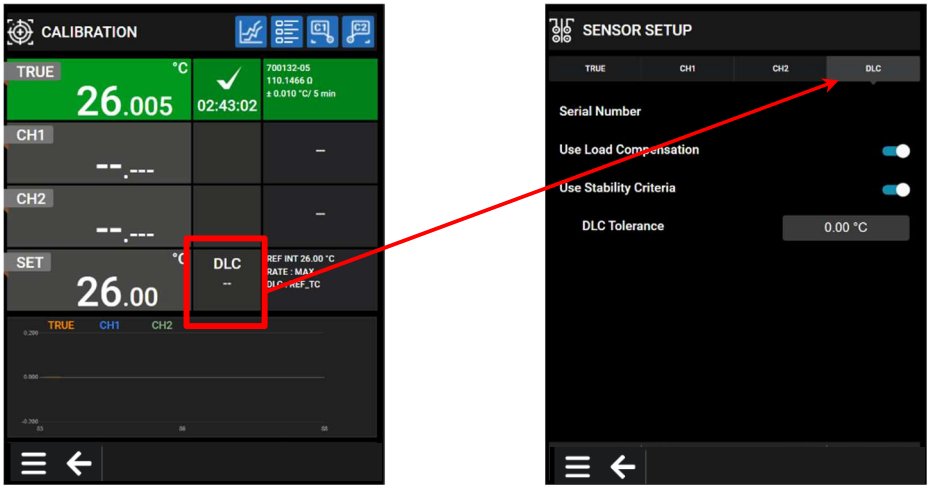
13. **Stability time:**
    (using thermocouple, voltage, current and RTD)

    Set the Stability time by pressing the NUMERIC keys. Stability time can be set from 1 – 99 minutes.

    When the SENSOR temperature has reached the specified Stability tolerance during the specified Stability time, then the stability indicator on the Calibration screen will turn green.

4.2.4 Setting the DLC parameters

1. Press DLC either on the CALIBRATION screen or in the SENSOR SETUP menu.



The DLC value on the Calibration screen will be read from the Intelligent Load Sensor as soon as it is connected to the DLC INPUT on the front panel (see section 3.7, pos. 1, page 23). The calibrator automatically reads the calibration data and serial number of the Sensor.

However, if the Dynamic Load Compensation shall be active, it must be enabled.

2. **Use load compensation:**

The active “DLC” function is indicated with the symbol at the DLC reading on the Calibration screen.

Note...

always use external reference sensor when calibrating with the DLC-function activated for specified accuracy.

3. **Use stability criteria:**

Beside the stability check on the Reference sensor, it is also possible to ensure that the Sensor Under Test (SUT Sensor) is stable before the temperature is indicated as stable.

- When activated – Stability will be checked on both Reference sensor (TRUE) temperature and Sensor Under Test (SUT Sensor) temperature.
- When not activated – Stability will be checked on Reference sensor (TRUE) temperature only.

4. **DLC tolerance:**

Enter the DLC tolerance (temperature) by pressing the NUMERIC keys.

The DLC tolerance can be set down to ±0.01° however the expected performance of the Sensor Under Test should be considered before setting the tolerance. To ensure a stable temperature the DLC Tolerance must be observed.

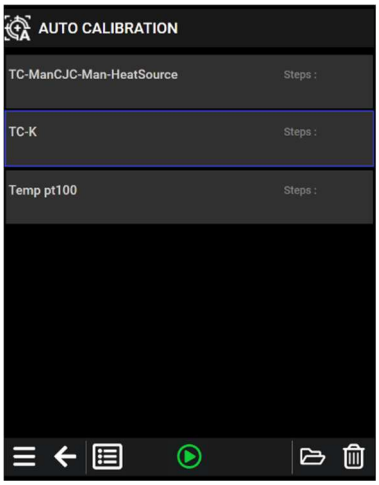
When the SET DLC value is met the DLC -- indicator turns green DLC 0.00 °C.

4.3 AUTO CALIBRATION

Note…
This Calibration function is for B models only.

This function enables you to perform automatic calibrations of different temperature sensors. The calibration procedure is semi-automatic, using parameters and settings, which are defined in workorders. These workorders are created and edited using the "JOFRACAL" PC program. Multiple calibrations can be performed using the same workorder settings.

1. Access the AUTO CALIBRATION menu from the Menu screen.



   A Workorder List is displayed.

2. Choose a workorder and run the selected workorder by pressing “Start” . A new calibration is started.

   You can also choose to activate:

   - (View) – shows the setting of the workorder.
   - (Results) - shows the previous calibration results from this workorder.
   - (Delete) - deletes the workorder setting and the results.

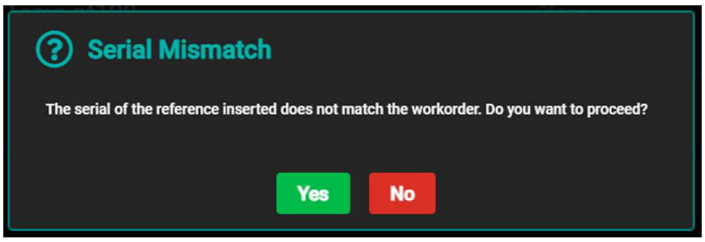
   For operating the Results menu see section 4.3.3.
   For operating the View menu see section 4.3.4.
   For operating the Delete function see section 4.3.5.

Note…
Calibration information is available in several places throughout the calibration menus. The content of this information is described in section 4.3.4.

4.3.1 Running a calibration

1. To run the calibration, press “Start” .

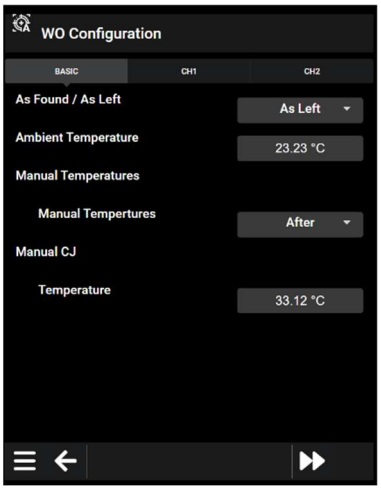
   If the serial number of the reference sensor used for calibration does not match the one specified in the workorder the following message is displayed :



If you proceed, the connected reference sensor will be documented along with the results.

If you do not wish this message to appear, the correct reference sensor must be specified when the workorder is edited using the “JOFRACAL” PC program.

2. Press **Yes** and the Work Order Configuration setup menu is displayed.



Before the actual calibration begins several BASIC, CH1 and CH2 parameters are available for editing:

BASIC:

- **As Found/As Left** - choose between calibration As Found or As Left
- **Ambient Temperature** - set/edit the Ambient Temperature.
- **Manual Temperatures** – choose between Manual Temperatures After and During calibration
- **Manual CJ (Cold Junction)** - The temperature for Cold Junction can be set manually using the NUMERIC keys.

CH1/CH2:

- **ID** – identification of the SUT sensor connected under test.
- **Serial No** - the serial number of the sensor can be edited.
- **LOC 1 – LOC 3** - use the NUMERIC keys to type in your choice of wording necessary to explain where your sensors are located in your facility.

Note…

If the sensor under test is a thermocouple sensor and the manual compensation mode is selected in work orders, a cold junction temperature must be defined.

Note…

The BACK key cancels a selection/edit and returns to the previous menu.

3. Press  “Next page” to proceed with the operation.

A Connection Guide is displayed, giving a graphical display of the setup and sensor connections.

4. Start the calibration by pressing  “Start”.

5. The Calibration Running step 1 of 2 is started and the temperature is heading towards step 1.

   The following screen is displayed :

6. When the temperature has reached the stable criteria, the calibration data will be stored, and the temperature goes towards the next set temperature.

Note…

The calibration can be stopped at any time by pressing  “Stop”, but this will erase the calibration results.

During calibration several other functions are available:

-  (Results) - To view the calibration results (no editing is possible).
-  (Pause) - To pause the calibration.
-  (Prev) - Force the calibration to jump a step backwards to the previous calibration screen regardless of the calibration stability.

- (Next) - Force the calibration to jump a step forward to the next calibration screen regardless of the calibration stability. This will leave the current step without saving calibration results

7. When the calibration has completed a green check ✓ is shown on the screen and the Calibration Result follows quickly hereafter.
8. Press “Results” to access the AUTO CALIBRATION RESULT screen.

   If the calibration has been forced to jump a step forward a blue arrow will be displayed in the Status column.

   If the calibration is still in progress an hourglass will be displayed in the Status column.

   If the calibration is out of tolerance a read cross will be displayed in the Status column.

9. Press “Save” to store the results in the calibrator

   or

10. press “Delete” and press “Yes” to delete the calibration results or “No” to return to the AUTO CALIBRATION RESULT screen.

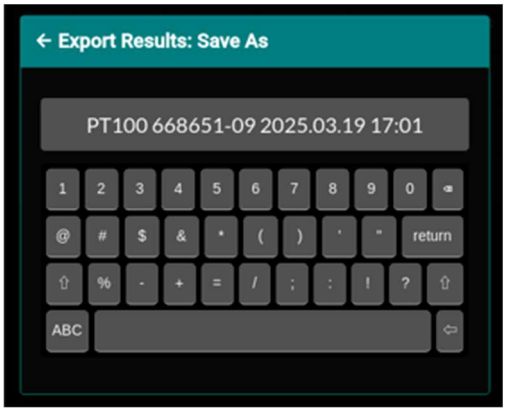
    A full Auto Calibration Result List can be viewed using the instructions in section 4.3.3

4.3.2 Saving calibration results

It is possible to export Auto Calibration results in csv-format to a USB-memory stick.

It is possible to use the export function immediately after the Auto Calibration is completed and the result is saved if the result has not been deleted from the calibrator memory.

