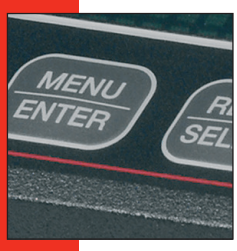
AMETEK®
SENSORS, TEST & CALIBRATION

Reference manual
Reference Temperature Calibrator
Jofra RTCt-156/157/159/168/700 A/B/C









Reference Manual

Reference Temperature Calibrator

JOFRA RTC^{t}-156/157/159/168/700 A/B/C

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About this manual….

- **The structure of the manual**
  This manual is divided into 11 sections. These describe how to set up, operate, service and maintain the calibrator. The technical specifications are described, and accessories may be ordered from the list of accessories.

  Along with the calibrator, you should have received a user manual, which sets out the operating instructions for the instrument. It is designed to provide a quick reference guide for use in the field.

- **Safety symbols**
  This manual contains several safety symbols designed to draw your attention to instructions that must be followed when using the instrument, as well as any risks involved.



Warning

Conditions and actions that may compromise the safe use of the instrument and result in considerable personal injury or material damage.



Warning

Conditions and actions that may constitute a hazard when using silicone oil.



Caution…

Conditions and actions that may compromise the safe use of the instrument and result in slight personal or material damage.



Note…

Special situations, which demand the user's attention.

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1.0 Introduction

Congratulations on choosing an AMETEK JOFRA RTC^t Calibrator - a highly efficient and precise instrument designed to meet the highest standards in industrial temperature calibration.

We are confident that this calibrator will exceed your expectations with its speed, reliability, and ease of use in on-site applications.

Patented and Innovative Calibrator Technology

The RTCt series features **AMETEK JOFRA's patented and patent-pending advancements**, ensuring the highest accuracy and performance:

- **Patented DLC system** – Delivers exceptional temperature uniformity in the calibration zone across all models.
- **Patent-pending DLC Visualization** – Provides a real-time graphical representation of temperature distribution, ensuring precise calibration adjustments.
- **Adjusting Graphical Visualization of Calibration** – Dynamic display that adapts during calibration, offering clear insights into temperature stability and process trends.

Exclusive JOFRA Features and Benefits

Beyond patented technologies, the RTCt series introduces **industry-leading innovations** for enhanced efficiency and user experience:

- **Automatic Reference Sensor Protection** – Ensures reliable readings and sensor longevity.
- **Touchscreen Interface** – Intuitive and streamlined operation for effortless calibration.
- **Real-Time Data Visualization** – Provides instant feedback for enhanced precision.
- **Intelligent Recalibration Information (IRI)** – Automatic alerts for timely recalibrations.
- **Selectable Silent or Fast Mode** – Adapts to your testing needs with optimized operation.
- **Specialized Sanitary Sensor Calibration** – Tailored solutions for hygienic applications.

With decades of expertise in industrial temperature calibration, we continuously refine our products to support demanding environments and everyday professional use. **Your feedback is invaluable to us**— If you have suggestions for improvement, we would greatly appreciate your feedback.

Thank you for choosing AMETEK JOFRA!

This reference 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} -159 A - Temperature calibrator**
- **JOFRA RTC^{t} -159 B - Temperature calibrator with sensor and reference inputs**
- **JOFRA RTC^{t} -159 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**
- **JOFRA RTC^{t} -700 A - Temperature calibrator**
- **JOFRA RTC^{t} -700 B - Temperature calibrator with sensor and reference inputs**
- **JOFRA RTC^{t} -700 C - Temperature calibrator with reference input**

Model A Model B Model C



ISO-9001 certified

AMETEK Denmark A/S was ISO-9001 certified in September 1994 by Bureau Veritas Certification Denmark A/S.

ISO-17025 certified

AMETEK Denmark A/S Accredited Laboratory was ISO-17025 certified in December 2007 by DANAK – Den Danske Akkrediteringsfond.

CE-label

CE

Your new temperature calibrator bears the CE label and conforms to the Electromagnetic Compatibility (EMC) Directive 2014/30/EU, the Low Voltage Directive 2014/35/EU and the RoHS Directive 2011/65/EU amended by Directive 2015/863/EU.*

Technical assistance

Please contact the dealer from whom you acquired the instrument if you require technical assistance.

1.1 Warranty

This instrument is warranted against defects in workmanship, material and design for two (2) years from date of delivery to the extent that AMETEK will, at its sole option, repair or replace the instrument or any part thereof which is defective, provided, however, that this warranty shall not apply to instruments subjected to tampering or, abuse, or exposed to highly corrosive conditions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED AND AMETEK HEREBY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY. AMETEK SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, ANY ANTICIPATED OR LOST PROFITS.

This warranty is voidable if the purchaser fails to follow any and all instructions, warnings or cautions in the instrument's User Manual.

If a manufacturing defect is found, AMETEK will replace or repair the instrument or replace any defective part thereof without charge; however, AMETEK's obligation hereunder does not include the cost of transportation, which must be borne by the customer. AMETEK assumes no responsibility for damage in transit, and any claims for such damage should be presented to the carrier by the purchaser.

1.2 Receiving the Reference Temperature Calibrator

When you receive the instrument…

1) Unpack and check the calibrator and the accessories carefully.

2) Check the parts according to the list shown below.

   If any of the parts are missing or damaged, please contact the dealer who sold you the calibrator.

You should receive:

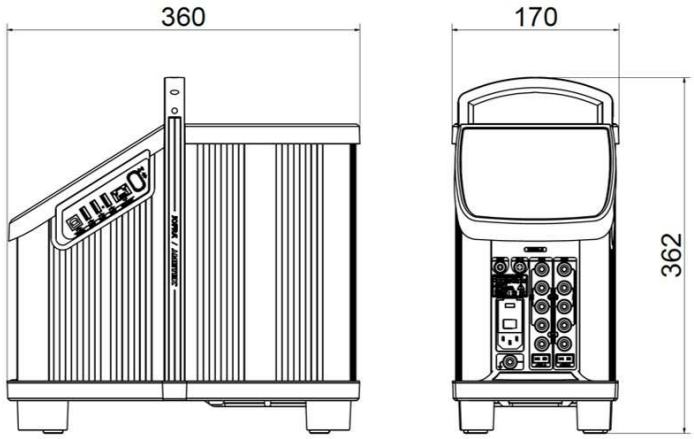
- 1 RTC^t Calibrator
- 1 mains cable
- 1 USB memory stick containing electronic manuals and software package: JOFRACAL, AMETRIM and CON050
- 1 Wifi USB Dongle
- 2 sets of test leads and test clips (2 black and 2 red – B models only)
- 1 tool for insertion tube
- 1 USB cable
- 1 Accredited Calibration 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)
- Thermal protection shield (RTC^t-700 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

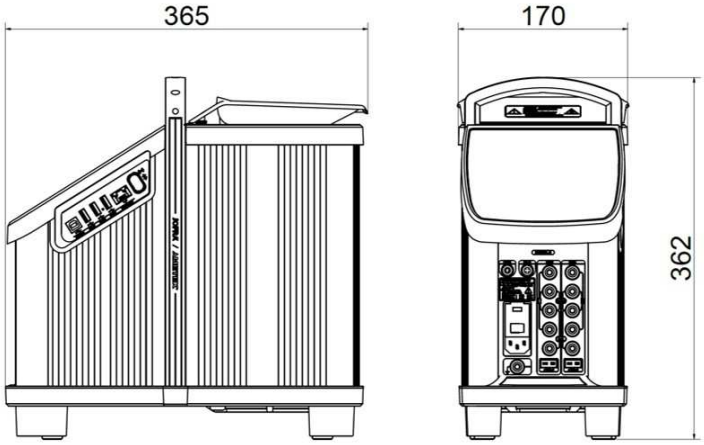
When reordering, please specify the part numbers according to the list of accessories, section 11.0.
Optional parts can also be found in the list of accessories.

1.3 Dimensioning drawings

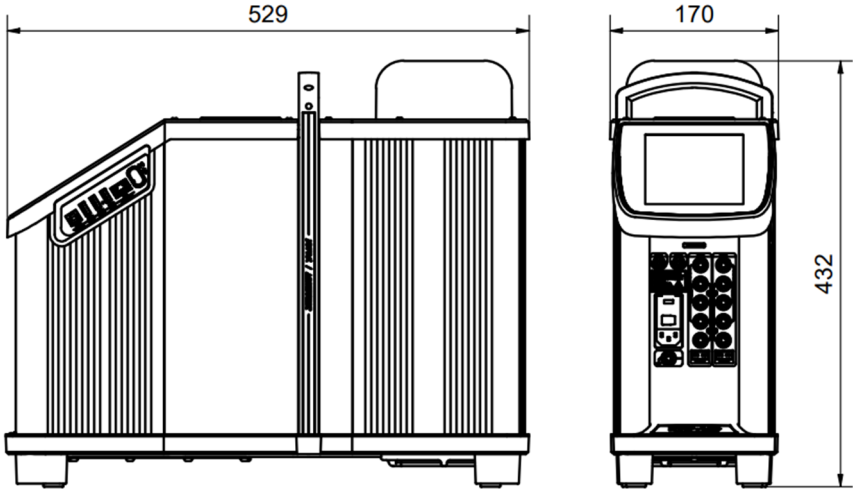
RTC^{t} -156/157 A/B/C



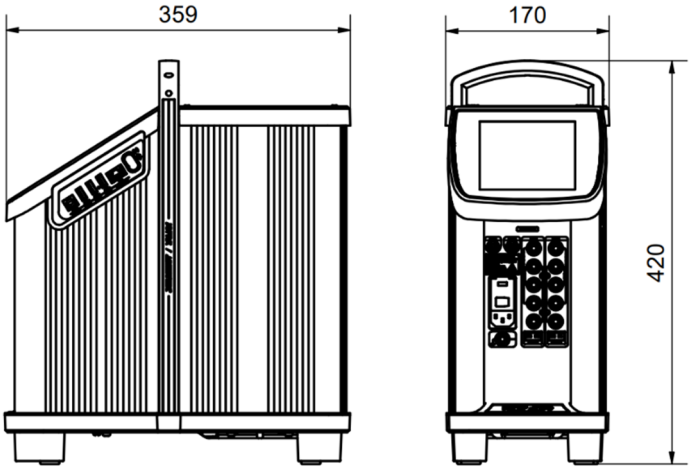
RTC^{t} -168 A/B/C



RTC^{t} -159 A/B/C



RTC^{t} -700 A/B/C



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.
- After transport or storage in humid conditions or if the calibrator has not been heated up to minimum 100°C within the last 10 days, the instrument needs to be operated with a well temperature of at least 140°C for 2 hours before it can be assumed to meet all safety requirements of EN61010-1 (RTC^t-700 only).
- 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.
- Use protection shield when calibrating at high temperatures (RTC^t-700).
- The RTC^t-159 contains R-1270 and R-704 under pressure. The calibrator must **under no circumstances** be stored at ambient temperatures above 50°C (122°F) or operated at ambient temperatures above 40°C (104°F). Doing so may cause a hazard.
- 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 –40°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 data sheets before use. Set the calibrator's maximum temperature accordingly to ensure a safe margin to the liquid's flash point.



Warning – Flammable fluid (RTC^t -159 only)

The instrument contains a sealed heat pipe with 8 gr of R1270 (Propylene), refrigerant safety classification A3 – highly flammable. The heat pipe is permanently sealed and is not accessible during normal operation or service.

Safety precautions:

- Keep away from ignition sources
- Do not damage or perforate the heat pipe
- Service by trained personnel only
- Use only in well-ventilated areas
- Not for use in harzardous areas



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 (applies only to the RTC^t -156/157/159/168 A/B/C models)

- **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 5.6.1 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 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.
- **Before** using new insertion tubes for the calibration, the insertion tubes **must** be heated up to maximum temperature 700°C (1292°F) - for a period of minimum 30 minutes (RTC^{t}-700 A/B/C only).
- 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 for use

3.1 Preparing the dry-block touch calibrator



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.
- After transport or storage in humid conditions or if the calibrator has not been heated up to minimum 100°C within the last 10 days, the instrument needs to be operated with a well temperature of at least 140°C for 2 hours before it can be assumed to meet all safety requirements of EN61010-1 (RTC^t-700 only).
- **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.
- The RTC^t-159 contains R-1270 and R-704 under pressure. The calibrator must **under no circumstances** be stored at ambient temperatures above 50°C (122°F) or operated at ambient temperatures above 40°C (104°F). Doing so may cause a hazard.



Note…

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

3.1.1 When setting up the dry-block calibrator, you must…

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.



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.

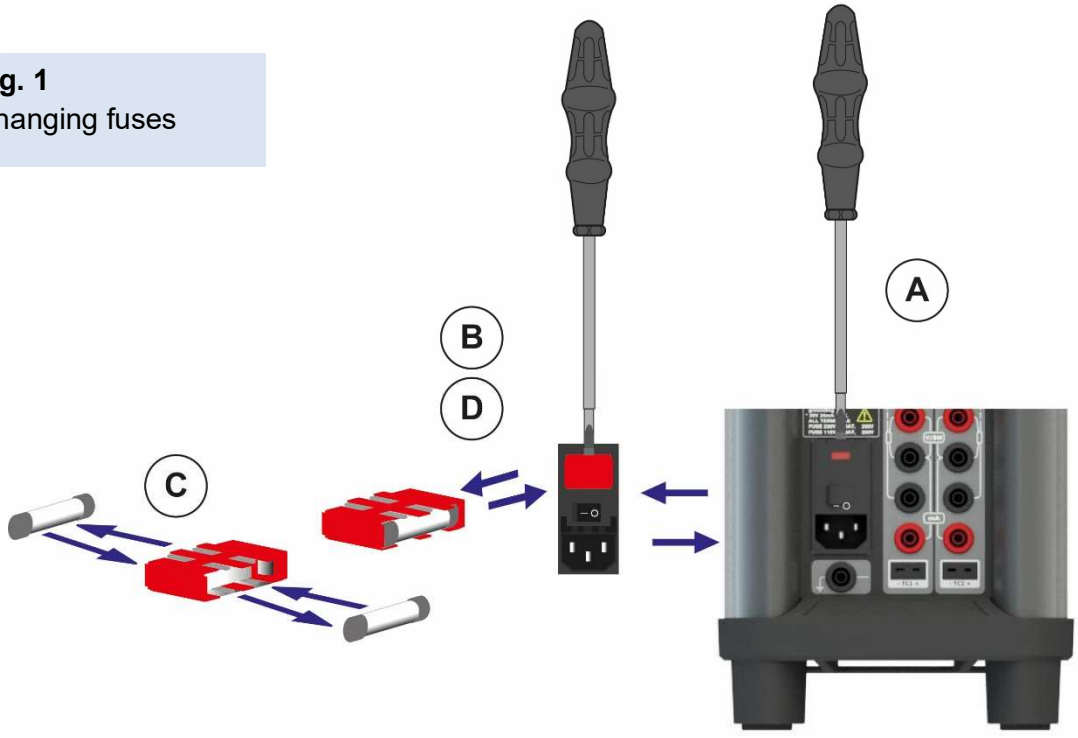
3. Check that the fuse size corresponds to the applied voltage on (pos.③). The fuse is contained in the power control switch (on/off switch). To check; do as follows (see fig. 1):



Warning

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. 1
Changing fuses



A. Open the fuse box lid using a screwdriver.

B. Take out the fuse box.

C. Remove both fuses replacing them with two new fuses. These must be identical and should correspond to the line voltage. See section 11.0.

B. Slide the fuse box back into place.

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. See section 3.2 for information on how to select insertion tubes.

6. The calibrator is now ready for use.

3.2 Choosing an insertion tube

Caution…

To get the best results out of your calibrator, the insertion tube dimensions, tolerance and material are critical. We highly advise using the JOFRA insertion tubes, as they guarantee trouble-free operation. Using other insertion tubes may reduce performance of the calibrator and cause the insertion tube to get stuck.

Caution…

Before using new insertion tubes for calibration in the RTC^{t}-700 instruments, the insertion tubes must be heated up to maximum temperature 700°C (1292°F) - for a period of minimum 30 minutes.

Insertion tubes are selected based on the diameter of the sensor to be calibrated.

Use the table for insertion tubes in section 3.2.1 to find the correct part number.

Alternatively, you may order an undrilled insertion tube and drill the required hole yourself. The finished dimensions should be as follows:

- Sensor diameter ØD+0.2mm +0.05/-0
- DLC hole : Ø3.1mm +0.05/-0 (RTC^{t}-156/157/159/168)
  Ø4.2mm +0.05/-0 (RTC^{t}-700)
- Reference sensor holes : Ø4.2mm +0.05/-0 and Ø6.55mm +0.05/-0

Note…

When drilling the holes it is important that the distance of the material between the drillings is at least 2mm. If the distance is less than 2 mm the calibration result could be compromised.

For RTC^{t}-156/157/159/168 A/B/C only:

In order to get optimum results and prevent ice from building up in the well of the cooling calibrators, a proper sized insulation plug must be placed over the well during the calibration process.

The holes in the plug must have a tight fit, and unused hole must be covered using e.g. silicone plugs (spare part no. 126280).

3.2.1 Standard insertion tubes

Caution…

To get the best results out of your calibrator, the insertion tube dimensions, tolerance and material are critical. We highly advise using the JOFRA insertion tubes, as they guarantee trouble-free operation. Use of other insertion tubes may reduce performance of the calibrator and cause the insertion tube to get stuck.

	PARTS NO. FOR UNDRILLED INSERTION TUBES			
Sensor Size	**RTC^t-156/157 A/B/C (Aluminium tubes)**	**RTC^t -159 A/B/C (Aluminium tubes)**	**RTC^t -168 A/B/C (Aluminium tubes)**	**RTC^t -700 A/B/C (Alu. Bronze tubes)**
Undrilled	127299	128453	130489	127197
Undrilled with DLC hole	127300	128454	130488	127198
Undrilled with DLC and ref. holes	127301	128455	130486	127199

	PARTS NO. FOR STANDARD INSERTION TUBES – MULTI-HOLE - METRIC			
Insert type	**RTC^t -156/157 A/B/C (Aluminium tubes)**	**RTC^t -159 A/B/C (Aluminium tubes)**	**RTC^t -168 A/B/C (Aluminium tubes)**	**RTC^t -700 A/B/C (Alu. Bronze tubes)**
Type M01	127329	128456	130490	127200
Type M02	127330	128457		127201
Type M03	127331	128458		127202
Type M04	127332	128459		127203
Type M07	127241	128462		127244
Type M08	127242	128463		127245
Type M09	127243	128464		127246
Set of 4 pcs. Inserts, 3mm to 13mm.	127326	128466		127252

	PARTS NO. FOR STANDARD INSERTION TUBES – MULTI-HOLE - IMPERIAL			
Insert type	**RTC^t -156/157 A/B/C (Aluminium tubes)**	**RTC^t -159 A/B/C (Aluminium tubes)**	**RTC^t -168 A/B/C (Aluminium tubes)**	**RTC^t -700 A/B/C (Alu. Bronze tubes)**
Type M02		128460	130491	127204
Type M05	127327	128461		127205
Type M06	127328	128465		127249
Type M10	127247	128467*		127254
Set of 3 pcs. Inserts, 1/8” to 1/2”	127311	128460		127204

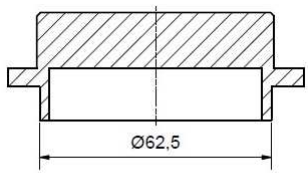
	PARTS NO. FOR STANDARD INSERTION TUBES WITH HOLES FOR 4 MM AND 1/4” REF. SENSORS AND DLC SENSOR - IMPERIAL		
Sensor size	**RTC^t -156/157 A/B/C (Aluminium tubes)**	**RTC^t -159 A/B/C (Aluminium tubes)**	**RTC^t -700 A/B/C (Alu. Bronze tubes)**
1/8”	127302	128468	127164
3/16”	127303	128469	127165
1/4”	127304	128470	127166
5/16”	127305	128471	127167
3/8”	127306	128472	127168
7/16”	127307	128473	127169
1/2”	127308	128474	127170
9/16”	127309	128475	127171
5/8”	127310	128476	127172
Set of 9 pcs. Imperial inserts	127335	128491	127173

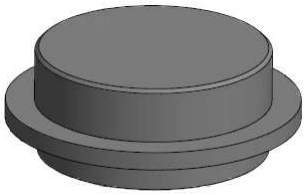
	PARTS NO. FOR STANDARD INSERTION TUBES WITH HOLES FOR 4 MM AND 1/4" REF. SENSORS AND DLC SENSOR - METRIC

Sensor size	RTC^t -156/157 A/B/C (Aluminium tubes)	RTC^t -159 A/B/C (Aluminium tubes)	RTC^t -700 A/B/C (Alu. Bronze tubes)
3 mm	127312	128477	127148
4 mm	127313	128478	127149
5 mm	127314	128479	127150
6 mm	127315	128480	127151
7 mm	127316	128481	127152
8 mm	127317	128482	127153
9 mm	127318	128483	127154
10 mm	127319	128484	127155
11 mm	127320	128485	127156
12 mm	127321	128486	127157
13 mm	127322	128487	127158
14 mm	127323	128488	127159
15 mm	127324	128489	127160
16 mm	127325	128490	127161
Set of 14 pcs. Metric inserts	127336	128492	127162

NOTE: All insertion tubes (metric and imperial) are supplied with a matching insulation plug.

The insulation plug for the RTC^t -168 can **ONLY** be used in the RTC^t -168 instrument.





3.3 Inserting the sensors

The sensor setup comes in different variations depending on the instrument model.



RTC^{t} -156



RTC^{t} -157



RTC^{t} -168



RTC^{t} -159



RTC^{t} -700

Before inserting the sensors and switching on the calibrator, please note the following important warning:

Warning

- **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.
- **Never** try to modify the insulation plugs to make them fit the sensor. Use only insulation plugs supplied by AMETEK Denmark A/S.

Insert the sensors as shown in fig. 2.



Fig. 2
Inserting sensors and insertion tube

The DLC sensor must be placed in the hole that is intended for the DLC sensor. Standard insertion tubes from AMETEK Denmark are marked with a dot on the rim to indicate the placement of the DLC hole, and the insulation plugs are marked with the letter D (RTC^t-156/157/159/168 A/B/C only). See fig. 3.

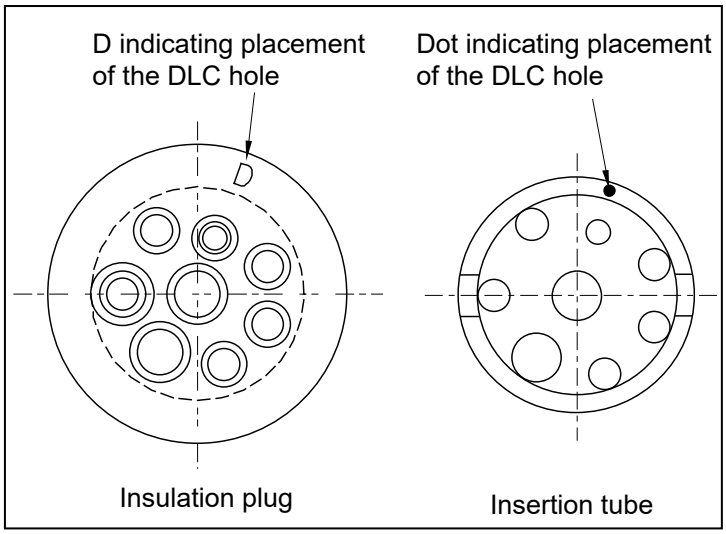


Fig. 3
Placement of DLC hole in insertion tube.



Caution…

- The well and the insertion tube **must** be clean before use.
- 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.



Caution – Hot surface

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



Caution – Cold surface

Below 0°C/32°F (applies only to the RTC^{t} -156/157/159/168 A/B/C models)

- 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.

3.4 Preparing the liquid bath touch calibrator (RTC^{t} -168 A/B/C only)



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).
- Liquid baths should **only** be operated by trained personal.
- AMETEK Denmark A/S **does not** take any responsibility, if the well is filled with other liquids than those recommended.
- Heat transfer liquids must **only** be used in calibrators with a liquid bath. If these liquids are heated above specified temperature, they will create noxious or toxic fumes. Proper ventilation must be used.
- Product information on the liquid must be carefully investigated before use.
- 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.



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



Note…

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

3.4.1 When setting up the liquid bath calibrator, you must…

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 (230V/115V) (on/off switch). To check; do as instructed in Section 3.1.1, Fig. 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 4a):
   - **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 4b). 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.

     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 4a)

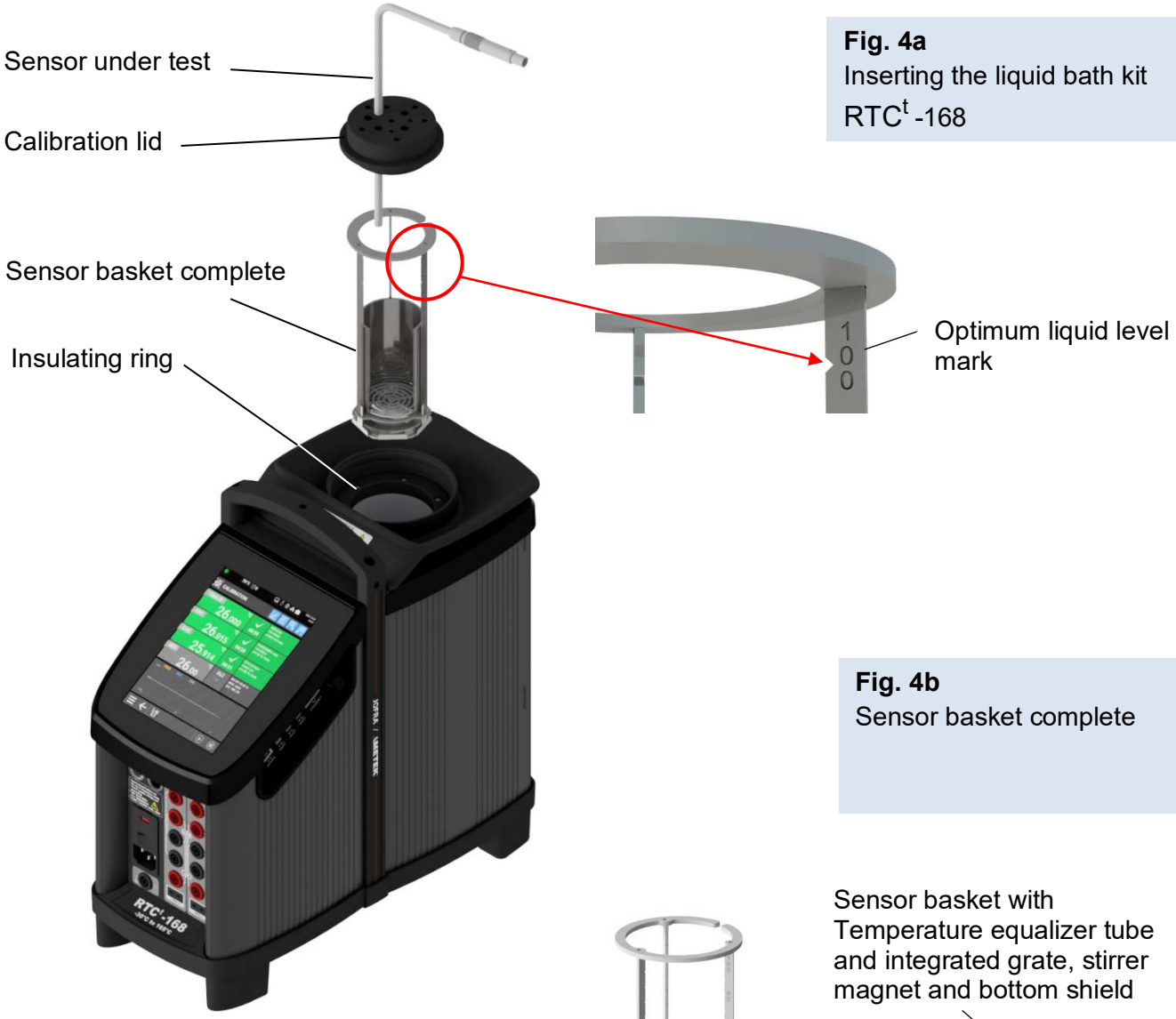
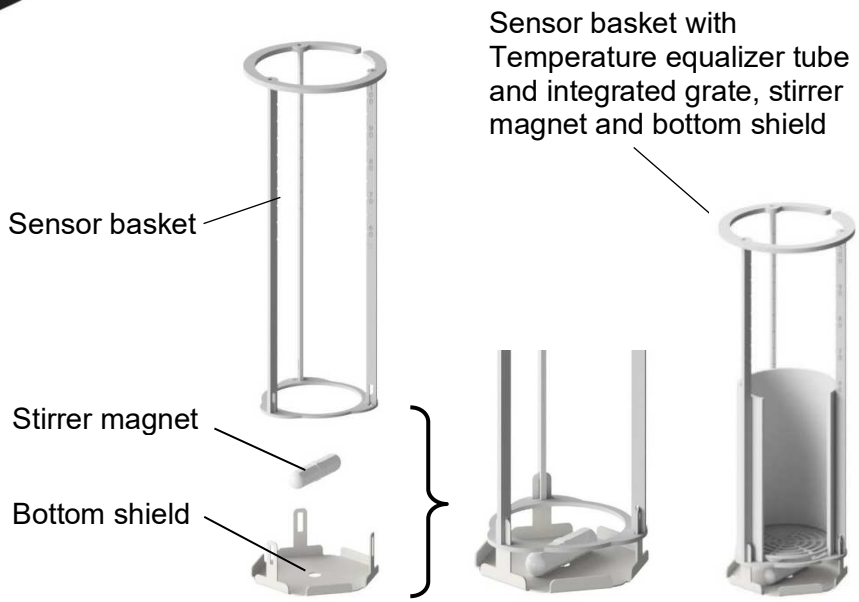


Fig. 4a
Inserting the liquid bath kit RTC^{t} -168

Fig. 4b
Sensor basket complete



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.

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. Please read instructions in section 3.4.2 about oil level. To stop overflow, switch off the mains power or set a low temperature and the oil level will decrease when cooled down.
- 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 syringe, as it might melt.

6. Start the stirring magnet by following the procedure in section 5.7.

7. Place the calibration lid onto the well. See section 3.4.3 for drilling information.

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 –40°C.

8. Select a SET-temperature according to the tables of recommended oil volume by following the procedure in section 5.2.1.

Warning

Ensure that the sensor is absolutely clean and dry, as a few drops of water might cause a steam explosion.

9. Place the sensor 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. 5.

If the sensor has expired a warning will be displayed.

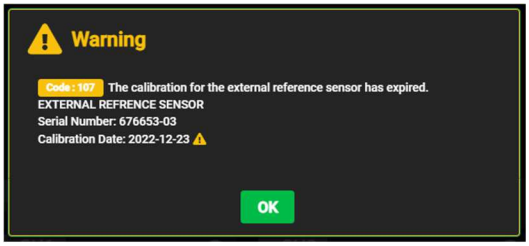




Fig. 5
Inserting sensor using support rod set

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.

10. The calibrator is now ready for use.

3.4.2 Selection of liquids

Caution…

Be careful to select the right liquid for the right task. Using other than the recommended liquids might cause damage to the calibrator or degrade the performance.

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.

AMETEK Denmark A/S recommends the following liquid:

Part no.*	Name	Recommended temperature range
125033	XIAMETER™ PMX-200 10cST	-30°C to 165°C

*0.75 litres

Technical specifications for the liquid baths have been produced using the liquid mentioned above.
For proper handling, use and disposal of liquid – read liquid product information. When reading this information pay special attention to details regarding fume point, flash point, boiling point and point of decomposition.