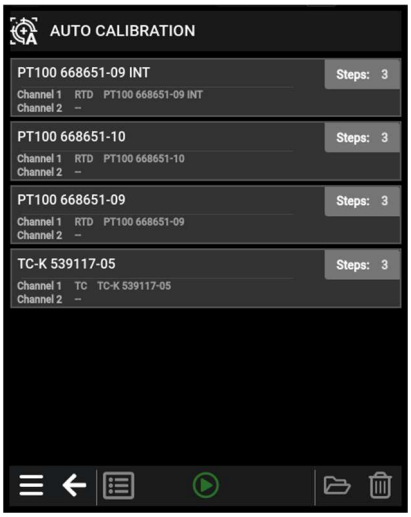
1. To export immediately after the Auto Calibration is completed, press .
2. Insert a USB memory stick and press .
3. It is now possible to enter the filename.



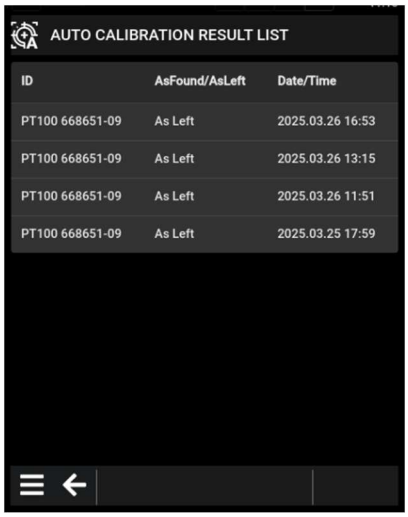
To export the result later, see Section 4.3.3 - Viewing calibration results.

4.3.3 Viewing calibration results

1. Select one of the Auto Calibrations available

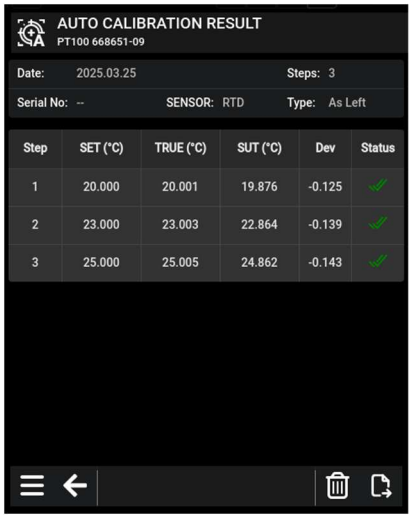


2. Access the AUTO CALIBRATION RESULT LIST by pressing  “Results” on the AUTO CALIBRATION screen.



A full Auto Calibration Result List is displayed

3. Select a workorder to be displayed showing the calibration details for the specific workorder.



The calibration results can be uploaded with the “JOFRACAL” PC program. This enables you to print out the results on a certificate.

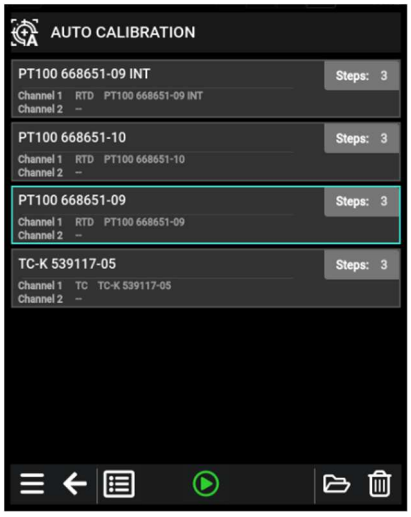
4. Press  “Export” if you wish to save the results on a USB drive.

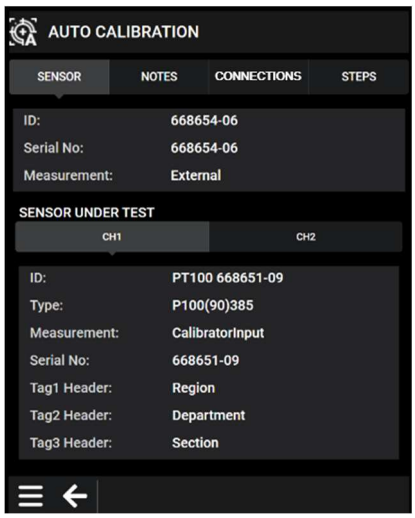
5. Press  “Back” to exit the AUTO CALIBRATION RESULT LIST and return to the AUTO CALIBRATION screen. Press  “Back” again to return to the CALIBRATION screen.

4.3.4 Displaying calibration information

Calibration information is defined within the workorders created on the PC using "JOFRACAL".

1. Choose a workorder from the AUTO CALIBRATION menu and press  “Open” to access the workorders sensor menu.

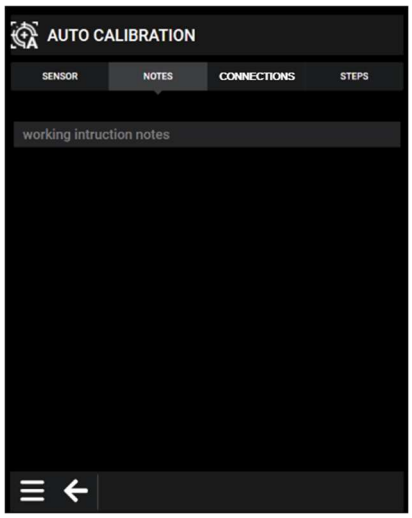




An AUTO CALIBRATION screen showing the workorder sensor setup is displayed.

This screen gives you an overview of the workorder sensor setup including a summary of Notes, Scenario and Steps. Each of these can be displayed in detail.

2. Press “NOTES” to access the NOTES function.



A list of working instruction notes is displayed.

The notes are information entered via the PC program, when the workorder is created.

3. Press “CONNECTIONS” to access the CONNECTION GUIDE function.

A workorder connection is displayed.

The calibration set up is shown in a graphic format, and the active sensor input is marked. The parameters for this setup are defined in the work order created using the PC program.

4. Press “STEPS” to access the STEPS function.

A list of Temperature Steps is displayed.

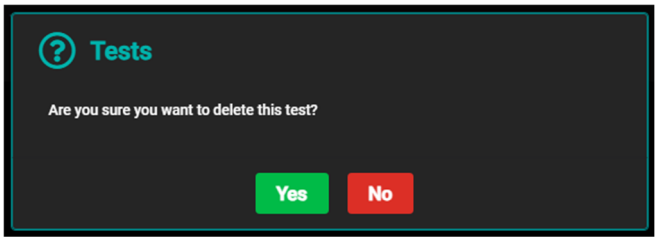
This function shows the pre-defined temperature steps for the calibration.

5. Press “Back” to exit the STEPS function and return to the AUTO CALIBRATION screen.

4.3.5 Deleting workorders

It is possible to delete a workorder using the Delete function from the AUTO CALIBRATION screen.

1. Press “Delete” to delete the test.



2. Press “Yes” if you want to delete your workorders and “No” if you want to exit the Delete function without deleting anything.

Warning

If you choose to delete a workorder, the whole workorder including the calibration results will be deleted.

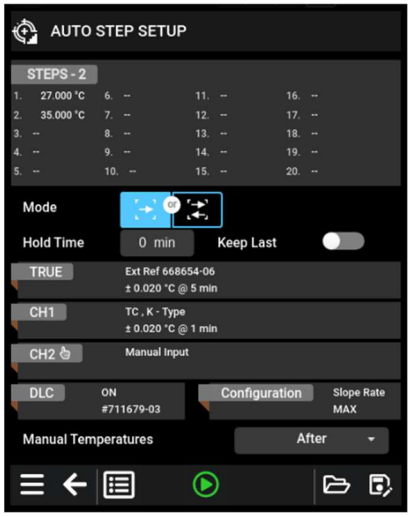
3. Press “Back” or “Menu” to exit the AUTO CALIBRATION function.

4.4 AUTO STEP SETUP

Auto step is used to step automatically between a range of different calibration temperatures.

4.4.1 Running an Auto Step Calibration

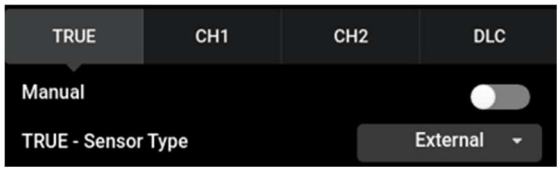
1. Access the AUTO STEP SETUP menu from the Menu screen.



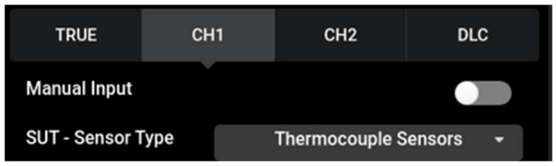
   The AUTO STEP SETUP menu is displayed.

2. Access the AUTO STEP SETUP parameters to edit:

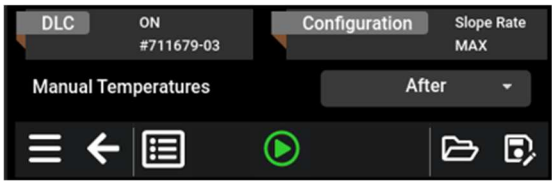
   - **No of steps** - the number of temperature steps per direction (T_1➔T_x) can be set using integers from 1 – 20. When a Two-way mode is selected, the same number of steps are used for the second direction (T_x➔T_1).
   - **Mode** - toggle between “One-way” and “Two-way” .
   - **HOLD time** - defines the time (in minutes) the temperature is maintained (after it is stable) for each step.
   - **Keep Last** – if activated the calibrator will maintain the temperatures last step. If disabled, the calibrator will proceed to Storage Temperature when the Auto Step is completed.
   - **TRUE** - the TRUE setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 4.2.2 – Setting the TRUE parameters. When running Auto Step, Manual input of TRUE temperature can be selected.



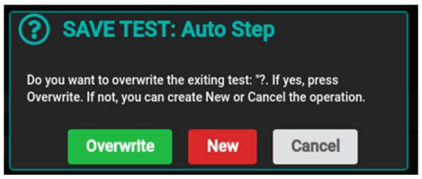
   - **CH 1/CH2** - the CH1/CH2 setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 4.2.3 – Setting the CH1 and CH2 (Channel 1 and 2) parameters. When running Auto Step, Manual input of temperature can be selected for CH1 and CH2.



- **DLC** - the DLC setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 4.2.4 – Setting the DLC parameters.
- **Configuration** - access the TEMPERATURE SETUP menu to edit the TEMPERATURE parameters and/or configurate the Silent Mode, the Max Speed and the Slope Rate.
- **Manual Temperatures** – If TRUE, CH1 or CH2 is set to Manual, it can be selected to enter results for each step during the calibration “During” or results for all steps when the calibration is completed “After”.



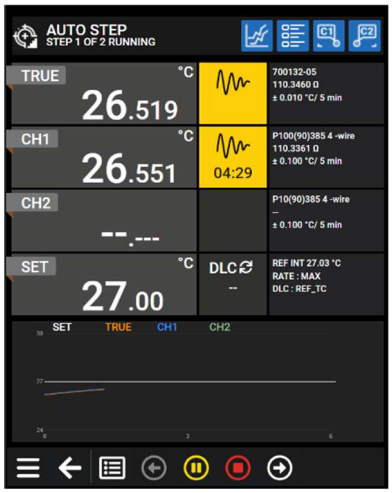
3. If you wish to save the Auto Step Setup, press the “Save as” key in the Navigation bar. If the Auto Step Setup is modified from previously saved setup, you will have the option to overwrite or create new.



4. Press “Open” to view/open saved Auto Step Setup’s.

5. When the parameters have been set press to start the AUTO STEP Calibration, and a CONNECTION screen is displayed showing the active sensor input marked.

6. Press to start the actual Auto Step calibration.



An AUTO STEP RUNNING step screen is displayed.

7. While the step test is in progress, the TRUE, CH1, CH2, DLC and Configuration Setups are available for Read Only.

   In the Navigation Bar the following functions are available. Press :

    to review the AUTO STEP RESULT (no editing is possible).

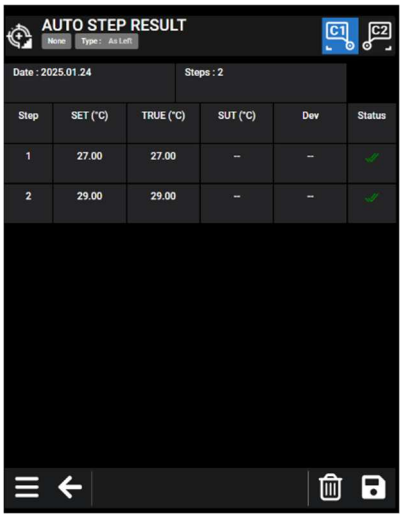
    to stop the Auto Step test.

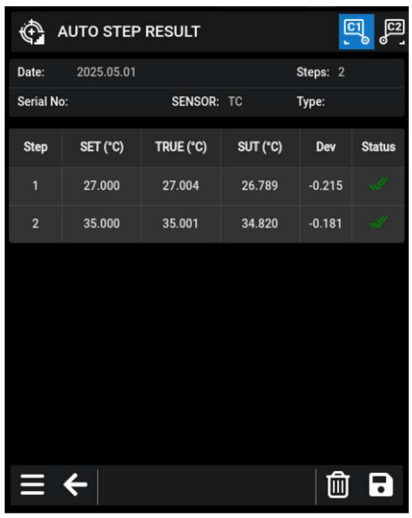
    to pause the test. The test will not continue to next running step.

    to force the test to jump a step backwards to the previous running step regardless of the step's stability.

    to force the test to jump a step forward to the next running step regardless of the step's stability.

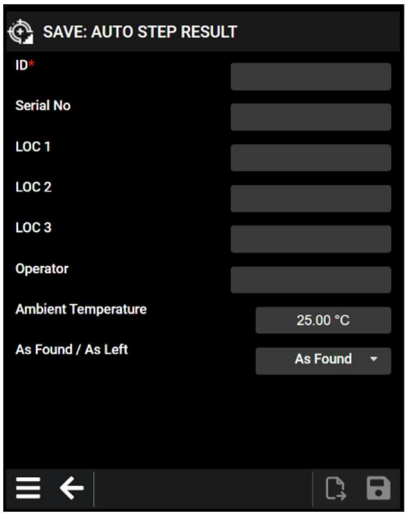
   When the Auto Step test is complete the results are displayed.





8. Press  "Save" to save the results storing them in the calibrator's memory.

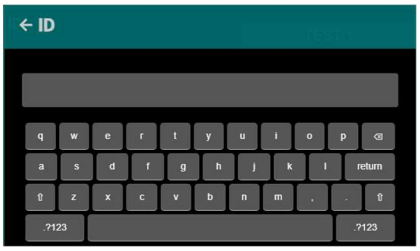
A SAVE: AUTO STEP RESULT setup menu is displayed.



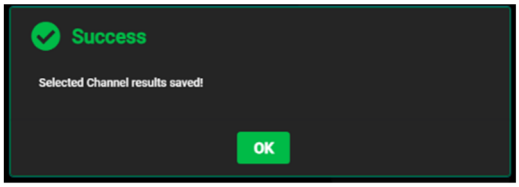
9. The following parameters are available for editing:

- **ID** – identification of the SUT sensor connected under test.
- **Serial No** - the serial number of the sensor can be edited.
- **LOC 1 – LOC 3** - use the NUMERIC keys to type in your choice of wording necessary to explain where your sensors are located in your facility.
- **Operator** – identification of the person operating the instrument.
- **Ambient Temperature** - set/edit the Ambient Temperature.
- **As Found/As Left** - choose between calibration As Found or As Left.

10. Press the grey fields in the setup and use the numeric keys to enter a value of your own choice.



11. Press  "Save" and a check-box is displayed confirming that the results are saved.



12. When pressing "OK" you return to the AUTO STEP RESULT screen.

    For external saving, connect a USB drive to the calibrator and press  "Export" to save the results on the USB drive.

13. Press  "Delete" to delete the results from the screen.

The calibrator then returns to the AUTO STEP SETUP menu.

Note…

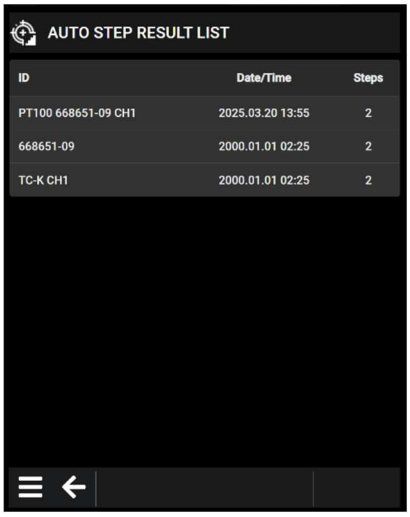
The BACK key returns you to previous the menu. The BACK key can be used throughout the process.

4.4.2 AUTO STEP test results

At the end of an Auto Step test the results are displayed and stored in the calibrators memory. The measured TRUE and SENSOR temperatures for each step are displayed.

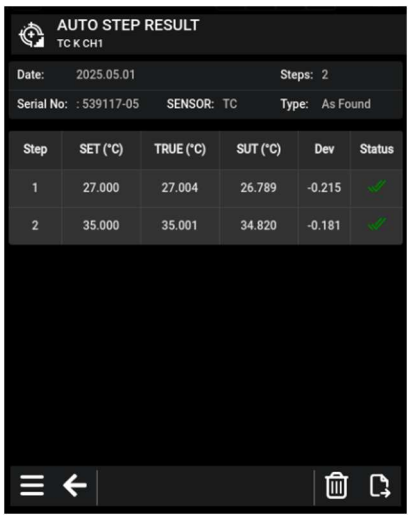
To view stored AUTO STEP test results

1. Access the AUTO STEP RESULT LIST by pressing "Results" in the Navigation Bar on the AUTO STEP SETUP screen.



The AUTO STEP RESULT LIST is displayed.

2. Select an Auto Step Result to be displayed by pressing on the line of the job.



3. Press "Back" twice to return to the AUTO STEP SETUP menu.

The memory can hold 50 Auto Step Results.

4.5 SWITCH TEST SETUP

Note…

This SWITCH TEST function is for B models only.

Switch test automatically locates the switch temperatures of a thermostat.

Three parameters are required:

- Start temperature (T_1)
- End temperature (T_2)
- Rate of change in temperature (slope rate).

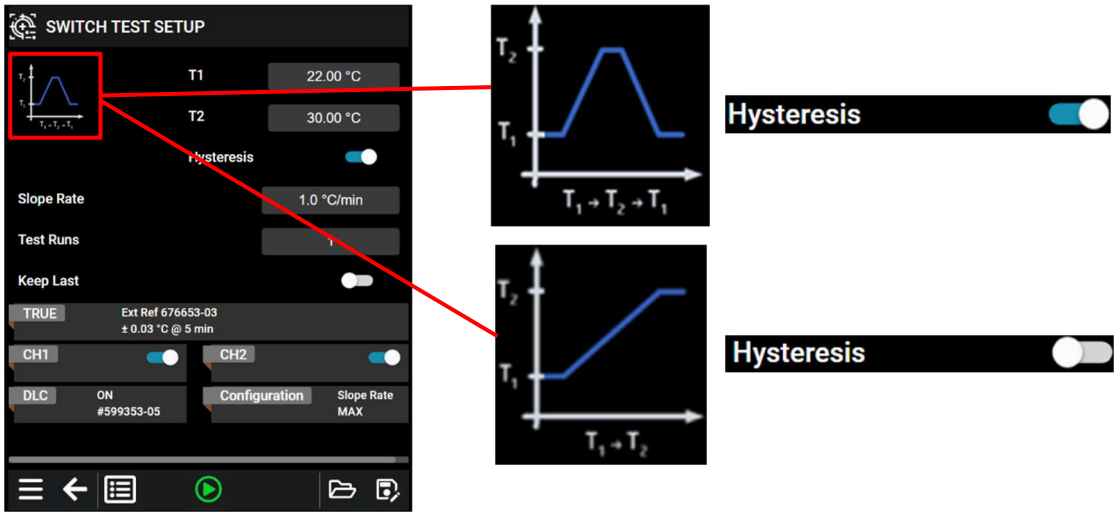
Hysteresis of a thermostat can also be determined here. Where the hysteresis determines the tolerance between the upper switch temperature and the lower switch temperature of the thermostat.