When the liquid temperature approaches the fume point, it is necessary to use proper ventilation. An exhaust hood is recommended. When ventilation is applied take care not to expose the calibrator to alternating draft, as it might influence the temperature stability. If possible, make the ventilation flow as constant as possible.

At low temperatures the viscosity of the liquid can constitute a problem. When the viscosity becomes too low, the stirring magnet can't provide proper circulation in the well to maintain temperature uniformity. Therefore, it is essential to investigate the physical property of the liquid before one is selected.

Tables of maximum recommended oil level @23°C well temperature

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%

For the best result, the oil should be in good condition and free of foreign objects. If water is accumulated in the oil due to melted ice crystals – the oil must be dried out, by heating it up.



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.



Warning

Do not under any circumstances pour water on burning oil. It might cause a dangerous steam explosion.

3.4.3 Handling of lids

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

To be able to use the lid for calibration, holes must be drilled into it, in order to fit your calibration needs. If you use many different sizes of sensors, more lids can be purchased from your JOFRA supplier.

It is advisable to drill the holes at the same size as the sensors plus 0,5mm and distribute the holes evenly over the lid.



Warning

- 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.
- When removing the sealing lid on the spill tray, be aware of overpressure in the well which can cause debris to be scattered. To reduce the risk of overpressure, only remove the lid when the well and liquid are tempered. Always use proper protective tools to avoid unwanted liquid contact with eyes, skin, clothes, or other equipment.
- Only apply the sealing lid onto the well when the liquid is tempered, to reduce the risk of pressure differences due to temperature expansion/compression.

3.4.4 Inserting the sensors

Be sure that the sensors can be calibrated in liquid. E.g. certain ceramic sensors might be destroyed.



Caution…

- Ensure that the allowed temperature range of the sensors is not exceeded by the calibrator's temperature range. See section 5.6 to set up the calibrator's allowed temperature range.
- Ensure that all external equipment and accessories in contact with the liquid are suited to this exposure.
- 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 power off the calibrator and send in the calibrator for service.
- The well and the insertion tube **must** be clean before use.
- Carefully wipe off all silicone oil from the sensor-under-test to avoid spreading of the silicone oil.



Caution – Hot surface

- **Do not touch** the lid or the spill tray when the calibrator is heating up – they may be very hot and cause burns.
- **Do not touch** the tip of the sensor when it is removed from the 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.
- **Do not** remove the insertion tube from the calibrator before the insertion tube has cooled down to less than 50°C/122°F.

3.4.5 Liquid container

For easy switch between dry and liquid calibration, is it recommended to use the optional liquid container. When using the liquid container, always use an external reference for temperature measurement, as specified accuracy is not valid when using the liquid container.

3.5 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 -159: STS-200 A 917, STS-200 B 917
RTC^t -168: STS-200 A 919, STS-200 B 919
RTC^t -700: STS-200 A 970, STS-200 B 970
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.

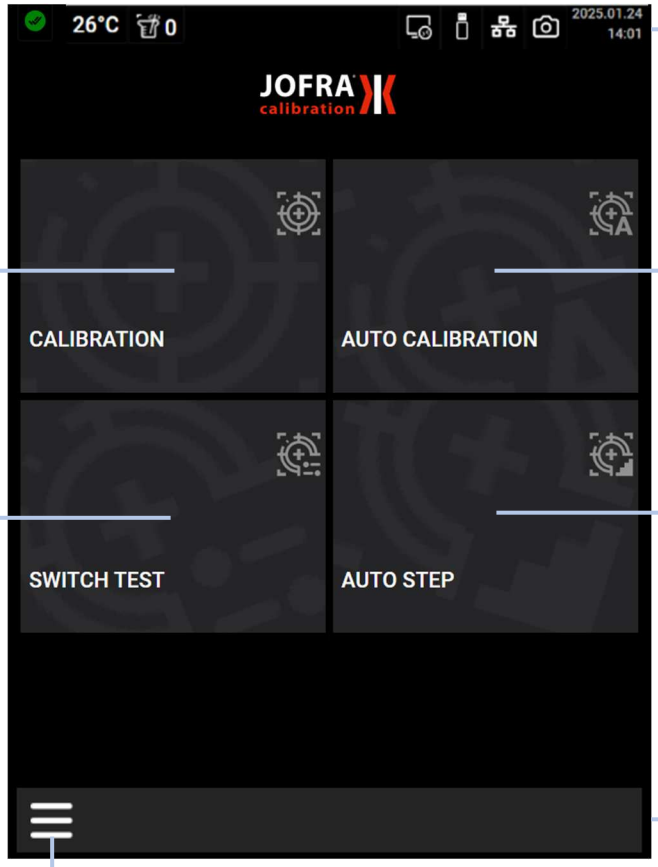
4.0 Calibrator Interface

4.1 Welcome Screen

The Welcome Screen is displayed when switching on the calibrator. Once activated the Welcome Screen will not be displayed again, and all operational options are selected using the Menu Screen.

The Welcome Screen is not accessible when using the browser access.

The Welcome Screen display is divided into four separate areas. A Status bar is visible at the top of the screen and a Navigation bar is visible at the bottom of the screen.



Calibration config.
Manual controlled calibration.

See section **5.2**.

Switch Test config.
Locates thermostats switch temperature automatically.
For B-models only.
See section **5.5**.

Status bar
Is always visible and informs you of the current status.
See section **4.1.1**

Auto Calibration config.
Perform automatic calibration defined in workorders generated by “JOFRACAL”
See section **5.3.**

Auto Step config.
Steps automatically between a range of different calibration temperatures.
See section **5.4.**

Navigation bar
Provides you with the relevant options that can be selected at the present point.
See section **4.3.2.**

Menu access
List of menu options.
See section **4.2.**

4.1.1 Status bar – Symbol description

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 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.



Do not touch the sensor or remove the insertion tube from the well - they might create frostbite / they might be very hot and cause burns.

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



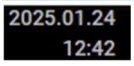
Indicates active Ethernet connection.

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.

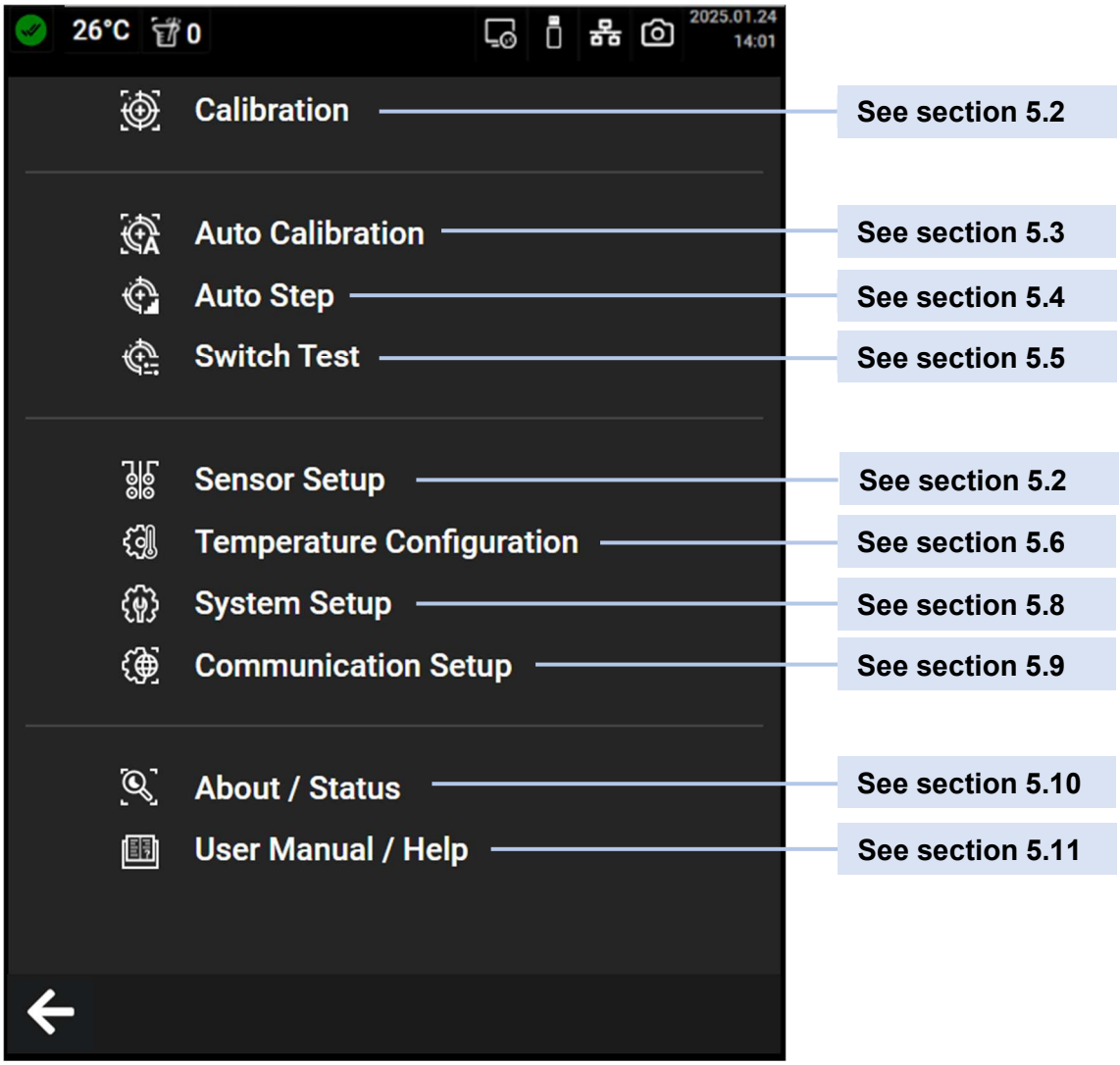
Real time clock and date display



Shows the present time and date

4.2 Menu screen

From the Menu Screen all the operational options can easily be accessed by touching the screen choosing a setup function.



4.3 Calibration screen display information

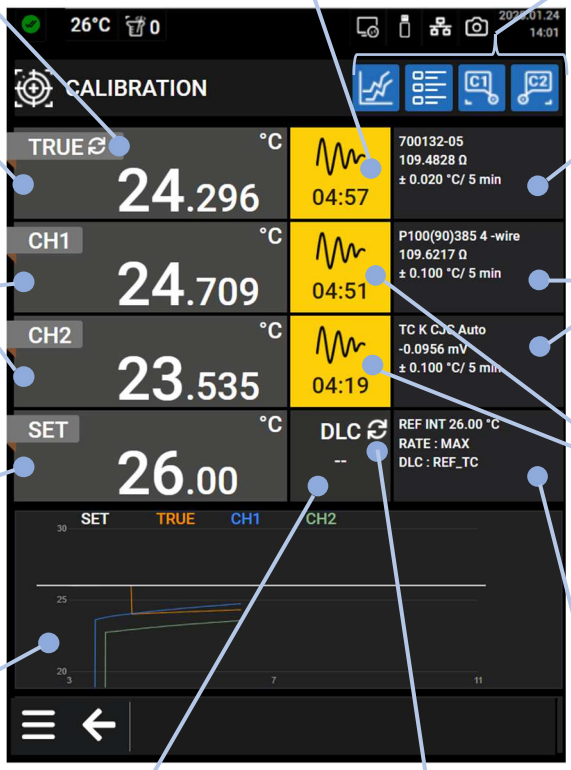
The screen gives an overview of the calibrator status and reads out the most relevant readings. In the Sensor Setup menu (see section 5.2) these readings can be changed.

SET follows TRUE activated
The symbol indicates that the SET follows TRUE function is active and will control the temperature of the external reference sensor to the SET temperature.

Stability indicator
Displays the status of the TRUE temperature stability. Yellow symbol indicates that stability is not yet obtained. A timer counts down. A green symbol indicates that the stability criteria is obtained, and the time of stability is displayed. When time of stability is more than 24 hours, the time is no longer displayed in the symbol, but only in the info screen.

Screen configuration symbols
See section **4.3.1** for description.

TRUE temperature reading
Can be either the internal reference sensor or an external reference sensor.



TRUE Sensor Info
Information about selected reference sensor.

Channel 1 / Channel 2
Shows the temperature measured by the Sensor Under Test connected to CH1/CH2.

CH1/CH2 Info
Shows the type of selected sensor, measured value and stability setting.

SET temperature
Shows the numeric value of the current SET target temperature selected.

Sensor Under Test Stability indicator
If Sensor under Test stability criteria is selected, a symbol will indicate the stability of the Sensor Under Test as well as the TRUE sensor. When both Sensor Under Test and TRUE sensor are stable, the calibrator is considered being stable.

Graph indicator
Shows the temperature or stability of TRUE, CH1 and CH2.
See section **4.3.5** for description.

Dynamic Load Compensation (DLC) indicator
Displays the measured temperature uniformity in the insert. If the load compensation is active, the DLC system will control the value towards 0.00°C/ 0.00°F.

DLC compensation activated
The symbol indicates that the DLC function is active.

Config. Information
Shows the internal reference temperature, selected slope rate and DLC serial number.

4.3.1 Screen Configuration symbols – Description

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

When activated the symbols are blue . When deactivated the symbols are black .

4.3.2 Navigation bar – Symbol description

Open Menu	Next step	Open folder/ Open file
Go back	Delete	Save results on USB drive
Start operation	Save results	Next page/screen
Stop operation	Save as	Enter manual readings
Pause operation	Test results	
Previous step	External Reference / DLC information	

4.3.3 Calibration screen temperature values

Two temperatures are always displayed:

- TRUE temperature: This is the reference temperature of the calibrator. In the A-model this is always the internal reference sensor. In B- and C-models the TRUE temperature can either be the internal reference or the external reference.

- SET temperature: This is the target temperature for the well. SET temperature displays the last value entered. If no value has been entered previously, "---,---" is displayed.

Additional temperatures displayed (B models only):

- CH1 SENSOR temperature: This is the temperature or input value measured by the sensor under test (SUT) connected to CH1.
- CH2 SENSOR temperature: This is the temperature or input value measured by the sensor under test (SUT) connected to CH2.

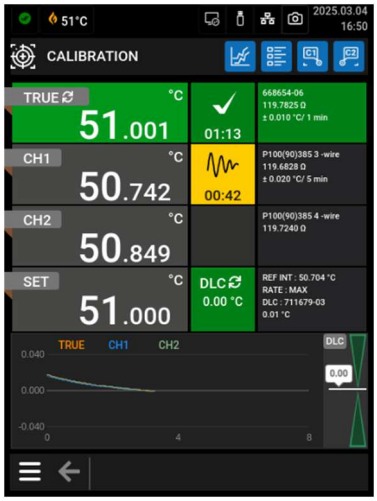
4.3.4 Stability of temperature values

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) 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.

Note…

- If External reference is selected as TRUE, the stability criteria will refer to this. The criteria can be changed, however, if the temperature stability criteria is set wider or the stability time is set shorter, the calibrator may not reach the SET temperature.
- If “Use stability criteria” is set to “Yes” for the SENSOR, the automatic calibration function will continue to next temperature step only when both TRUE and SENSOR indicate stability.

4.3.5 Understanding the graph indications

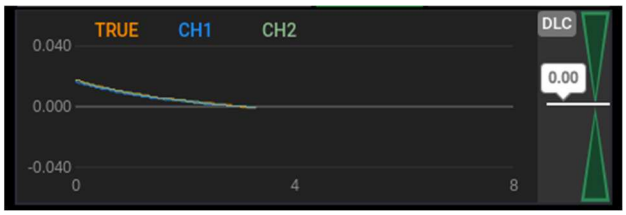
The calibrator graphs consist of a Temperature Graph and a DLC-indicator.

The temperature graph will show temperature over time and operates in 3 modes:

“New temperature”-mode
When a new SET-temperature is applied, the graph will switch to “New temperature”-mode, which will show the heating/cooling process from start to the SET-temperature applied.