4.5.1 Running a switch test

Note…

Temperature range is limited by Min. SET Temp. and Max. SET Temp. settings are editable in the TEMPERATURE SETUP menu (see section 4.6) and by the temperature range of the external reference sensor, if connected.

Access the SWITCH TEST SETUP menu from the Menu screen.



1. A SWITCH TEST SETUP menu is displayed.

   The small graph illustrates the current T_1, T_2 and hysteresis selections. Note that T_1 can be greater than T_2.

2. Access the setup fields to edit the parameters:

   - **T1** - first set temperature
   - **T2** - second set temperature
   - **Hysteresis** - to determine hysteresis, slide the Hysteresis button to the right activating the Hysteresis parameter. When activated a two-way-temperature measurement is set and when not activated a one-way-temperature measurement is set.

- **Slope rate** – sets the slope rate used between T1 and T2. The permitted range is 0.1 - 9.9°C/min. / 0.2 - 17.8°F/min.
- **Test Runs** – can be set from 1 to 3 making it possible to run the test more than once.
- **Keep Last** – if activated the calibrator will maintain the temperatures last step. If disabled, the calibrator will proceed to Storage Temperature when the Switch Test is completed.
- **TRUE** - the TRUE setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 4.2.2 – Setting the TRUE parameters.
- **CH 1/CH2** - the CH1/CH2 can be enabled or disabled by sliding the buttons to the right activating the CH1/CH2. When activated the CH1/CH2 are enabled. When not activated the CH1/CH2 are disabled.
- **DLC** - the DLC setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 4.2.4 – Setting the DLC parameters.
- **Configuration** - access the TEMPERATURE SETUP menu section 4.6 to edit the TEMPERATURE parameters.

Note…

the slope rate should be set so that the thermostat sensor can follow the temperature in the calibrator's well.

3. When the parameters have been set press  to start the Switch Test and a CONNECTION screen is displayed showing the active sensor input marked. The parameters for this setup are defined in the work order created using the PC program.

4. Press  to start the actual Switch Test.

A SWITCH TEST RUNNING step screen is displayed.

5. While the Step Test is in progress, the TRUE, CH1, CH2, DLC and Configuration Setups are available for Read Only.

In the Navigation Bar the following functions are available. Press :

 to review the SWITCH TEST STEP RESULT (no editing is possible).

 to stop the Switch Test.

 to pause the test. The test will not continue to next running step.

 to force the test to jump a step backwards to the previous running step regardless of the step's stability.

 to force the test to jump a step forward to the next running step regardless of the step's stability.

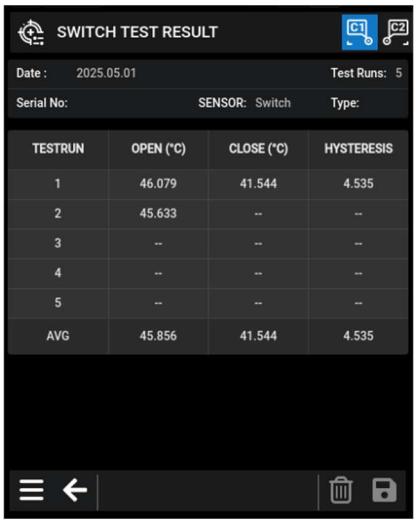
4.5.2 Showing Switch Test Results

Two types of Switch Test Results are available:

- Results during a switch test.
- Results of a finished switch test.

Results during a switch test

1. Access the SWITCH TEST RESULT list by pressing  "Result " from the SWITCH TEST Navigation bar.

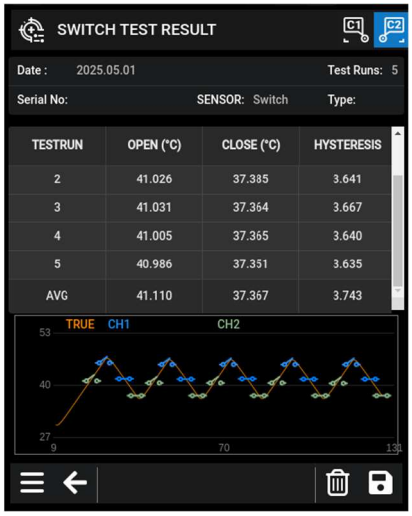


2. This shows the results that are currently available. These results change as the test progresses.

   Press  “Back” to return to the switch test.

Finished Switch Test Results

At the end of a switch test the results are displayed. These show the temperature when the thermostat has closed and the temperature when it has opened – whichever comes first. The difference between these 2 temperatures is calculated as the hysteresis.

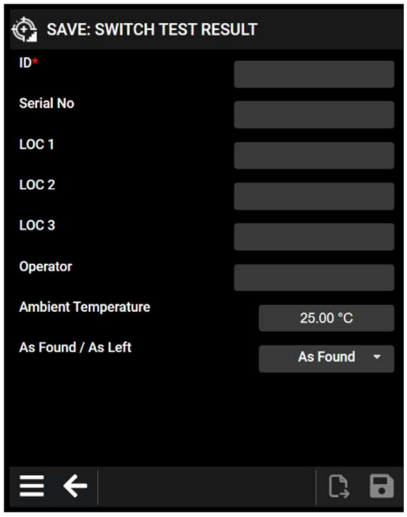


1. Press  “Save” to save the results storing them in the calibrator’s memory.

Note...

A hysteresis result is only measured when hysteresis is set to “Yes”.

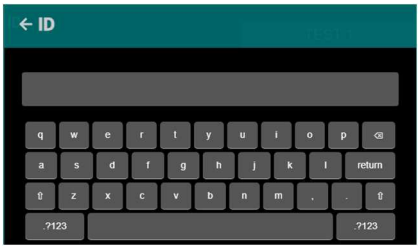
A SAVE: SWITCH TEST RESULT setup menu is displayed.



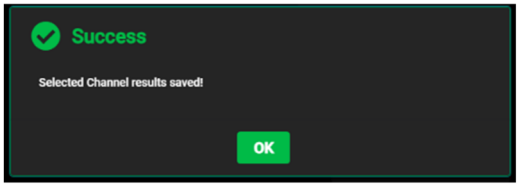
2. The following parameters are available for editing:

- **ID** – identification of the SUT sensor connected under test.
- **Serial No** - the serial number of the sensor can be edited.
- **LOC 1 – LOC 3** - use the NUMERIC keys to type in your choice of wording necessary to explain where your sensors are located in your facility.
- **Operator** – identification of the person operating the instrument.
- **Ambient Temperature** - set/edit the Ambient Temperature.
- **As Found/As Left** - choose between calibration As Found or As Left.

3. Press the grey fields in the setup and use the numeric keys to enter a value of your own choice.



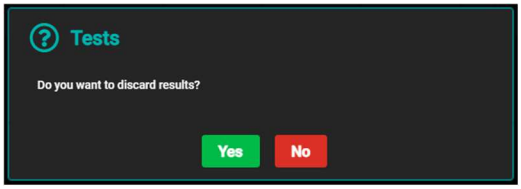
4. Press  "Save" and a check-box is displayed confirming that the results are saved.



5. When pressing "OK" you return to the SWITCH TEST RESULT screen.

   For external saving, connect a USB drive to the calibrator and press  "Export" to save the results on the USB drive.

6. Press  "Delete" to delete the results from the screen.



The calibrator then returns to the SWITCH TEST SETUP menu.

Note…

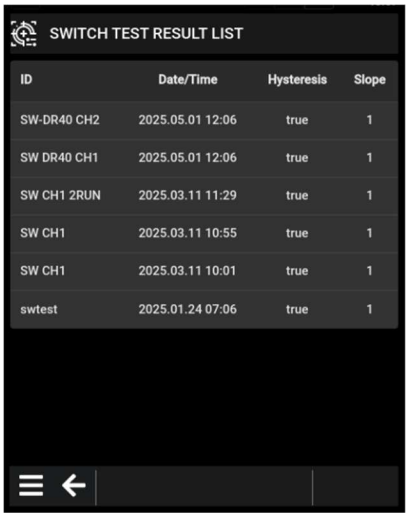
The BACK key returns you to previous the menu. The BACK key can be used throughout the process.

If no change in the switch position is registered during the test, the test will stop and show the Switch Test Result screen

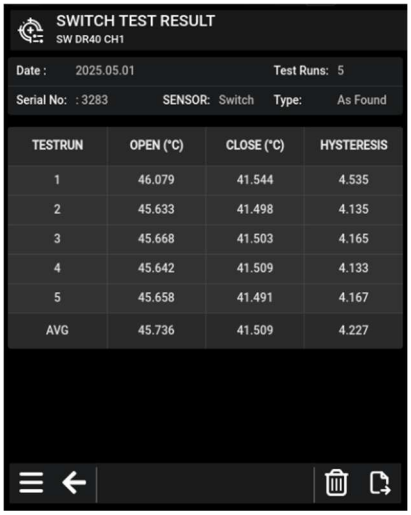
7. Delete the result by pressing “Delete” or save the result by pressing “Save”.

To view stored Switch Test Results

1. Access the Switch Test Result List by pressing “Result” from the Switch Test Setup menu.



2. Select a test result to be displayed.

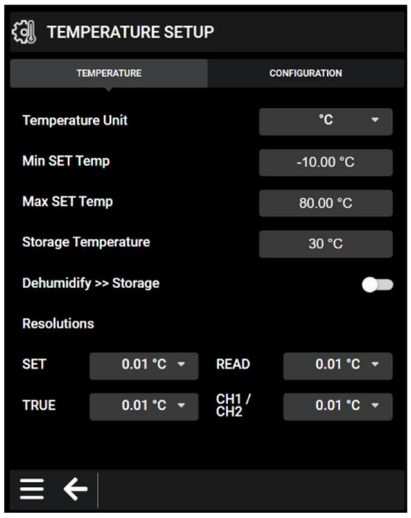


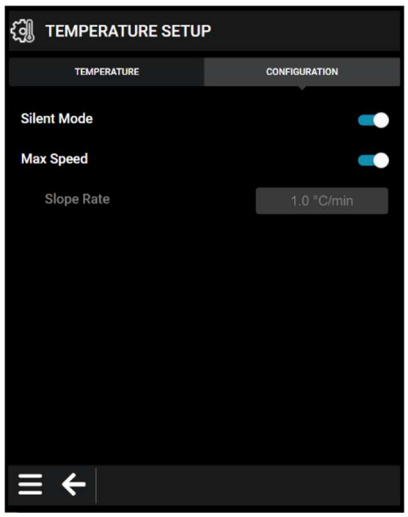
3. Press twice to return to the Switch Test Setup menu.

The memory can hold 50 SwitchTest Results.

4.6 TEMPERATURE CONFIGURATION menu

1. Access the TEMPERATURE CONFIGURATION menu from the Menu screen.





A TEMPERATURE SETUP menu is displayed.

The TEMPERATURE SETUP can also be accessed when working with AUTO STEP and SWITCH TEST.

You can choose between TEMPERATURE parameters and CONFIGURATION parameters.

4.6.1 Setting the Temperature parameters

1. **Temperature unit:**

   Choose between:

   - °C (Celsius)
   - °F (Fahrenheit)
   - K (Kelvin)

2. **Min SET Temp / Max SET Temp:**

   Use the NUMERIC keys to set the Min/Max SET temperature in Celsius, Fahrenheit or Kelvin.

3. **Storage Temperature:**

   Use the NUMERIC keys to set the Storage Temperature in Celsius, Fahrenheit or Kelvin.

4. **Dehumidify >> Storage:**

   Slide the button to the right to activate the Dehumidify >> Storage function.

   - When activated the Prepare for Storage function will heat to 105°C/221°F before proceeding to storage temperature.
   - When not activated the Prepare for Storage will go directly to storage temperature.

4.6.2 Setting the Temperature Resolutions

1. Choose between:
   - SET
   - READ
   - TRUE
   - CH1/CH2

2. Choose between the resolutions:
   - 1
   - 0.1
   - 0.01
   - 0.001

4.6.3 Setting the Configuration parameters (noise, speed)

1. **Silent Mode:**

   Slide the button to the right to activate the Silent Mode.

   - When activated the fan operates in a silent mode reducing the noise. Using this option the cooling process is working at a reduced speed.
   - When not activated the fan operates in a fast mode giving the best performance of cooling.

2. **Max Speed:**

   Slide the button to the right to activate the Max Speed.

   - When activated the calibrator will heat/cool at fastest speed and Slope Rate will be in Read Only mode.
   - When not activated the calibrator will heat/cool with the rate defined by Slope Rate. Slope Rate can be edited using the NUMERIC keys.

4.7 Selecting the stirrer speed (RTC^t -168 A/B/C only)

1. The Set Stirrer Speed can be accessed from all the functions through the Status Bar.

   Press the Stirrer Speed symbol in the Status Bar 

2. Use the NUMERIC keys to enter a value.

   Select a speed setting between 0 and 100.
   The normal setting is between 30 and 40.

Note…

When using the RTC^t -168 A/B/C with a dry block kit the stirrer speed must be set to 0.

The DLC will be disabled when the stirrer is started.

3. Press  to accept the value.

   The selected speed setting is now visible in the Status Bar 

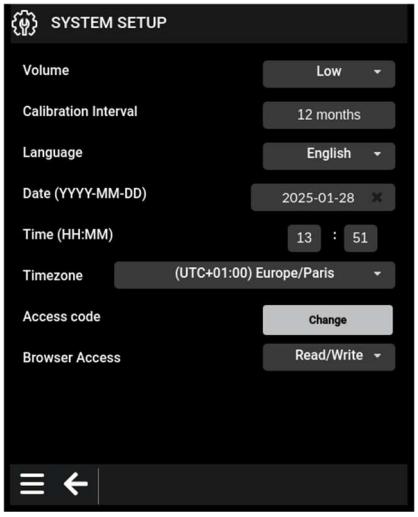
Caution...

If the speed level chosen is too high, the magnet will fall off making a rattling sound and there will be no stirring in the liquid. With no stirring of the liquid, temperature gradients will emerge in the bath, which will again affect the result of the calibration.

To reconnect the magnet, set the speed level to 0 and select a speed setting lower than the previous.

4.8 SYSTEM SETUP menu

1. Access the SYSTEM SETUP menu from the Menu screen.



A SYSTEM SETUP menu is displayed.

4.8.1 Setting the Volume, Calibration Interval and Language parameters

1. **Volume:**

   The volume of the sound can be adjusted choosing between:

   - Off
   - Low
   - Medium
   - High

2. **Calibration Interval:**

   Set the required recalibration interval for the calibrator using the NUMERIC keys. Choose a value between 1 month and 999 months.

   When the recalibration interval is exceeded, a warning will be displayed at Power on and the warning symbol will appear on the screen.

Note...

The recalibration interval is not used for the external reference sensor and the DLC. The interval for these sensors is stored in the intelligent sensor.

3. **Selecting a language:**

   Select the required language from the list of installed languages (depends on region).

   When selected the calibrator will restart with the selected language.

4.8.2 Setting the Date, Time and Time zone parameters

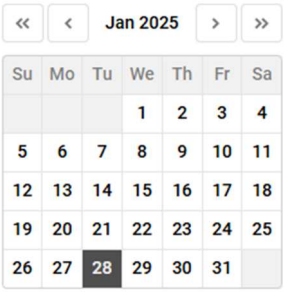
Date:

The calibrator is set up with a default date (present date).

1. Change the date by pressing the Date field on the screen 

and a calendar appears.

2. Choose a date from the calendar. When selected the date will appear in the date field.



3. When restarting the calibrator, the present date will be the default date.
The date can be deleted by pressing the ✖ in the date field.

Time:

The calibrator is set up with a default time (present time).

4. Change the time by pressing the Hour and Minute fields on the screen 

Use the NUMERIC keys to type in the new time.

Time zone:

5. Select the relevant time zone from a list of various zones by pressing the Time zone field 

When restarting the calibrator, the selected time zone will be the default time zone.

When connected to the network through ethernet or Wi-Fi, date and time will be synchronized.

4.8.3 Setting the Access Code

1. The following features can be protected by an access code:
   - Resetting the calibrator to Factory default settings
   - Setting the Min/Max SET Temperature
   - Setting calibration interval
   - Editing the Access Code while it is enabled

2. To set an access code, press the Change field on the screen 

3. Use the NUMERIC keys to type in a value from 0000 to 9999. Use all 4 digits.
Typing 000 disables the Access Code function.
When the access code is accepted a green check  will be visible for a few seconds allowing you to continue.

Note...

If you choose to let your access code consist of only 1, 2 or 3 digits you must enter the access code with 0 followed by the chosen value to get the requested 4 digits.

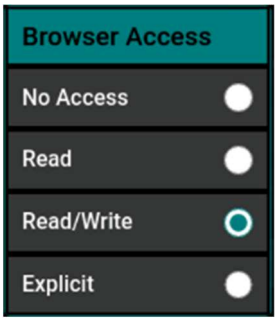
The access code can be deleted allowing you to change the Min/Max SET temperature without having to enter the access code.

1. Use the NUMERIC keys to type in your access code.
2. Delete the access code. No new value is typed.
3. Accept the new empty setting.
   It is now possible to access the editor without using the access code.

4.8.4 Setting the Browser Access

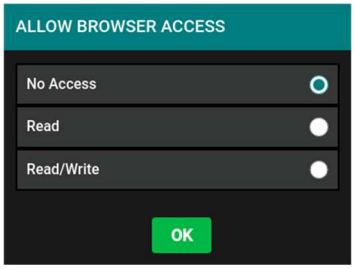
The Browser Access can only be used operating directly from the calibrator and is controlling remote access to the calibrator. It is not possible to access this function when working remote.

1. Access the Browser Access by pressing the setting field on the screen.



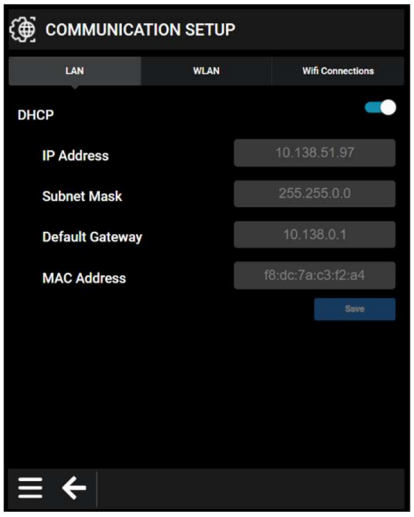
   A Browser Access list is displayed.

2. Choose between :
   - **No Access** – Remote operation is not allowed.
   - **Read** – Remote read only access is allowed.
   - **Read/Write** – Remote operation is allowed. The remote host can access parameters and change them.
   - **Explicit** – Access privileges can be granted to remote hosts by the user of the calibrator whilst operating the calibrator. See section 4.9.6 for Remote Access Privileges



4.9 COMMUNICATION SETUP

1. Access the COMMUNICATION SETUP menu from the Menu screen.



The COMMUNICATION SETUP menu is displayed.

4.9.1 Setting LAN

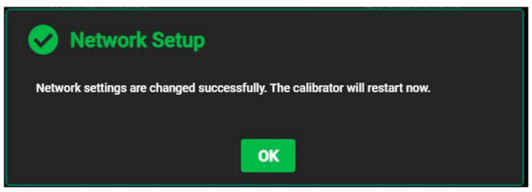
The LAN and WLAN are set up in DHCP (Dynamic Host Configuration Protocol) mode as default.

1. Slide the DHCP button to the left to get editable access to the LAN parameters:
   - **IP Address**
   - **Subnet Mask**
   - **Default Gateway**
   - **MAC Address**
2. You can configure the LAN-settings manually using the NUMERIC keys

   When editing the IP Address, the Subnet Mask and the Default Gateway you need to type in 4 sets of digits with a full stop between them using digits from 0 to 255.

3. When the DHCP button is in active mode, the IP address will be updated when leaving the COMMUNICATION SETUP menu.
4. Press 

“Save” when the parameters have been edited and the calibrator will restart.