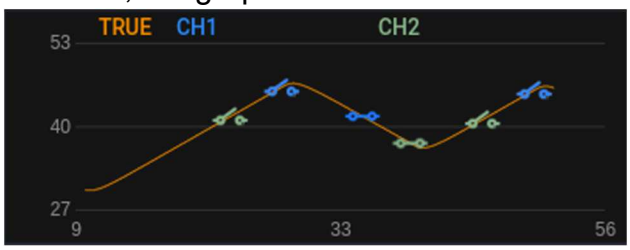
“Stability“-mode
When approaching the SET-temperature, the temperature graph will switch to “Stability” mode, which will show the change in temperature over time and help evaluating if required stability has been achieved or more time is needed.
Temperature axis is scaled based on the Stability Tolerance setting for TRUE, CH1 and CH2.



If for instance noisy 4-20mA transmitter converters are being used on CH2 the graphics makes it clearly visible.

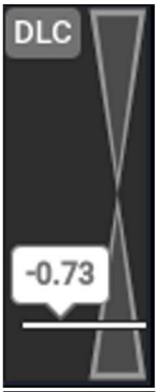


“Switch Test”-mode
When running a Switch-test, the graph will show the full temperature run and indicate where the thermostats connected has switched between open and close. If multiple runs have been selected, the graph will show the full test.

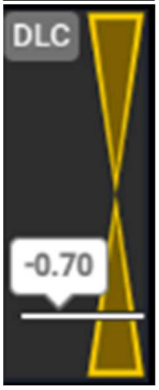


DLC-indicator (B- and C-models only)

The DLC-indicator is displayed when graph is enabled, and a DLC-sensor is connected and will show the reading in the middle when the DLC measures 0.00°C corresponding to the best achievable temperature uniformity in the well. Colour of the indicator will follow the DLC stability status.



RTCt extremely loaded without Load Compensation activated.
DLC Use Stability Criteria is disabled.



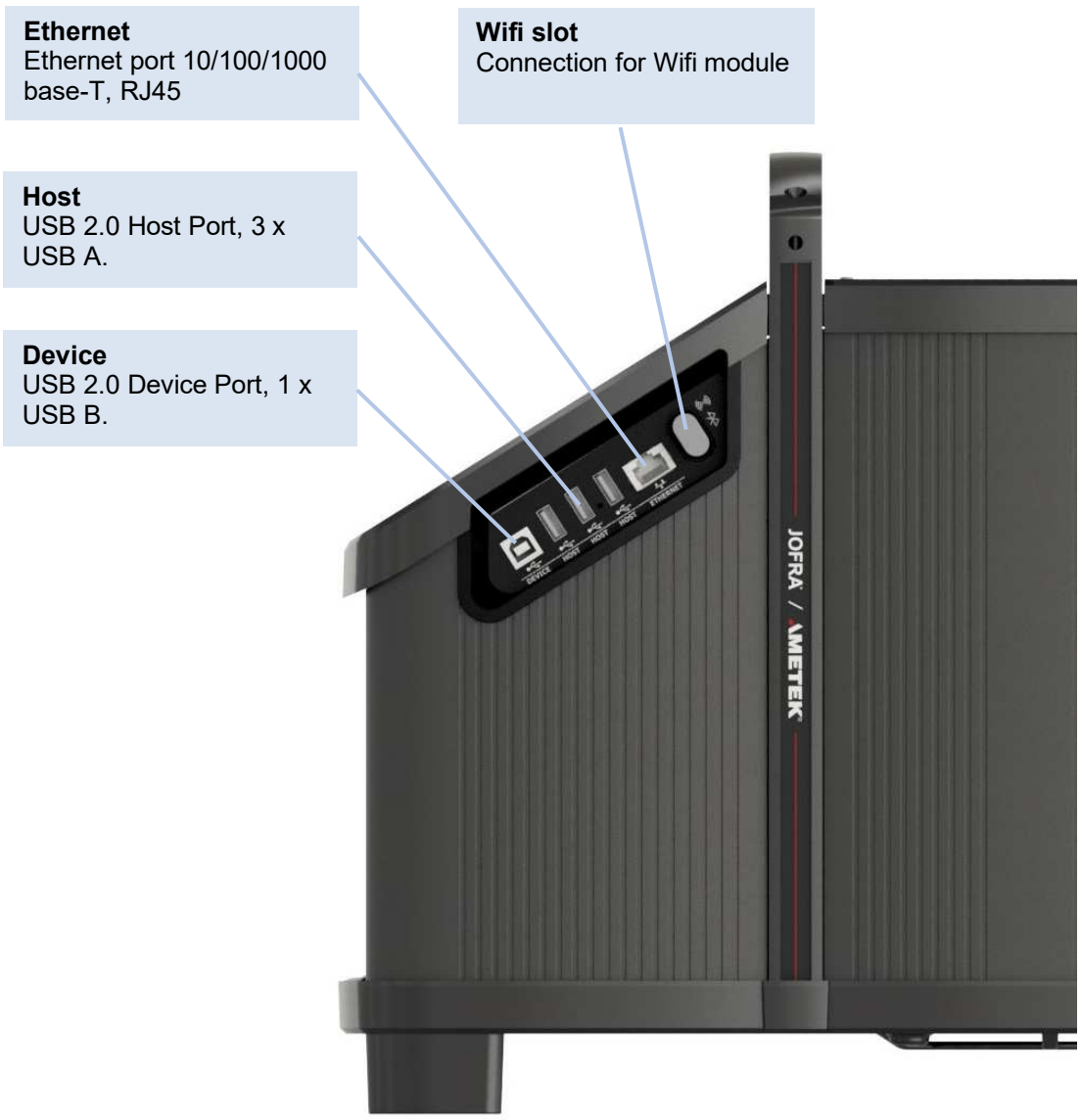
RTCt extremely loaded without Load Compensation activated.
DLC Use Stability Criteria is enabled, but reading is outside DLC Tolerance.



RTCt extremely loaded with Load Compensation activated.
DLC Use Stability Criteria is enabled and DLC-reading is within DLC Tolerance .

4.4 Input/Output Connections

Fig. 6
Communication connections (all models)



4.5 Input sections (B and C models only)

Warning

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

Fig. 7
Description of sockets for external connections

6. Input for DLC sensor (B and C models)

5. Input for external reference sensor (B and C models)

4. Label indicating fuse value (all models)

3. Power control switch with a cable connection and on/off switch. It also contains the main fuse. See section **9.1** for information on how to change the fuses (all models)

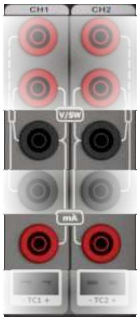
2. Connection to chassis (earth/ground) (B-model)

7. Chanel 1 and Chanel 2 - Connection for Sensor Under Test (B-model)
Note that this connection is for voltage free switches.



1. TC connection for thermocouples (B-model)

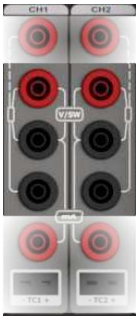
7a. mA input



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.

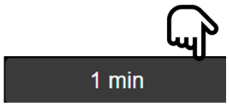
5.0 Operating the calibrator

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.

5.1 Starting the calibrator

Switch on the calibrator using the power control switch (pos. 3, fig. 7). 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”.

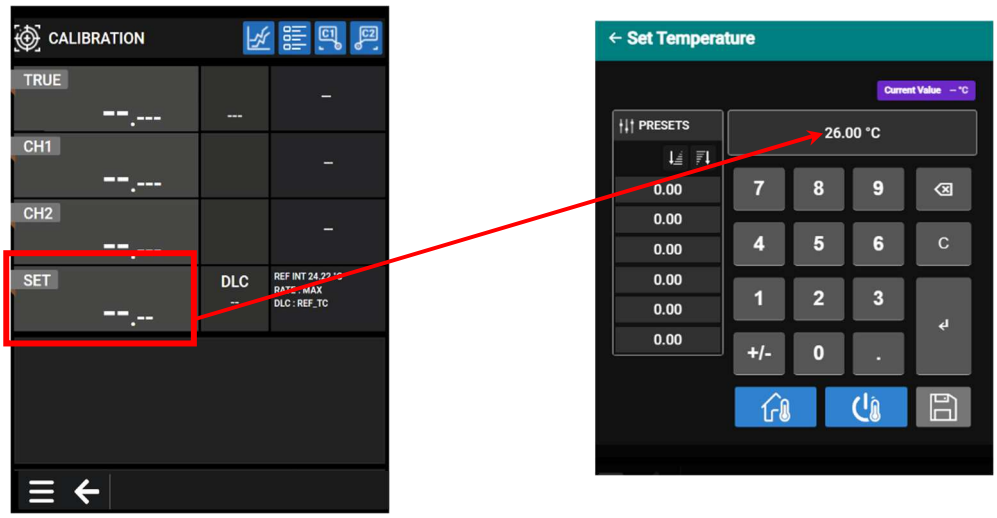
Once activated the Welcome Screen will not be displayed again, and all operational options are selected using the Menu Screen.

5.2 CALIBRATION

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

5.2.1 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.

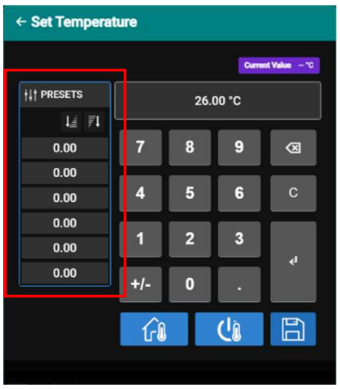
4. Press  to switch off the temperature controller. The temperature controller will remain off until a new SET-temperature is entered, or Auto Step/Switch Test/Auto Calibration is started.

   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.**

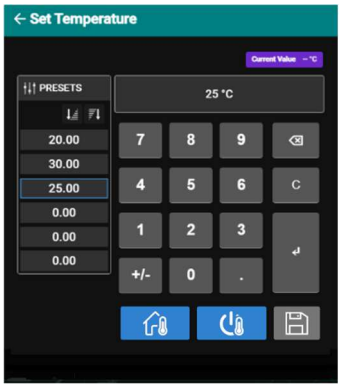
5.2.1.1 Saving the temperature as a Preset temperature

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.

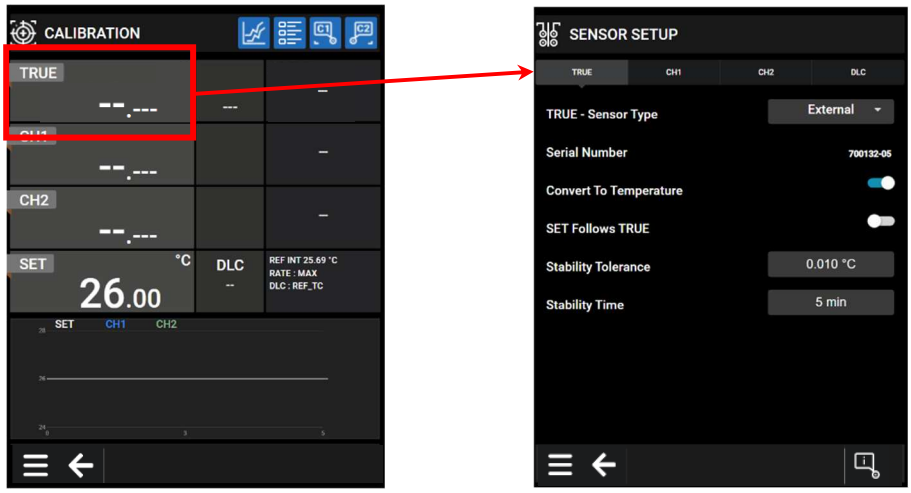
4. Press  to accept the value and the calibrator returns to the CALIBRATION screen.

5.2.2 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 4.5 fig. 7 pos. 5). 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.

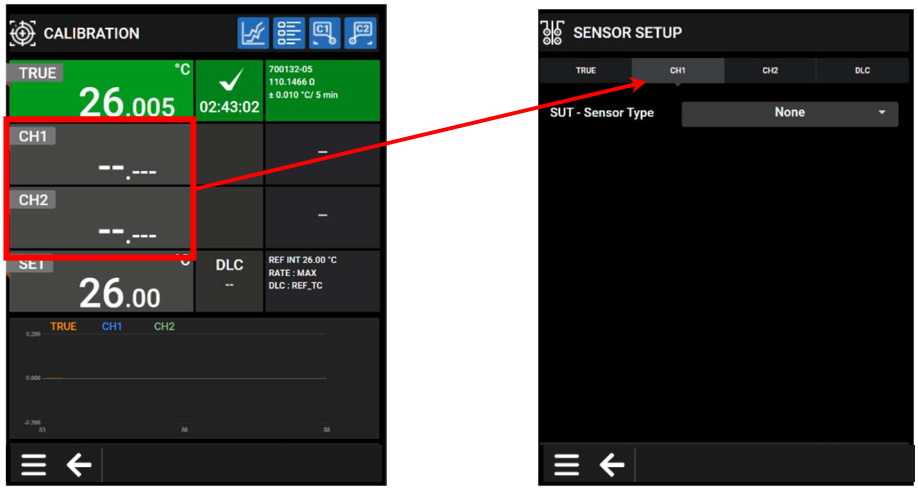
   Stability time is set (in minutes) using integers from 1 – 99.

   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.

5.2.3 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.

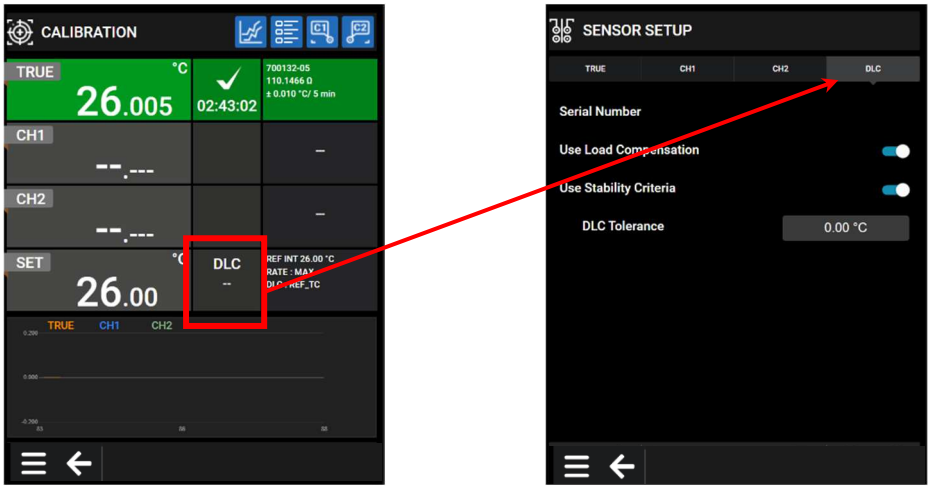
13. **Stability time:**
(using thermocouple, voltage, current and RTD)

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.

5.2.4 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 4.5 fig. 7, pos. 6). 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 

indicator turns green 

.



5.3 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.

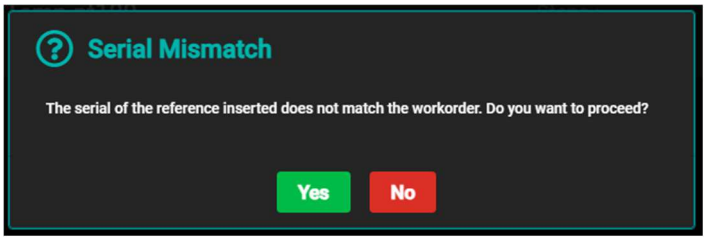
   For operating the Results menu see section 5.3.3.
   For operating the View menu see section 5.3.4.
   For operating the Delete function see section 5.3.5.

Note…
Calibration information is available in several places throughout the calibration menus. The content of this information is described in section 5.3.4.