4.9.2 Setting WLAN

In addition to current IP address and subnet mask of the wireless network interface, the corresponding MAC (hardware) address is displayed.

1. With the DHCP button active  the network DHCP server will decide a vacant IP address and default subnet mask for the calibrator's wireless network interface.
   When the DHCP button is inactive  the user will be able to choose an:
   - **IP Address**
   - **Subnet Mask**
   - **Default Gateway**
2. When connected to a wireless network, the status bar on the top of the screen will display a symbol indicating the connection status  .

4.9.3 Subnet Mask

The subnet mask defines the range of IP addresses that can communicate with each other as a sub-network. Typical values are "255.255.255.0" and "255.255.0.0". In most cases, match the subnet mask of another device on the network, or let the DHCP server apply it.

Example:
The calibrator has IP address 192.168.8.10 and subnet mask 255.255.255.0. Only devices with IP addresses in the 192.168.8.xxx range (xxx value from 0 to 254) can communicate with the calibrator.

Example:
The calibrator has IP address 172.10.20.30 with subnet mask 255.255.0.0. Devices with IP addresses in the range 172.10.xxx.yyy (xxx and yyy values each from 0 to 254) can access the calibrator.

4.9.4 Using Wifi Connections

The RTCt calibrator can communicate over Wifi 802.11ac/abgn (2.4 GHz / 5 GHz ISM bands) using an external Wifi certified USB Dongle as wireless network interface.

It is possible to connect to a Wifi network shared by a smartphone for direct access to the calibrator.

It is possible to connect to a Wifi network and a wired ethernet network at the same time. Only the IP address range specified for the particular network interface can be used for accessing the calibrator user interface. Network interfaces are not bridged.

Note...

Local approvals
A wide set of radio approvals for the USB dongle exists. Before using the dongle, confirm that the approvals cover the geographic area in which usage is intended. Using outside areas covered by the approvals may conflict with local laws and is at the user's own risk.

1. Attach the dongle in the dedicated, recessed USB connector marked with wireless symbols.

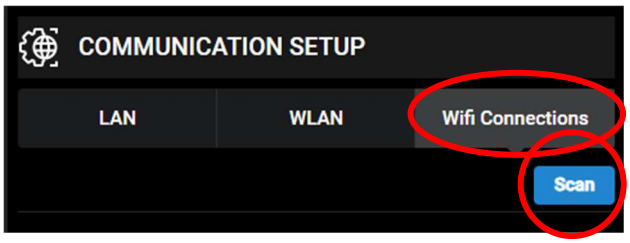
   Notice the orientation of the Wifi dongle and USB A connector. The dongle can be mounted in the connector even during storage or transport of the calibrator.

Caution…

When mounting the USB dongle in any of the USB ports marked “HOST”, the dongle will extend beyond the calibrator side, leading to a risk of mechanical stress to the dongle and/or the USB connector when storing or transporting the calibrator. Only use the designated, recessed USB connector for the USB dongle.

2. Access the Communication Setup from the Menu screen and select Wifi Connections.

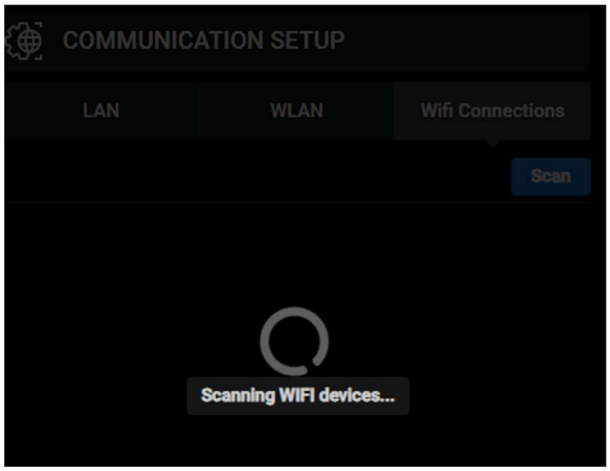
3. If no Wifi network SSIDs are listed, press Scan to list available Wifi network SSIDs.

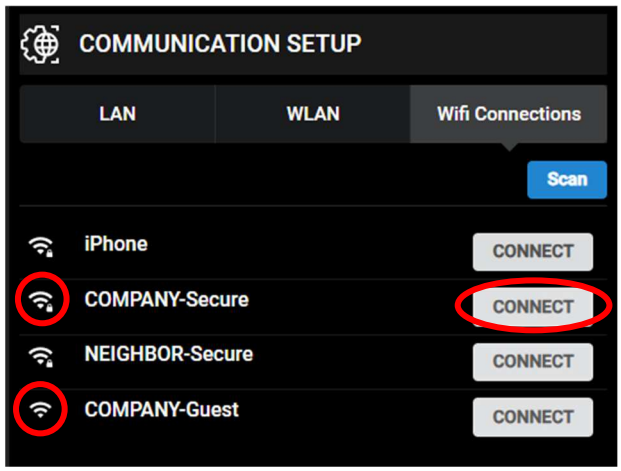


Note…

If no SSIDs are listed, first check the correct connection of the USB dongle and wait a moment for the calibrator to recognize it. If problems persist, restart the calibrator. Also ensure that at least one Wifi network is available, having adequate signal strength for the dongle to discover and communicate with the network access point.

The available Wifi networks are scanned and the discovered SSIDs are listed.





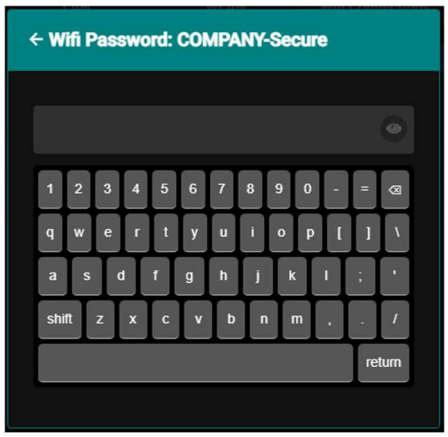
Each SSID is accompanied by a symbol, indicating the security level of the network.

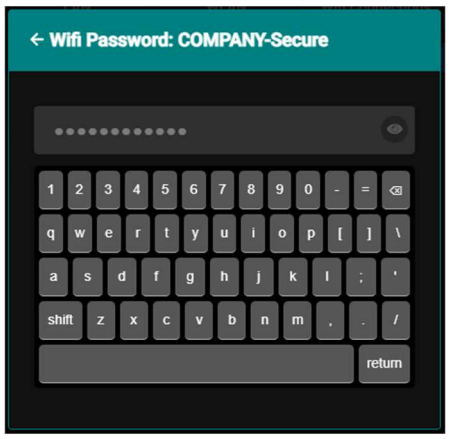
Networks protected by a password are displayed with a lock symbol .

Networks without password protection are displayed without a lock

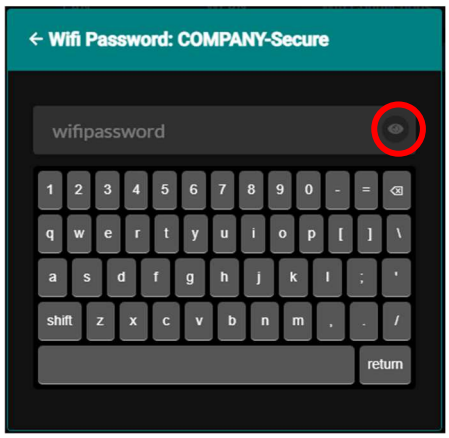
4. For the desired wireless network, press CONNECT . If the network is not password protected, the calibrator immediately connects to the network.

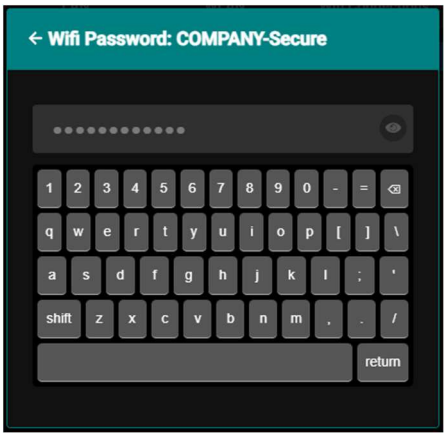
5. If the network is protected by password, a dialog appears, requesting the password. Use the NUMERIC keys to enter the password for the network. Entered characters are displayed in the password input field as dots.



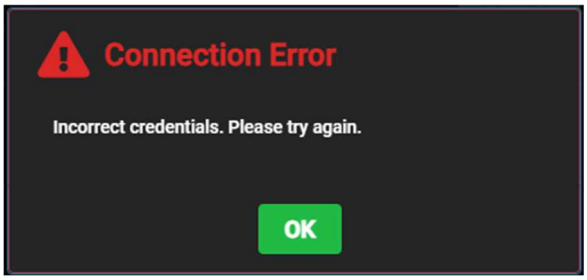


6. Press and hold the eye symbol to momentarily display the password as clean text. When released, the password characters are displayed as dots again.





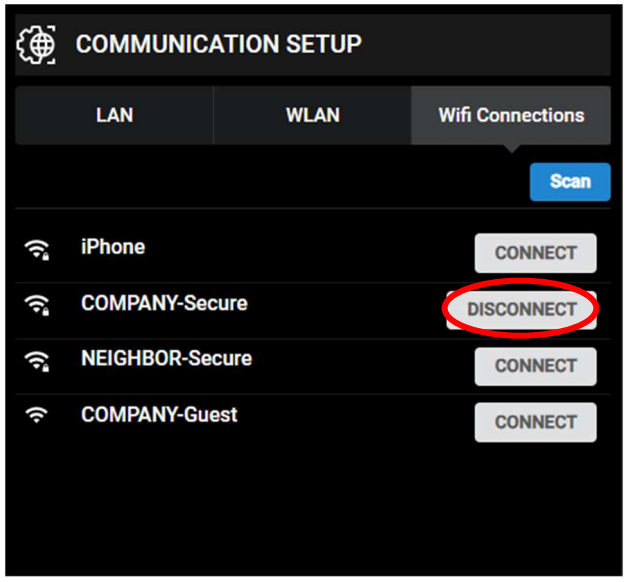
7. If the entered password is incorrect connection fails, and an error message is displayed.



8. When connection to a wireless network is established, the network address settings can be set up on the WLAN tab of the Communication Setup page. See section 4.9.2.

4.9.4.1 Disconnecting from Wifi network

1. When connection to a wireless network is established, connection can be terminated by pressing DISCONNECT in the Wifi Connections tab of the COMMUNICATION SETUP page.



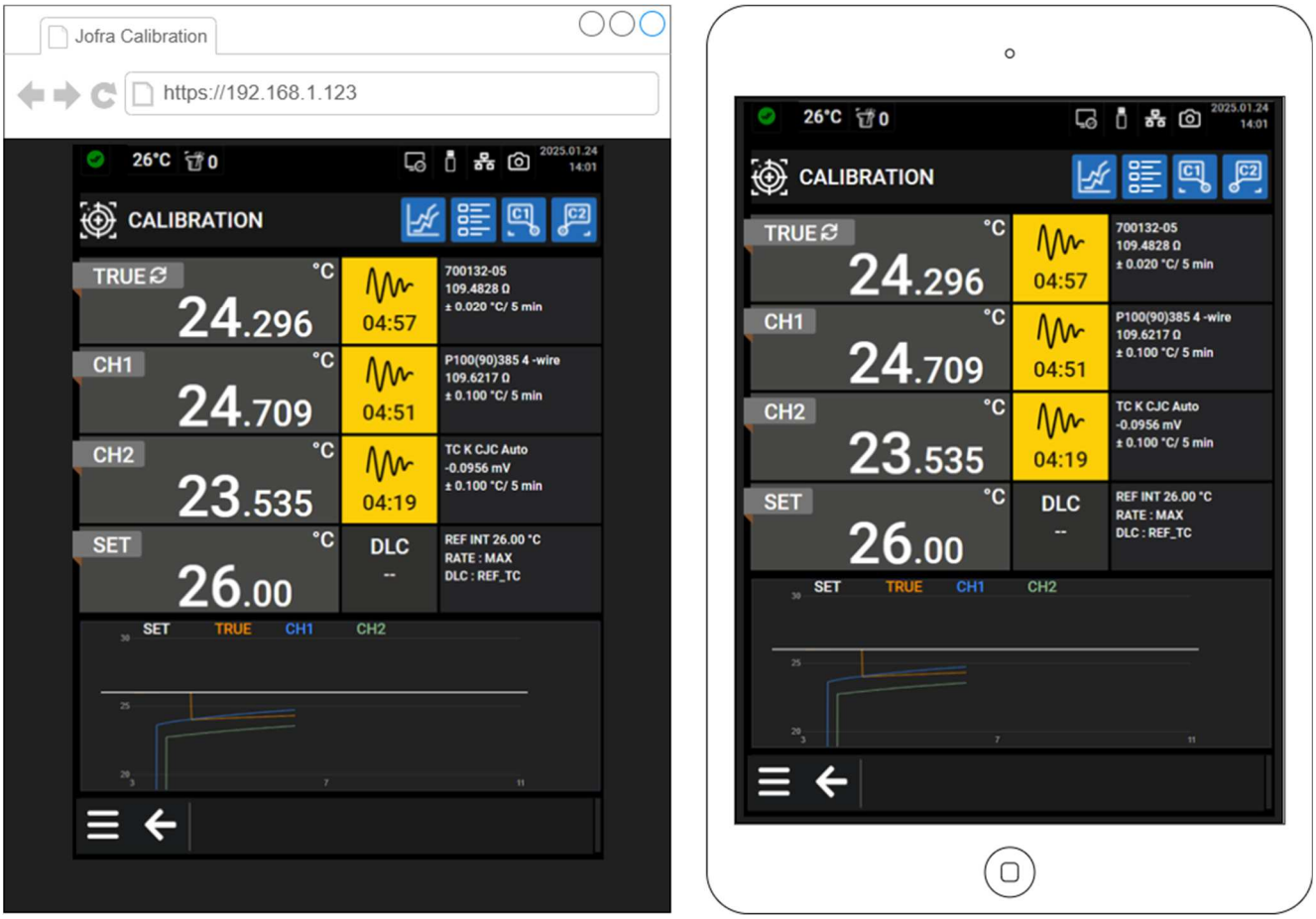
4.9.5 Remote Access

The remote user interface can be used to supervision readings and calibration progress, or manually control set temperature, run automated calibration procedures from a connected device. All system settings, temperature setup and sensor input configurations can be viewed, and if privileges are granted, edited.

When connection to a network is established and configured, the calibrator user interface can be remotely accessed from a web browser using the calibrator's IP address or a host name that resolves to the IP address.

The address syntax to access the remote web user interface is: http://IP-address.

The remote web browser user interface will display the Calibration window as default. Any active warnings and errors will be displayed on the remote interface upon logging on.



Use the computer's mouse or the device's touchscreen to press on active elements and buttons in the user interface.

When a remote device has Read/write privileges, the local user interface on the calibrator has limited functionality. System settings, temperature setup, and sensor configurations are disabled. Control can be regained by revoking Remote Access Privileges, as described in section 4.9.6 below.

The remote user interface is supported by all modern browsers (Edge, Firefox, Chrome, Safari, etc.), which has JavaScript enabled. The user interface has a native resolution of 640(h) x 480(w) pixels, which is the recommended minimum window size. Web browsers with larger viewport will scale/zoom the displayed calibrator screen accordingly.

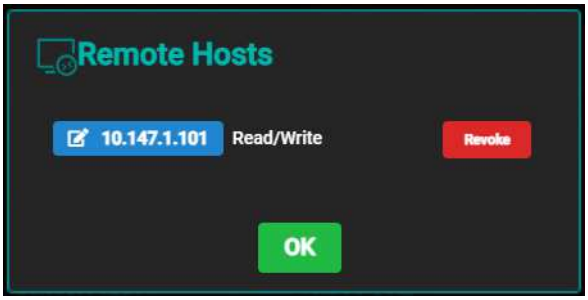
4.9.6 Remote Access Privileges

Upon connection from a remote web browser, the user interface displays a notification stating, "Remote host connected".

A list of currently connected Remote Hosts can be displayed by pressing the screen symbol in the status bar on the top of the screen.

A popup appears, listing the IP address and current privileges for the connected hosts.

Privileges can be revoked by pressing Revoke, essentially limiting the access to read-only for that particular host.



See section 4.8.4 for details on how to set up default privileges for remote hosts.

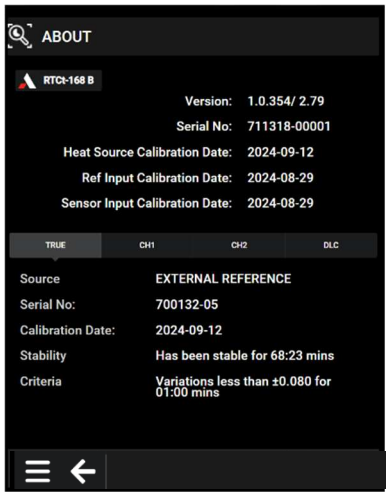
4.9.7 Remote communication API (TBD)

See RTCt Remote Communication manual.

4.10 ABOUT / STATUS

1. Information about the calibrator and the status can be viewed using the ABOUT / STATUS function.

   Access the ABOUT / STATUS function from the Menu screen.



   An ABOUT / STATUS summary about the calibrator type, the software version installed, the serial number and the date when it was last calibrated is displayed.

2. Press either the TRUE, CH1, CH2 or DLC field to get access to an ABOUT / STATUS summary of the sensors setting and stability information.

Note...

The list will be cleared, when the calibrator is switched off.

4.11 USER MANUAL / HELP

1. Access the USER MANUAL / HELP function from the Menu screen.

2. Press one of the sections to enter the requested text.

   Choose between:

   - enlarging the text
   - reducing the text
   - returning to default text size

3. When browsing through the sections you can return to the previous pages by pressing and proceed to the next page, having already been displayed by pressing .

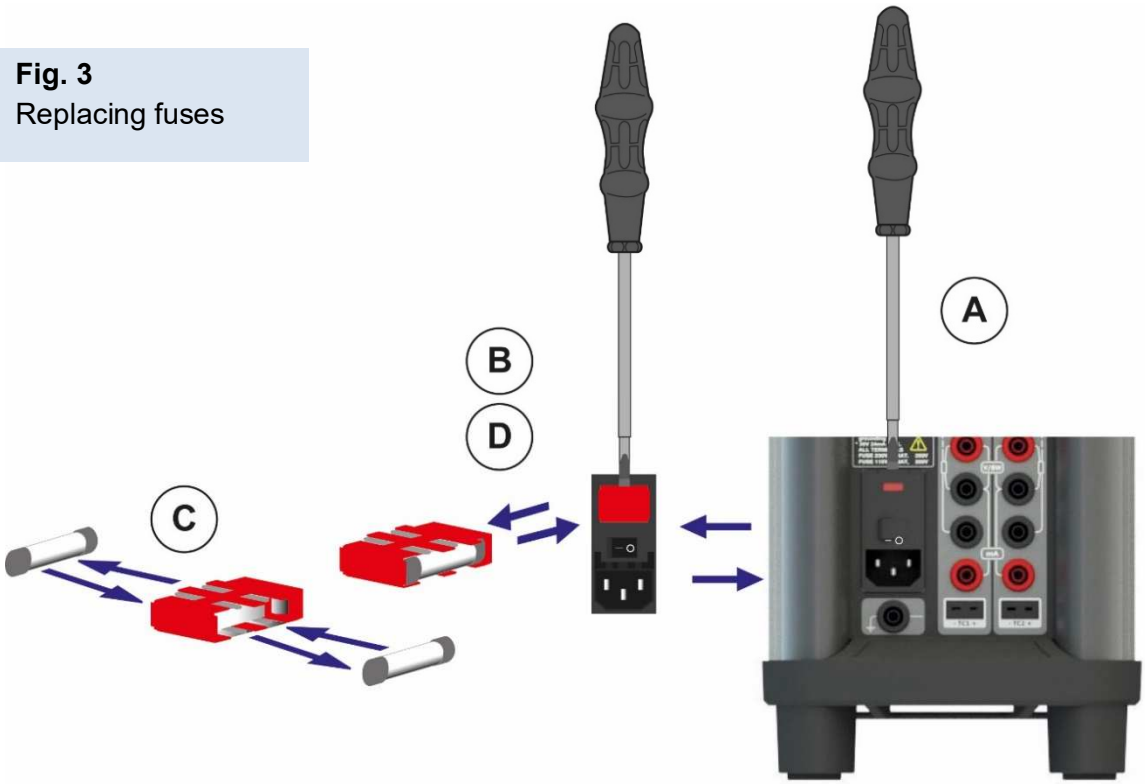
4. Press to return to the List of Contents.