5.3.1 Running a calibration

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

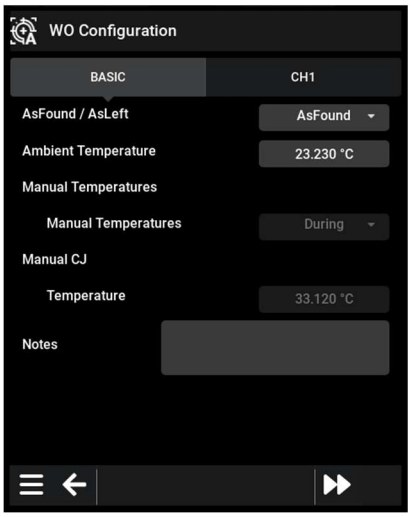
   If the serial number of the reference sensor used for calibration does not match the one specified in the workorder the following message is displayed :



   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:

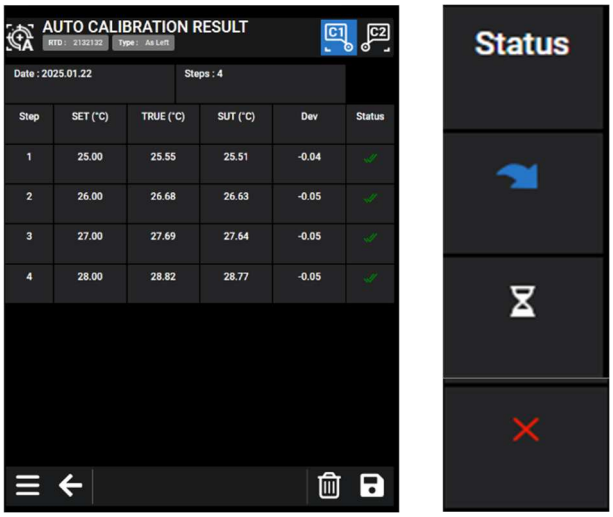
- (Results) - To view the calibration results (no editing is possible).
- (Pause) - To pause the calibration.
- (Prev) - Force the calibration to jump a step backwards to the previous calibration screen regardless of the calibration stability.
- (Next) - Force the calibration to jump a step forward to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

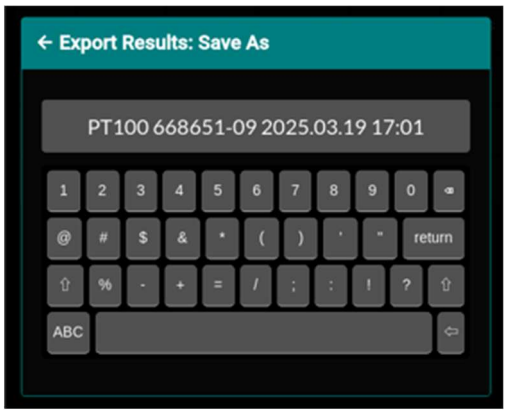
    A full Auto Calibration Result List can be viewed using the instructions in section 5.3.3

5.3.2 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.

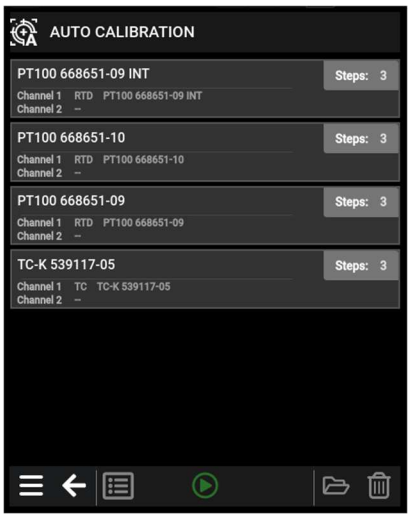
1. To export immediately after the Auto Calibration is completed, press .
2. Insert a USB memory stick and press .
3. It is now possible to enter the filename.



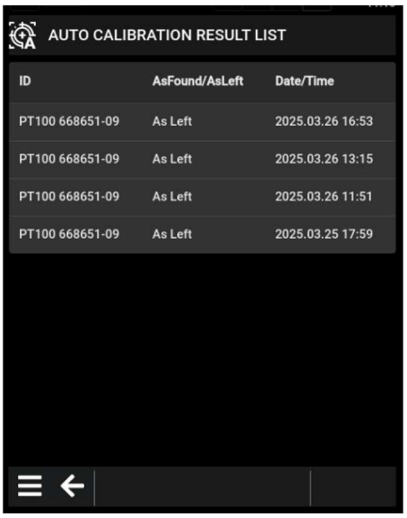
To export the result later, see Section 5.3.3 - Viewing calibration results.

5.3.3 Viewing calibration results

1. Select one of the Auto Calibrations available.

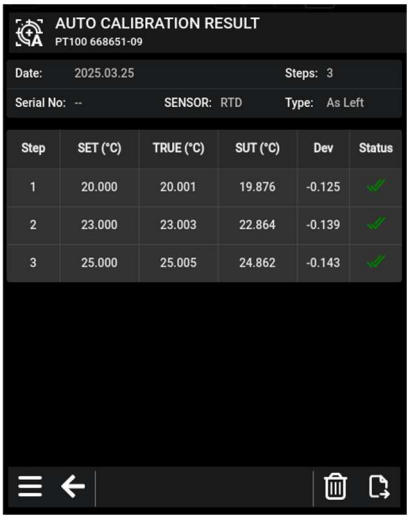


2. Access the AUTO CALIBRATION RESULT LIST by pressing  “Results” on the AUTO CALIBRATION screen.



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.

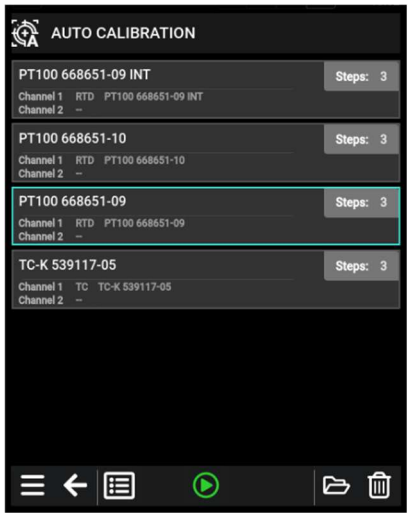
4. Press  “Export” if you wish to save the results on a USB drive.

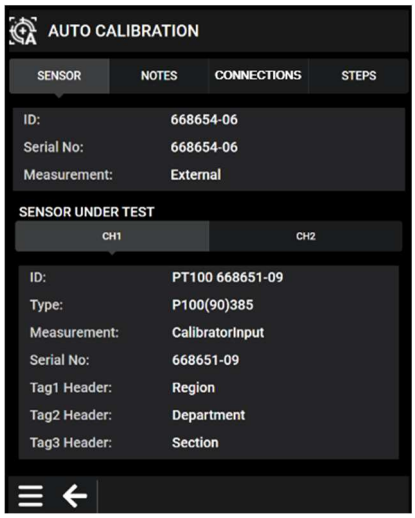
5. Press  “Back” to exit the AUTO CALIBRATION RESULT LIST and return to the AUTO CALIBRATION screen. Press  “Back” again to return to the CALIBRATION screen.

5.3.4 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 workorder info menu.

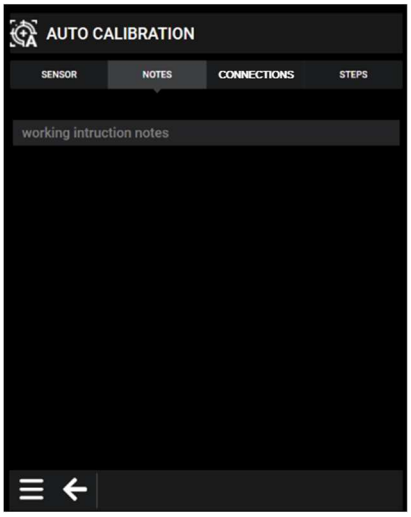




An AUTO CALIBRATION screen showing the workorder sensor setup is displayed.

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.

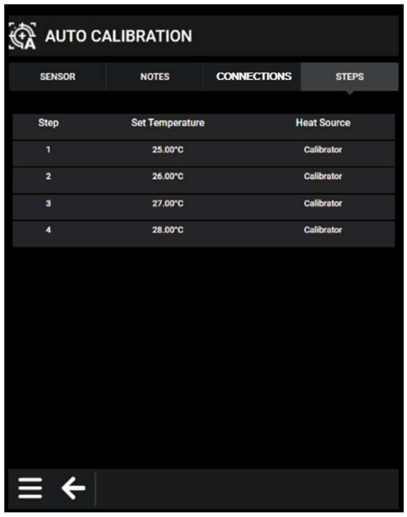
3. Press “CONNECTIONS” to access the CONNECTION GUIDE function.



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.

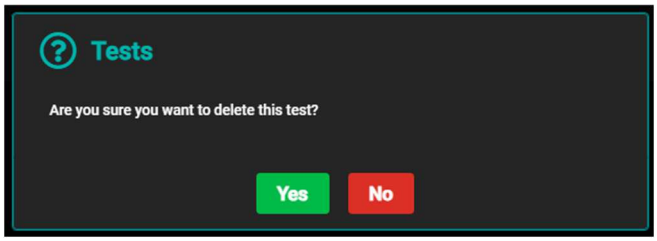
This function shows the pre-defined temperature steps for the calibration.

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

5.3.5 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.



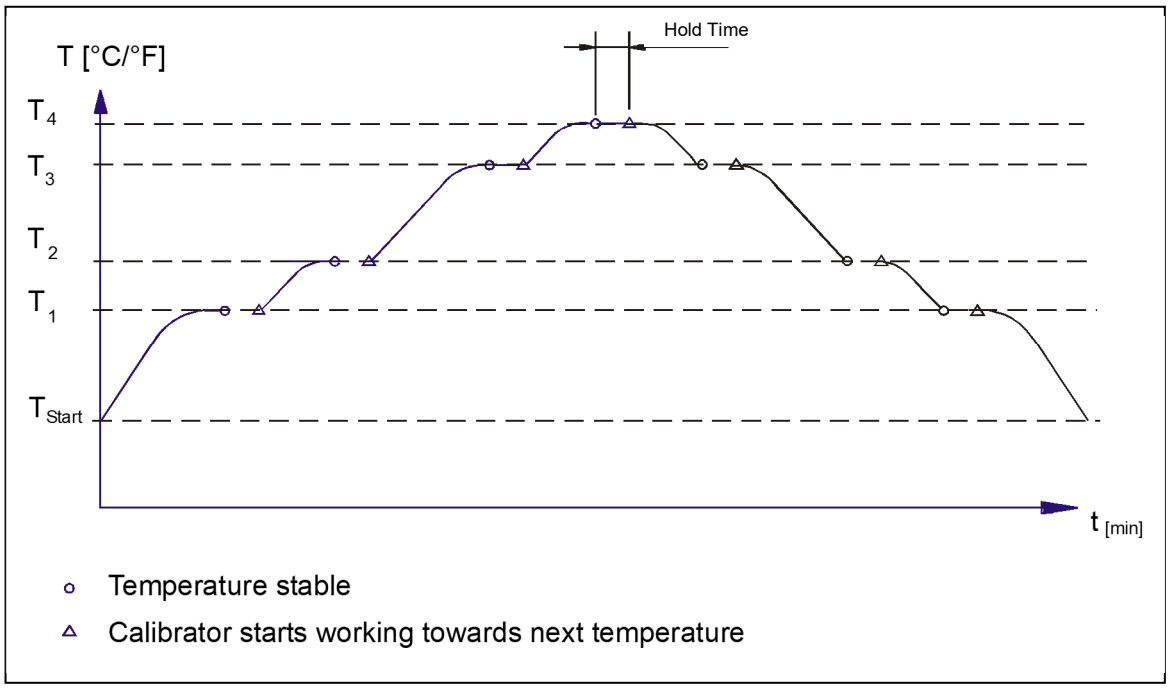
Warning

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.

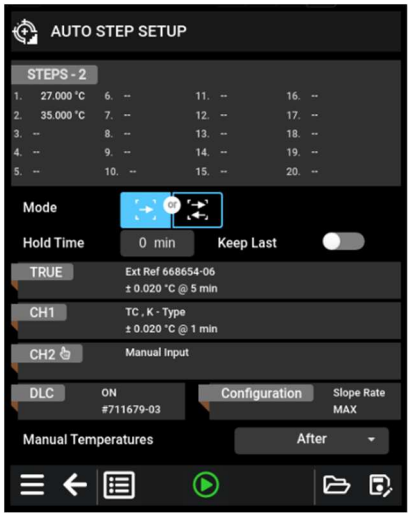
5.4 AUTO STEP SETUP

Auto step is used to step automatically between a range of different calibration temperatures. This is useful when calibrating sensors in places that are difficult to reach and sensors where the output is displayed in a different location.



5.4.1 Running an Auto Step Calibration

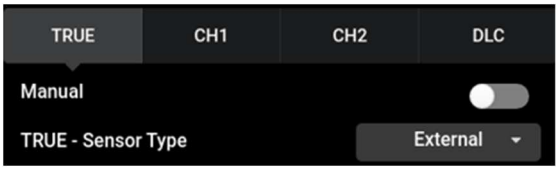
1. Access the AUTO STEP SETUP menu from the Menu screen.



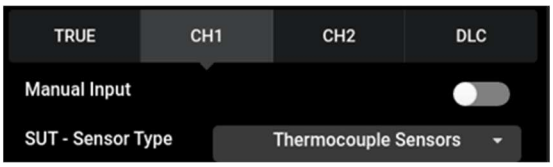
The AUTO STEP SETUP menu is displayed.

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.

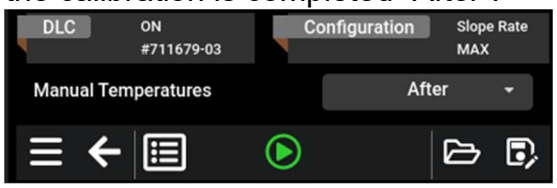
- **Keep Last** – if activated the calibrator will maintain the temperatures last step. If disabled, the calibrator will proceed to Storage Temperature when the Auto Step is completed.
- **TRUE** - the TRUE setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 5.2.2 – Setting the TRUE parameters. When running Auto Step, Manual input of TRUE temperature can be selected.



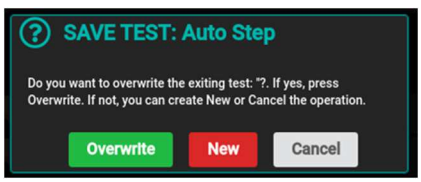
- **CH 1/CH2** - the CH1/CH2 setup menu is displayed. In this menu you have the opportunity to check and if necessary, change the settings as described in section 5.2.3 – Setting the CH1 and CH2 (Channel 1 and 2) parameters. When running Auto Step, Manual input of temperature can be selected for CH1 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 5.2.4 – 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.

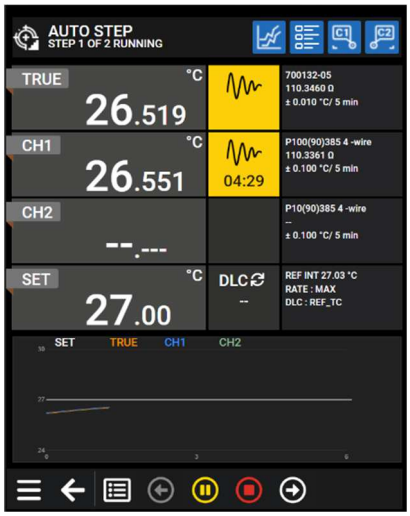


4. Press  “Open” to view/open saved Auto Step Setup’s.

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).

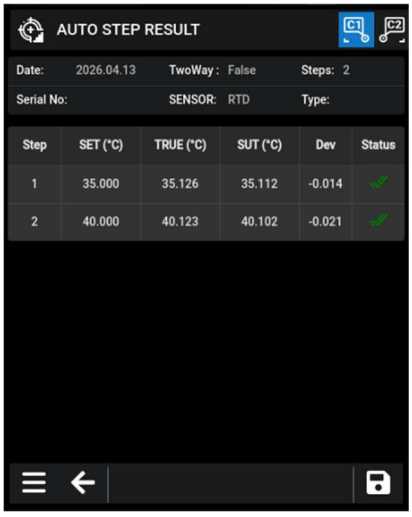
 to stop the Auto Step test.

 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.

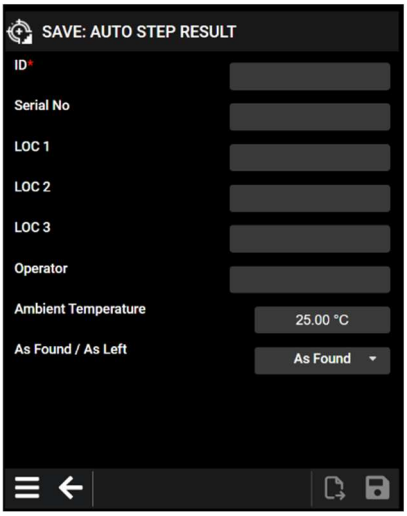
 to force the test to jump a step forward to the next running step regardless of the step's stability.

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.

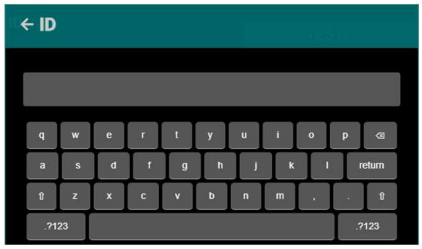
A SAVE: AUTO STEP RESULT setup menu is displayed.



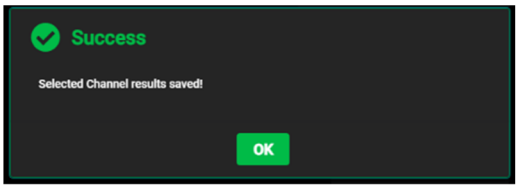
9. The following parameters are available for editing:

- **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.



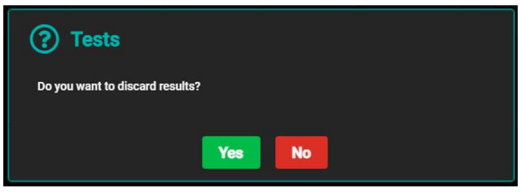
11. Press  “Save” and a check-box is displayed confirming that the results are saved.



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…

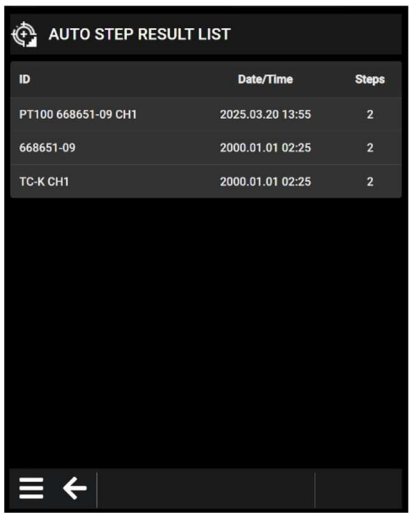
The BACK key  returns you to previous the menu. The BACK key can be used throughout the process.

5.4.2 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.

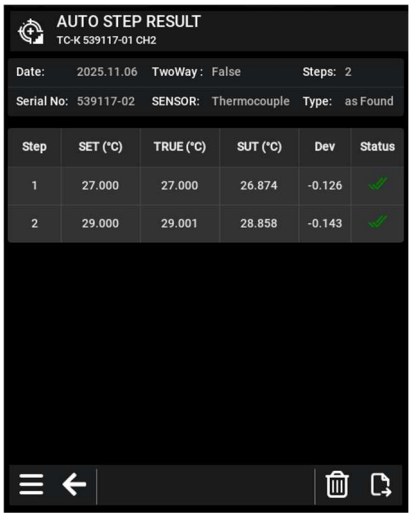
To view stored AUTO STEP test results

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.

5.5 SWITCH TEST SETUP

Note…

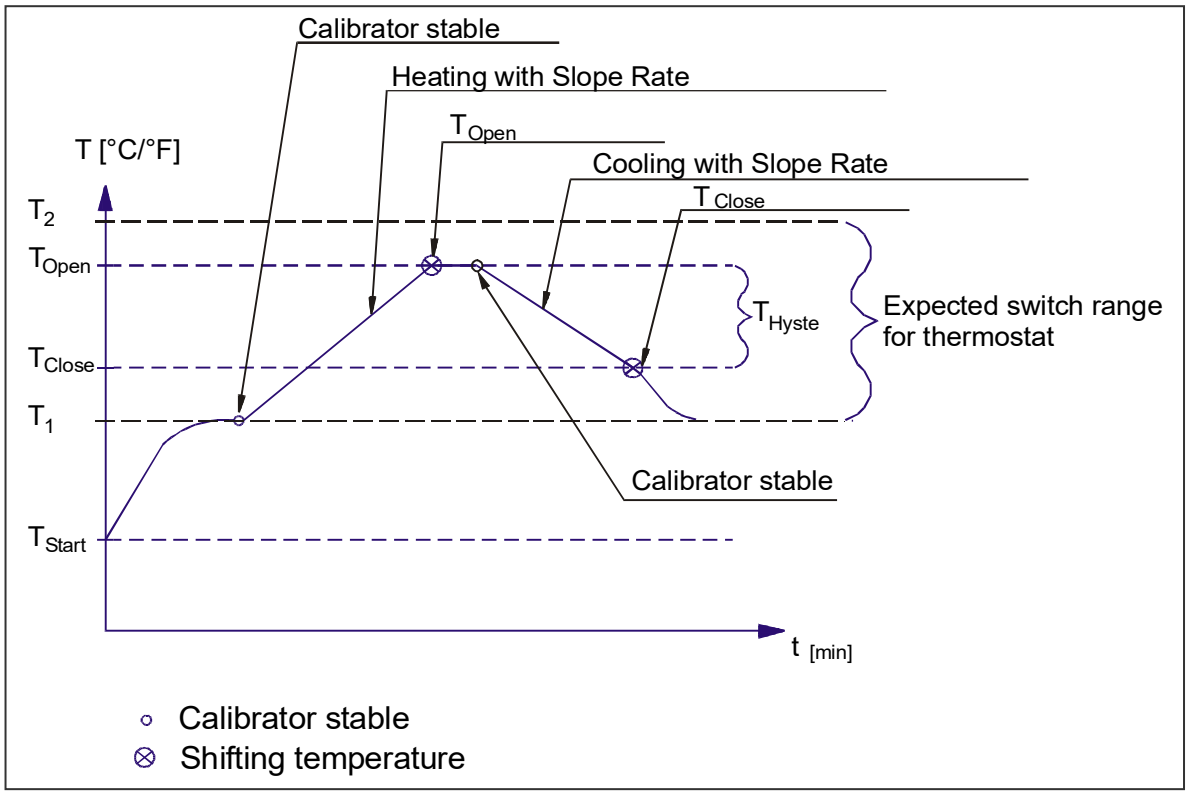
This SWITCH TEST function is for B models only.

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.



5.5.1 Running a Switch Test

Note…

Before running the Switch Test, make sure that the switch is connected to the Switch Test input.

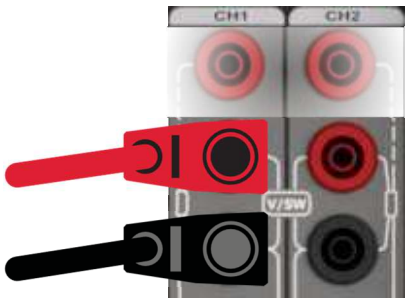
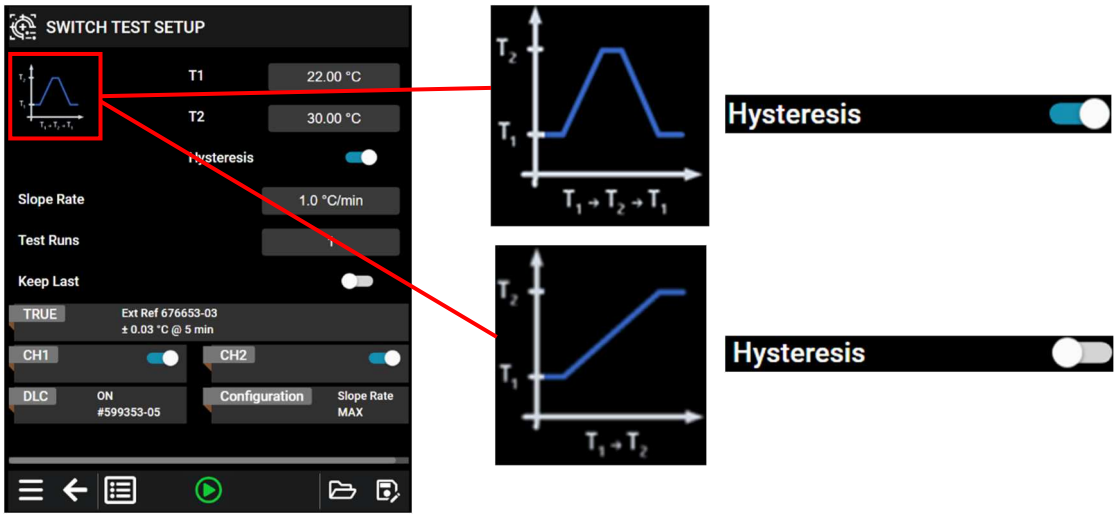


Fig. 8
Switch Test input

Note…

Temperature range is limited by Min. SET Temp. and Max. SET Temp. settings are editable in the TEMPERATURE SETUP menu (see section 5.6) 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 5 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 5.2.2 – 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 5.2.4 – Setting the DLC parameters.
- **Configuration** - access the TEMPERATURE SETUP menu section 5.6 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.



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.

The calibrator's switch test procedure

1. Once the Switch Test is started, the calibrator starts working towards T_1 as quickly as possible. The calibrator's temperature changes (heating or cooling) and switch status are shown in the display.

2. When T_1 is achieved and the temperature is stable, the text and the graphic in the middle of the screen will change accordingly.

3. The calibrator now starts working towards T_2 at the specified slope rate.

4. In a normal situation, the thermostat changes state before T_2 is achieved. If T_2 is achieved and the temperature is stable, a red cross will be displayed instead of a green check ✓.

5. When hysteresis is not selected (single temperature change) (the graphic indicates the choice), the finished Switch Test result is displayed.

   When hysteresis is selected (two switch changes), the calibrator starts working towards T_1 at the specified slope rate.

6. Normally, the thermostat changes state before T_1 is achieved. If T_1 is reached and the temperature is stable, a red cross will be displayed instead of a green check ✓.

7. The finished Switch Test results are displayed.

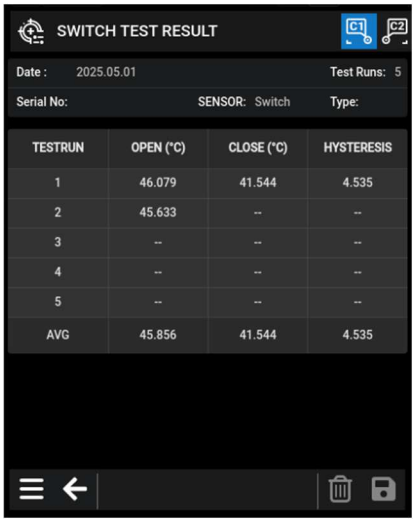
5.5.2 Showing Switch Test Results

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.

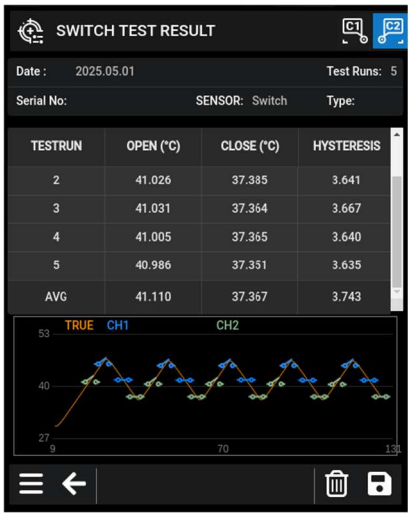


2. This shows the results that are currently available. These results change as the test progresses.

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.

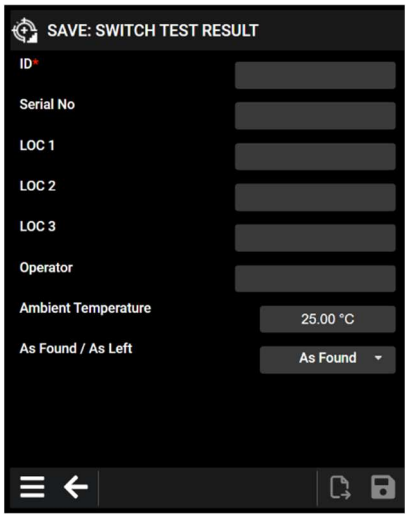


1. Press “Save” to save the results storing them in the calibrator’s memory.

Note...

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

A SAVE: SWITCH TEST RESULT setup menu is displayed.



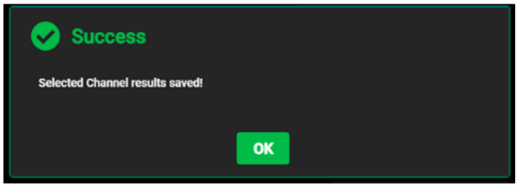
2. The following parameters are available for editing:

- **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 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.



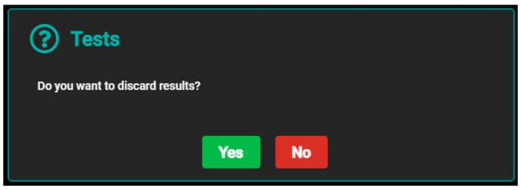
4. Press  “Save” and a check-box is displayed confirming that the results are saved.



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…

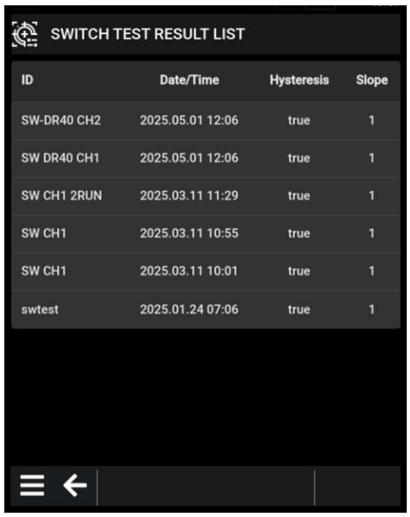
The BACK key  returns you to previous the menu. The BACK key can be used throughout the process.

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

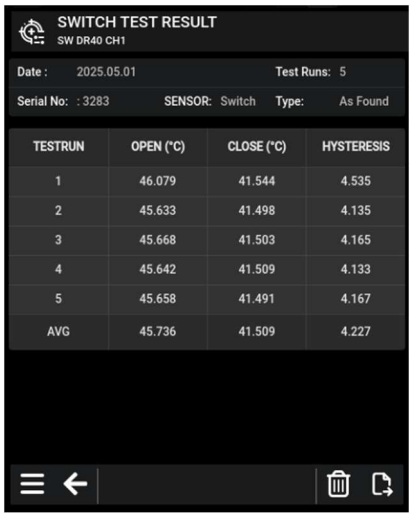
7. Delete the result by pressing  “Delete” or save the result by pressing  “Save”.

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.