5.0 Setting the mains voltage and replacing the main fuses

Warning

- The calibrator **must** be switched off before any attempt to service the instrument is made. There are no user serviceable parts inside the calibrator.
- The fuse box **must not** be removed from the power control switch until the mains cable has been disconnected.
- The two main fuses must have the specified current and voltage rating and be of the specified type. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited and may cause a hazard.

Fig. 3
Replacing fuses



A. Locate the main fuses in the fuse box in the power control switch and check the voltage of the power control switch (on/off switch (230V/115V)). If the voltage of the power control switch differs from the line voltage, you must adjust the voltage of the power control switch.

B. Open the lid of the fuse box using a screwdriver and remove the fuse box.

C. Replace the fuses. The fuses must be identical and should correspond to the line voltage.

- RTC^{t}-156/157/168: 115V/230V, F6AL = 130972

If the fuses blow immediately after you have replaced them, the calibrator should be returned to the manufacturer for service.

D. Slide the fuse box into place with the correct voltage turning upwards.

6.0 After use

6.1 Storing and transporting the calibrators

Caution…

The following guidelines should always be observed when storing and transporting the calibrator. This will ensure that the instrument and the sensor remain in good working order (all models).

Warning

- The calibrator **must** be switched off before any attempt to service the instrument is made. There are no user serviceable parts inside the calibrator.
- Remember to use appropriate protective equipment or get help when carrying the calibrator (for a longer distance) to prevent injuries from dropping the calibrator.

The following routine must be observed **before the insertion tube is** removed and the instrument switched off:

Dry-block calibrators only

Over 50°C/122°F

If the calibrator has been heated up to temperatures above 50°C/122°F, you must wait until the instrument reaches a temperature **below 50°C/122°F** before you switch it off.

Below 0°C/32°F

- **Do not** touch the well or insertion tube when these are below 0°C/32°F - they might create frostbite.
- If the calibrator has reached a temperature below 0°C/32°F, ice crystals may form on the insertion tube and on the well. This, in turn, may cause the material surfaces to oxidize.
  To prevent this from happening, the insertion tube and the well must be dried. This is done by heating up the calibrator to min. 100°C/212°F until all water left has evaporated.
  Remove the insulation plug while heating up.
  It is very important that humidity in the well and insertion tube is removed to prevent corrosion and frost expansion damages.

1. Switch off the calibrator using the power control switch.

   Note that the calibration procedure may be interrupted at any time using the power control switch. Switching off the calibrator during the calibration process will not damage either the instrument or the sensor.

2. Remove the insertion tube from the calibrator using the tool for insertion tube supplied with the instrument as shown in fig. 4.

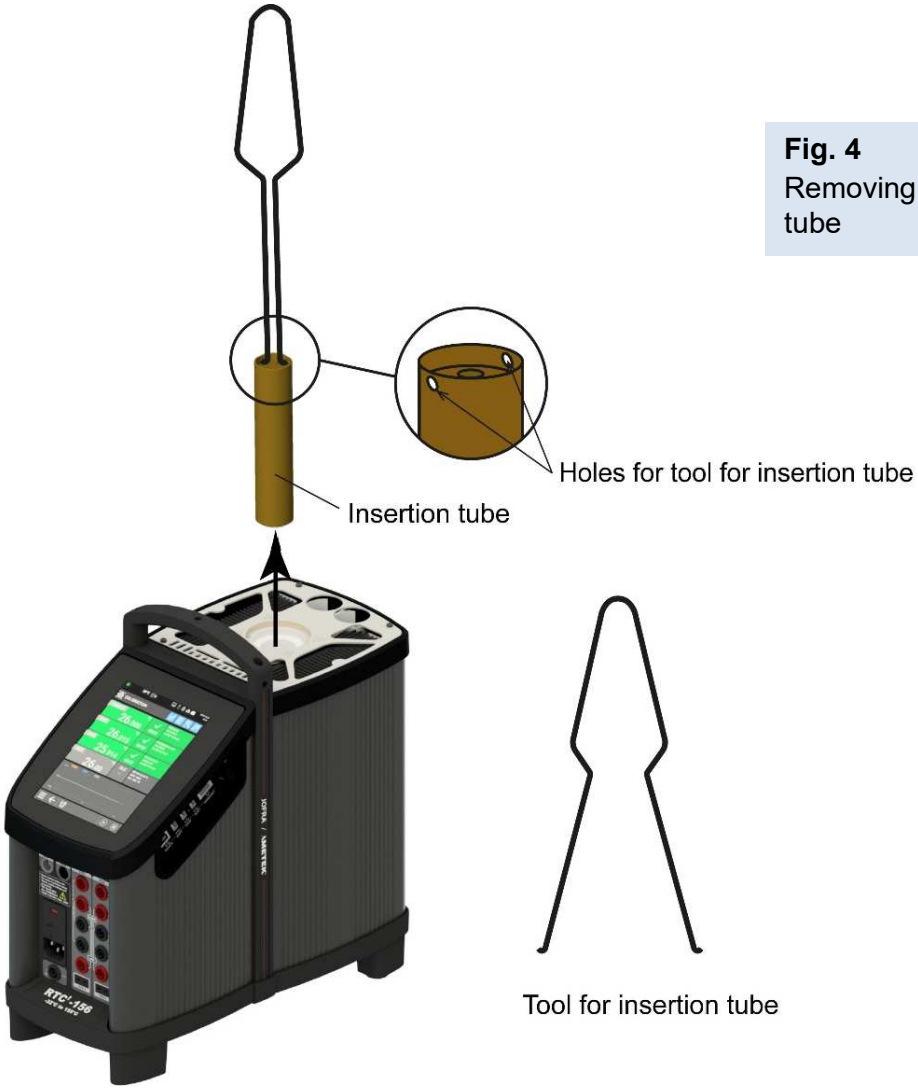


Fig. 4
Removing insertion tube

Caution – Hot surface

Do not remove the insert from the calibrator before the insert has cooled down to less than 50°C/122°F.

Caution…

The insertion tube must **always** be removed from the calibrator after use.

The humidity in the air may cause corrosion oxidation on the insertion tube inside the instrument. There is a risk that the insertion tube may get stuck if this is allowed to happen.

Warning (all models)

- **Never** leave hot insertion tubes that have been removed from the calibrator unsupervised – they may constitute a fire hazard or personal injury.

  If you intend to store the calibrator in the optional protection carrying case after use, you **must** ensure that the instrument has cooled to a temperature **below 50°C/122°F** before placing it in the carrying case.
- **Never** place a hot insertion tube in the optional carrying case.
- **Do not** touch the well or insertion tube when these are deep frozen – they might create frostbite.

6.1.1 Transporting the dry-block calibrator

Caution…

The insertion tube **must** be removed to avoid damage to the instrument if the calibrator is to be transported long distances.

6.1.2 Transporting the liquid bath calibrator (RTC^t-168 A/B/C only)

Warning

Do not move the liquid bath calibrator containing hot liquid. When spilled the liquid might cause serious wounds. Before transporting the liquid, it must be cooled down to a temperature near ambient.

Warning – Silicone oil

- Silicone oil is flammable when heated up to temperatures above its flash point. Always consult the selected heat transfer medium's technical and safety data sheets before use. Set the calibrator's maximum temperature accordingly to ensure a safe margin to the liquid's flash point.
- **Do not** handle hot liquid.
- If the liquid is heated beyond the flash point, it may constitute a fire hazard.

If the liquid has caught fire, switch off the main power to prevent further heating of the liquid. Flames are best extinguished by cowering the well with a non-flammable lid.

When the liquid has cooled down it is possible to move the liquid bath calibrator by hand. The special designed lid must be used to reduce the risk of spilling.

Note…

A liquid tight lid is available. The lid comes with a security valve, which, in case of overpressure, will let the air pass.

RTC^t -168 with liquid tight transportation lid

For any longer form of transportation, the liquid **must** be removed (see section 6.2).

6.2 Emptying the well (liquid bath only)

It is not recommendable to leave the liquid in the well for long-term storage. The best way to store the liquid is in its original airtight container.

Caution – Hot surface

- **Do not** handle hot liquid
- **Do not** attempt to remove hot liquid with the liquid drainage tube, as it might melt.
- **Do not** leave any liquid (silicone oil) in the spill tray.
- **Do not** touch the items removed from the well – they may be very hot and cause burns.
- **Never** leave hot items, which have been removed from the well, unsupervised – they may constitute a fire hazard or personal injury.

The following guidelines must be observed before emptying the well :

1. Switch off the calibrator using the power control switch.
2. Before handling the liquid, it must be cooled down to a temperature close to ambient.
3. Remove the sensor basket containing the stirrer magnet and clean it with disposable paper towels.
4. Empty the well using the liquid drainage tube supplied. Tilting the calibrator is not recommendable, as it increases the risk of splashing oil all over the test area.

Caution…

Avoid getting silicone oil on the clothes. It is impossible to wash off.

5. Any remaining oil in the well is cleaned up using disposable paper towels. It is recommendable to use the optional cleaning oil when cleaning the well.

Warning

- **REMEMBER**, wear goggles when using the cleaning oil.
- **Do not** inhale vapours. Proper ventilation must be used.
- Product information on cleaning oil must be carefully investigated before use.

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