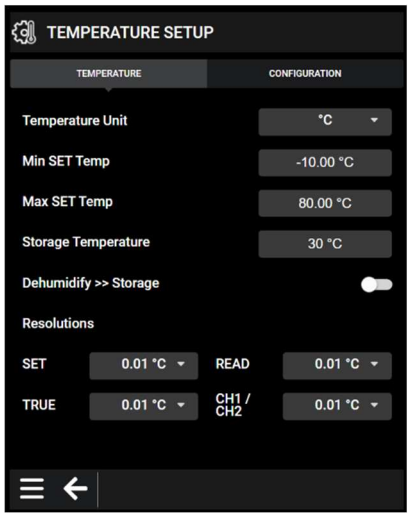


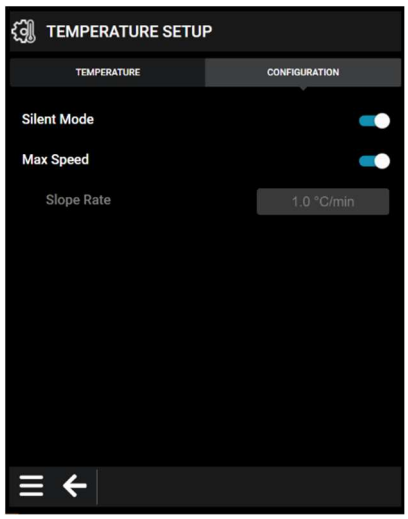
3. Press  twice to return to the Switch Test Setup menu.

The memory can hold 50 SwitchTest Results.

5.6 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.

5.6.1 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.

5.6.2 Setting the Temperature Resolutions

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

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

5.6.3 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.

5.7 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 

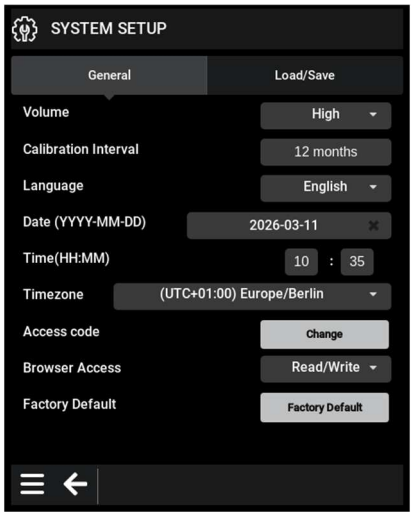
Caution...

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.

5.8 SYSTEM SETUP menu

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



A SYSTEM SETUP menu is displayed.

5.8.1 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.

5.8.2 Setting the Date, Time and Time zone parameters

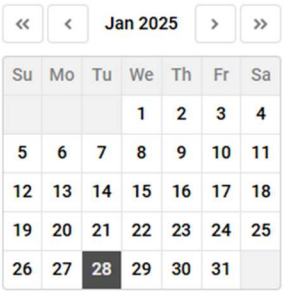
Date:

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.

5.8.3 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.

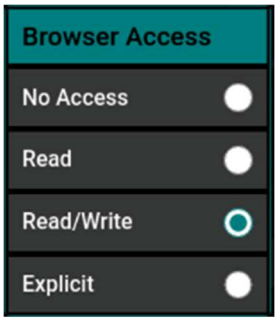
The access code can be deleted allowing you to change the Min/Max SET temperature without having to enter the access code.

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.

5.8.4 Setting the Browser Access

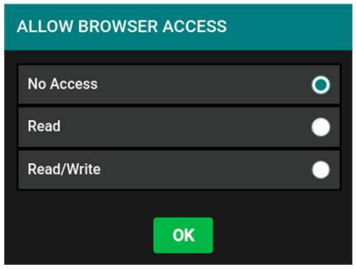
The Browser Access can only be used operating directly from the calibrator and is controlling remote access to the calibrator. It is not possible to access this function when working remote.

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 5.9.6 for Remote Access Privileges



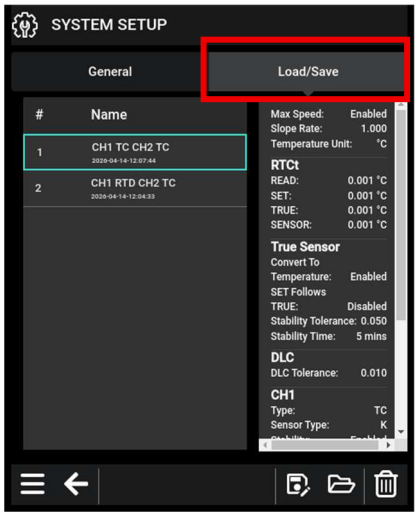
5.8.5 Setting the Factory Default

Selecting the “Factory Default” will change the active setup to the initial settings.

5.8.6 Load/Save settings

Calibrator configuration can be saved and restored from the SYSTEM SETUP menu.

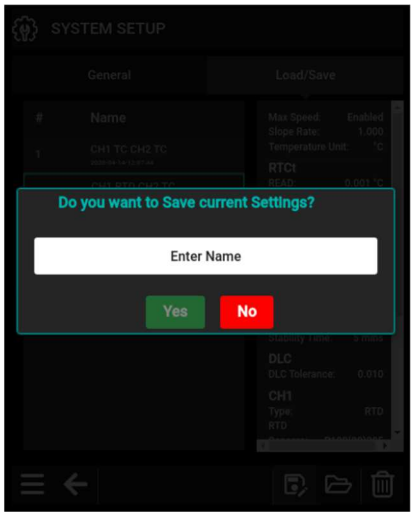
1. Select “Load/Save” on the screen.
   The Load/Save tab lists all previously stored calibrator configurations. If no calibrator configurations have been stored, the list is empty.

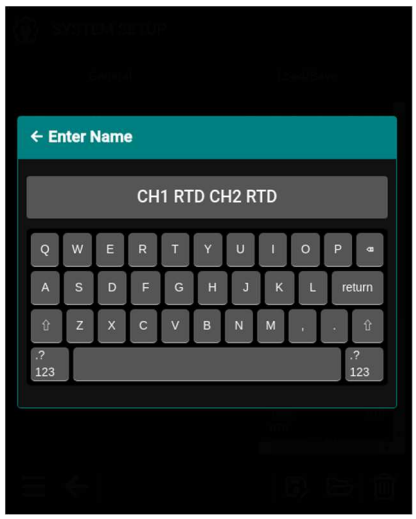


Save Settings

1. To save the current calibrator settings, press  “Save as”.
   A confirmation popup requests a name to store the settings under.

2. Press the text box and use the on-screen keyboard to enter the name followed by pressing ‘return’.

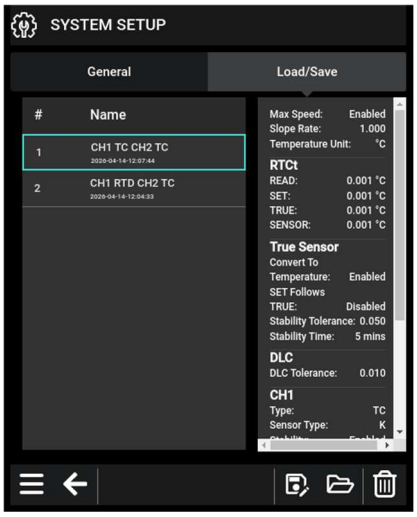




3. Press **Yes** to store the calibrator configuration, or **No** to cancel.
   The stored configuration will be displayed in the list.

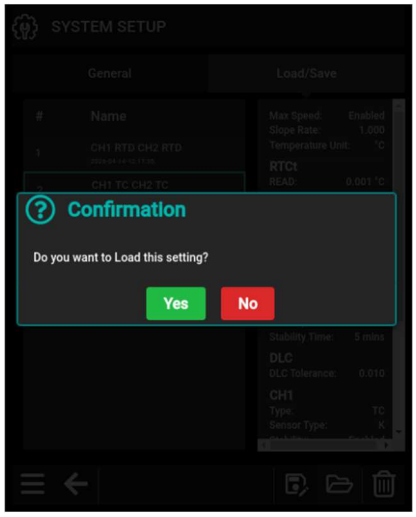
Load Settings

1. To load a previously stored calibrator configuration, select the relevant line in the list. The configuration details will be displayed to the right of the list.



Scroll down to read all details.

2. Press  “Open folder/Open file” and a confirmation popup is displayed

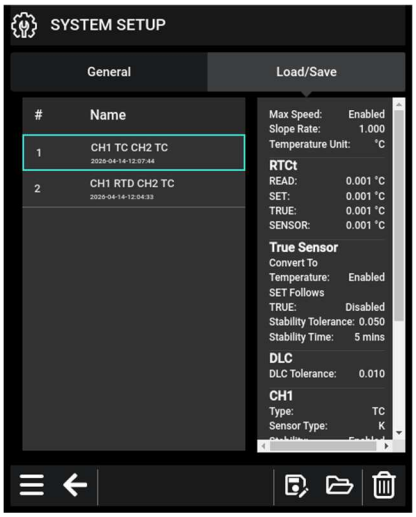


3. Press Yes to load the selected configuration, or No to cancel.

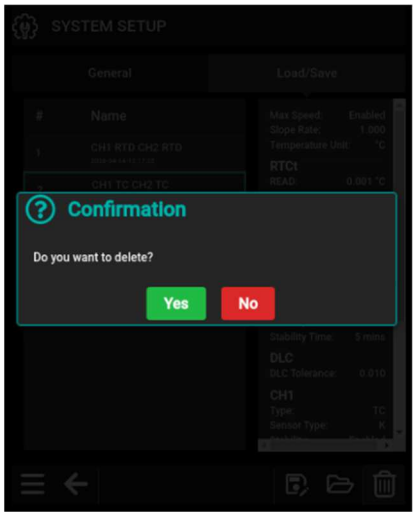
Note...
Loading a previously stored calibrator configuration overwrites the current calibrator configuration and cannot be undone! Store current configuration before loading previously stored configuration if needed.

Delete stored Settings

1. To delete a previously stored calibrator configuration, select the relevant line in the list. The configuration details will be displayed to the right of the list.



2. Press  “Delete” and a confirmation popup is displayed



3. Press Yes to delete the selected configuration, or No to cancel.

Note...
Deleting stored calibrator configurations cannot be undone.

5.9 COMMUNICATION SETUP

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



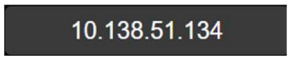
The COMMUNICATION SETUP menu is displayed.

5.9.1 Setting LAN

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

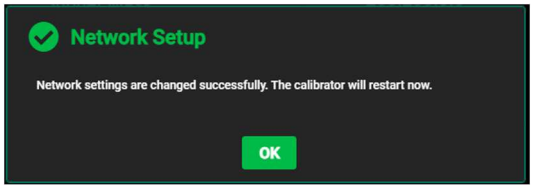
1. Slide the DHCP button to the left to get editable access to the LAN parameters:
   - **IP Address**
   - **Subnet Mask**
   - **Default Gateway**
   - **MAC Address**
2. You can configure the LAN-settings manually using the NUMERIC keys

   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.



5.9.2 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**
   - **MAC Address**
2. When connected to a wireless network, the status bar on the top of the screen will display a symbol indicating the connection status .

5.9.3 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.

5.9.4 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.

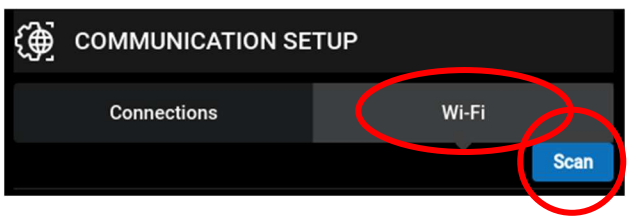


Caution…

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.

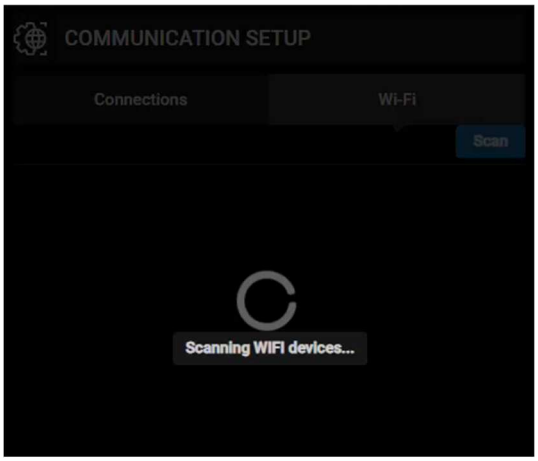
3. If no Wifi network SSIDs are listed, press Scan to list available Wifi network SSIDs.

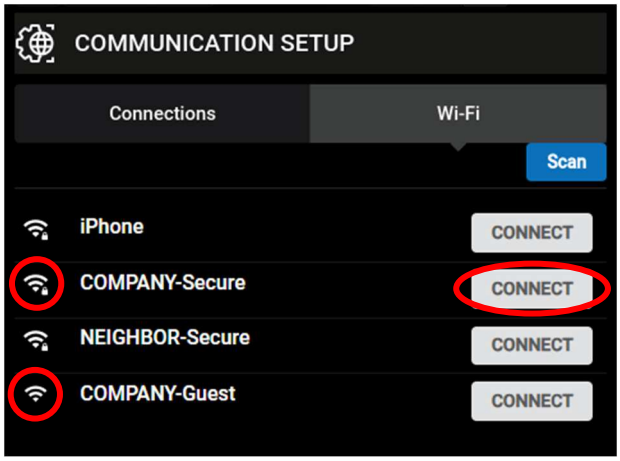


Note...

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.

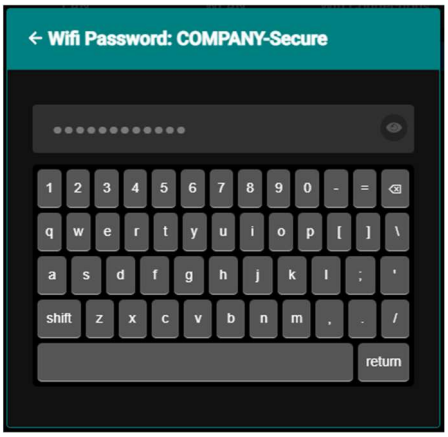
Networks protected by a password are displayed with a lock symbol .

Networks without password protection are displayed without a lock

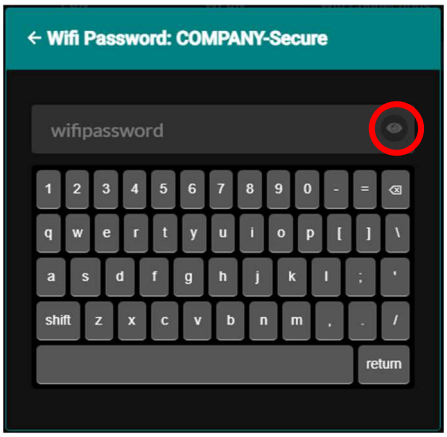
4. For the desired wireless network, press CONNECT. If the network is not password protected, the calibrator immediately connects to the network.

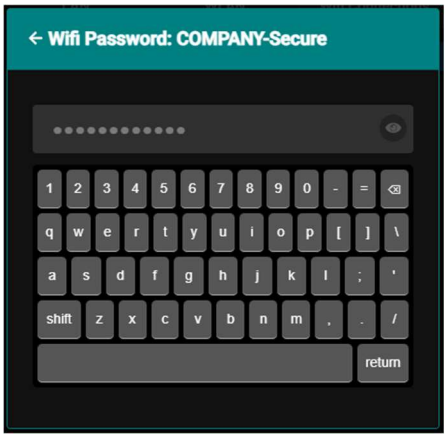
5. If the network is protected by password, a dialog appears, requesting the password. Use the NUMERIC keys to enter the password for the network. Entered characters are displayed in the password input field as dots.



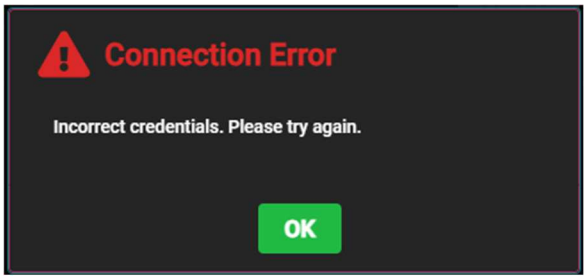


6. Press and hold the eye symbol to momentarily display the password as clean text. When released, the password characters are displayed as dots again.





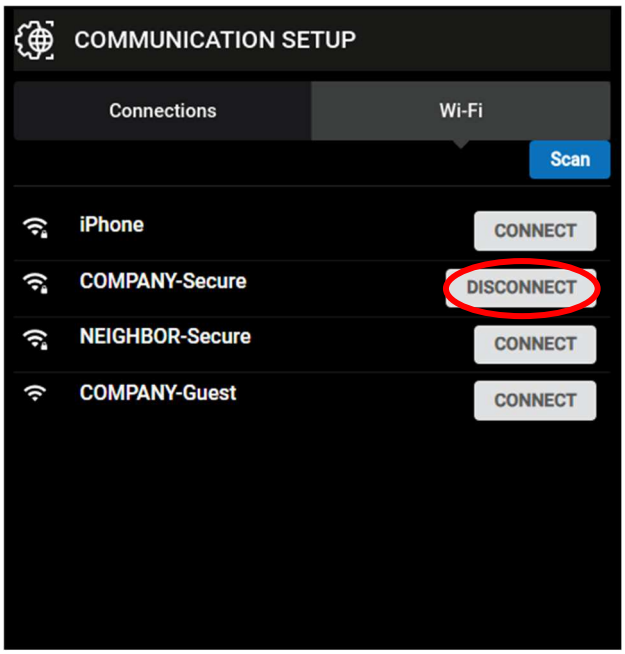
7. If the entered password is incorrect connection fails, and an error message is displayed.



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 5.9.2.

5.9.4.1 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.



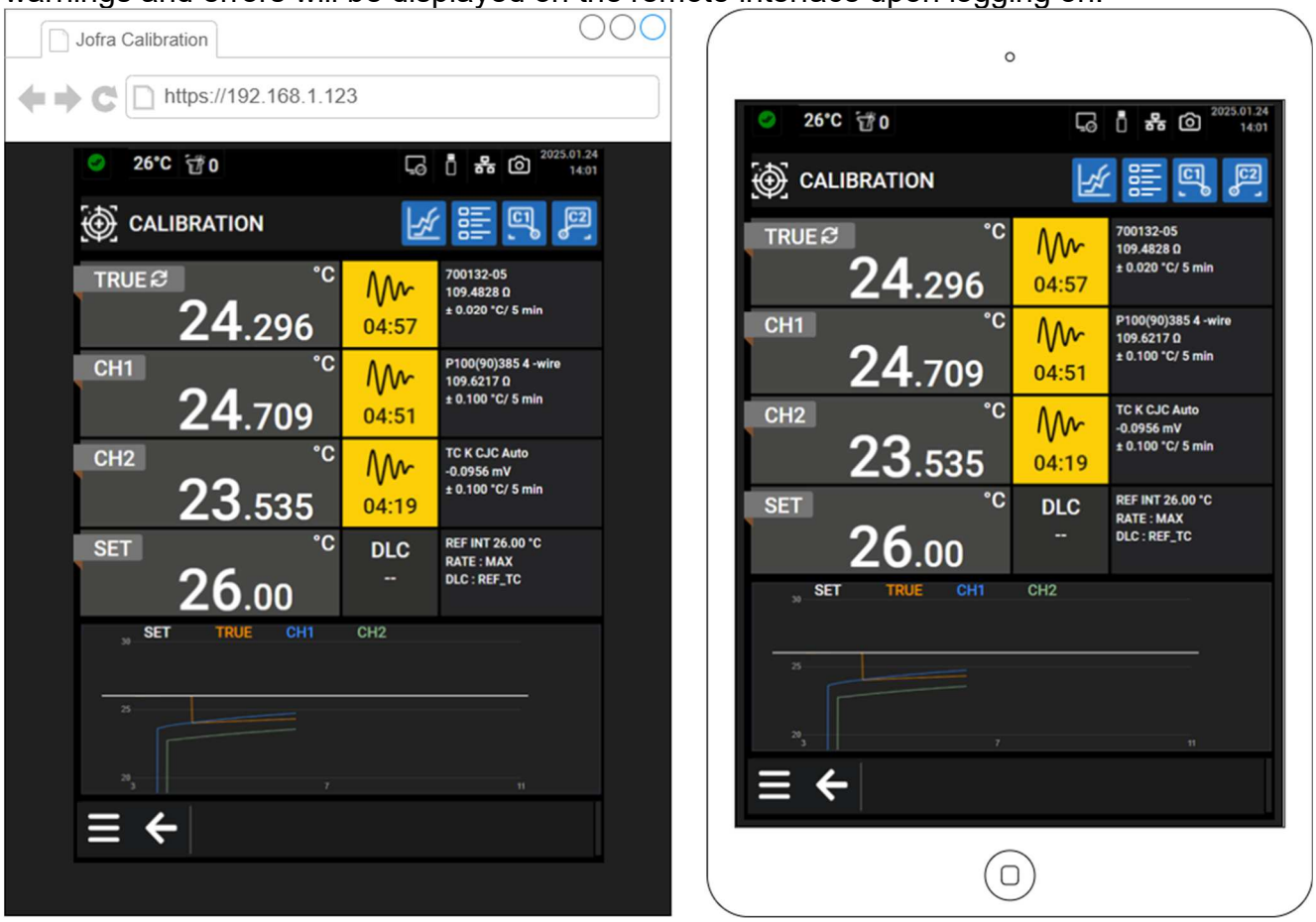
5.9.5 Remote Access

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 5.9.6 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.

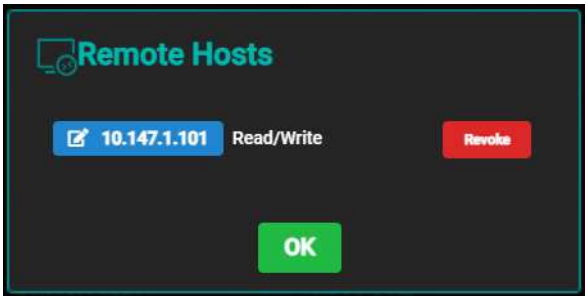
5.9.6 Remote Access Privileges

Upon connection from a remote web browser, the local 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 5.8.4 for details on how to set up default privileges for remote hosts.

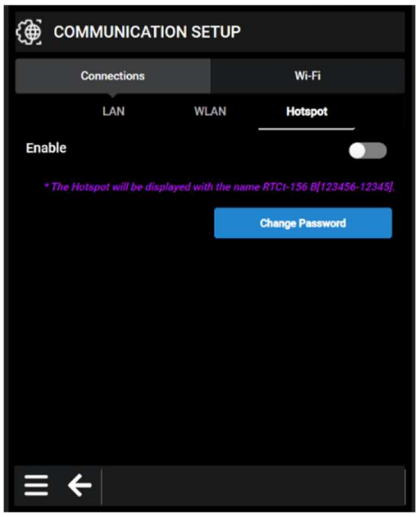
5.9.7 Remote communication

See RTCt Remote Communication manual.

5.9.8 Hotspot

The RTCt calibrator can create a local, isolated Wi-Fi Hotspot, to which Wi-Fi enabled client devices such as smartphones, tablets or computers can connect directly.

In the Connections tab of the Communications Setup window, the Hotspot can be enabled. It creates a Wi-Fi network with an SSID related to the calibrator model.



Hotspot SSID naming: “Calibrator Model[Serial Number]”. Example: An RTCt-156 B with serial number 123456-12345 will generate a Hotspot SSID called “RTCt-156B[123456-12345]”.

Default Hotspot password: The default password for the Hotspot is the calibrator model type. Example: An RTCt-156 B has default Hotspot password “RTCt-156 B”. To increase security, change the password for an active Hotspot to a strong and unique one.

Once enabled, the Hotspot can be accessed by any compatible client device using Wi-Fi. The calibrator’s Hotspot IP address is displayed in the Connections tab of the Communications Setup window. Also, the number of devices currently connected to the hotspot is displayed in this tab.



When Hotspot connection is established, use the device’s web browser and enter the calibrator’s Hotspot IP address or scan the displayed QR code shortcut to access the calibrator user interface.

To prevent unintentional external connections to the Hotspot, disable it when not used.

5.9.8.1 Connect to calibrator using Hotspot

1. Enter the Communication Setup window and select the Hotspot tab.

2. Press the toggle switch button next to “Enable” to enable the Hotspot. The toggle switch has blue background when enabled.



3. On the client device, scan available Wi-Fi networks and select the calibrator’s Hotspot – or use the device’s camera to scan the QR code displayed in the Communication Setup window on the calibrator screen to connect to the Hotspot automatically.

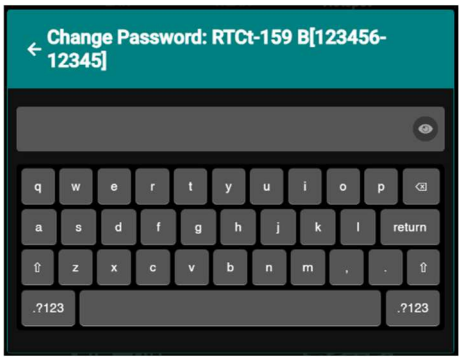
4. Open the client's web browser and enter the calibrator's Hotspot IP address in the address bar – or use the device's camera to scan the QR code displayed in the Communication Setup window on the calibrator screen to navigate to the calibrator's Hotspot IP address automatically.

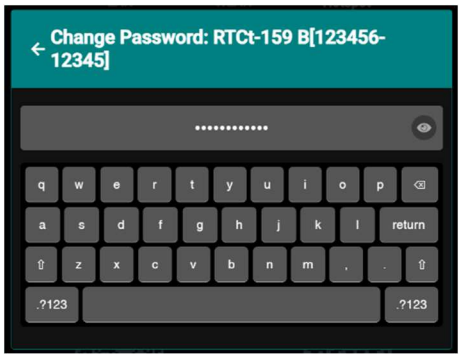


5.9.8.2 Change password

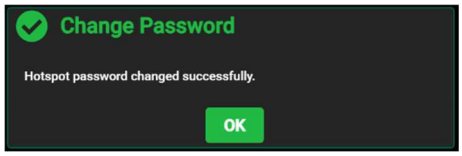
1. On the Hotspot tab of the Communication Setup window, press the Change Password button.

2. Enter a strong password using the on-screen keyboard. During typing, characters are displayed as dots in the password field. Press the eye symbol to momentarily displaying the typed password characters as plain text.





3. On Press "return". The Hotspot password will be updated, confirmed by a popup dialog.



5.9.8.3 Disconnect from Hotspot

1. On the Hotspot tab of the Communications Setup window, press the toggle switch button next to "Enable" to disable the Hotspot. The toggle switch has grey background when disabled. Hotspot details such as IP address and number of connected devices are hidden.

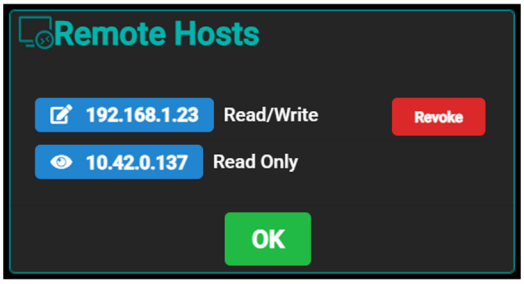
5.9.8.4 Multi-client behavior

It is possible to simultaneously access the calibrator from multiple client devices, across different calibrator network interfaces.

Depending on the Browser Access setting in the System Setup, the first client is granted read or read/write access. Clients, connecting hereafter, are granted read access.

1. To view a list of the currently connected client devices, press the Screen-icon  in the top status bar.

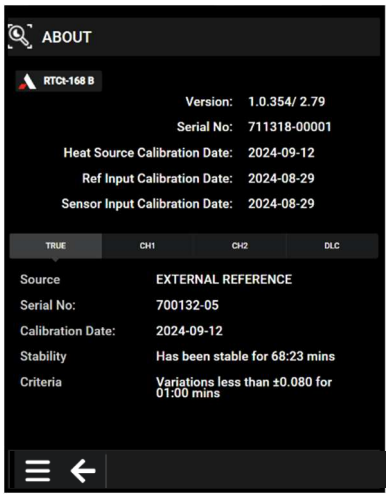
2. Write access for a particular client device can be revoked by pressing Revoke-button Revoke next to the IP address of that client device.



5.10 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.

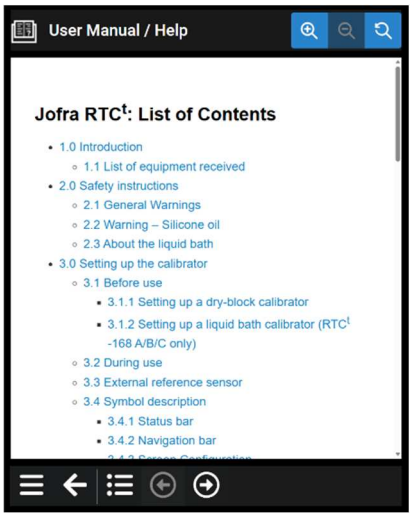
2. Press either the TRUE, CH1, CH2 or DLC field to get access to an ABOUT / STATUS summary of the sensors setting and stability information.

Note...

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

5.11 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.

6.0 After use

6.1 Storing and transporting the calibrator



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 (applies only to the RTC^{t} -156/157/159/168 A/B/C models)

- **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. 9.

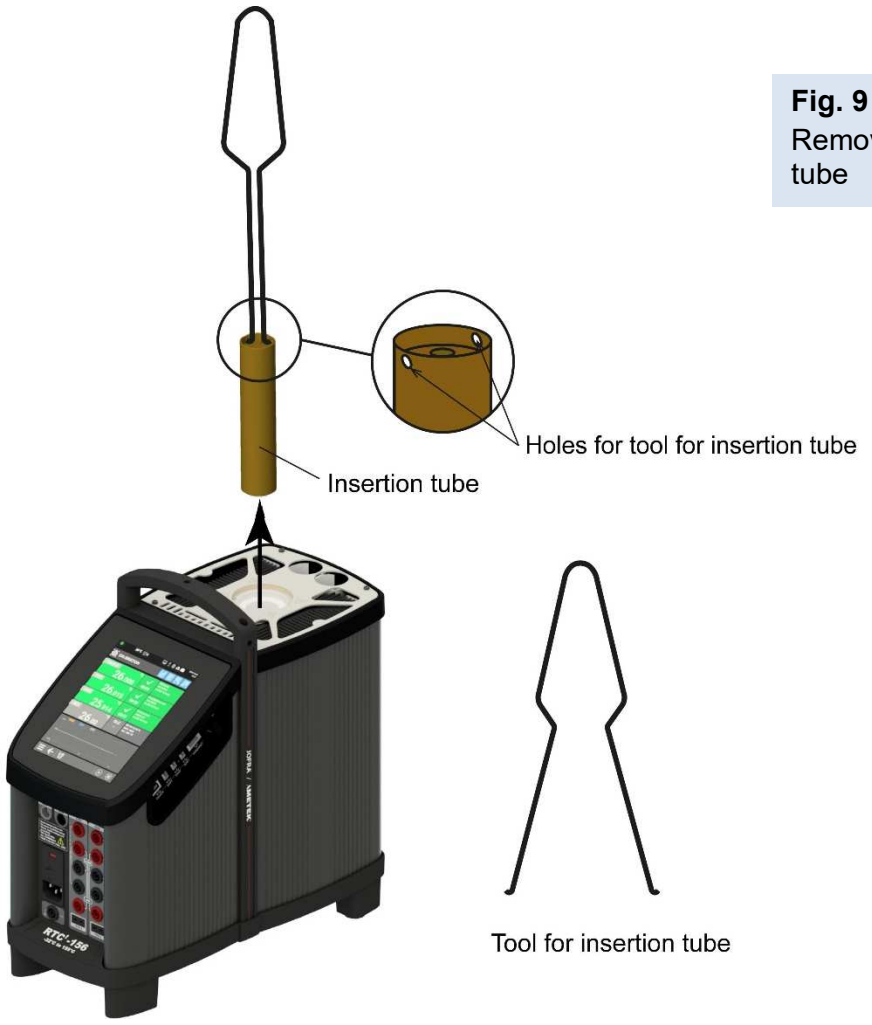


Fig. 9
Removing insertion tube



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 both 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.

7.0 Error messages (List of alarms)

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.

Note…

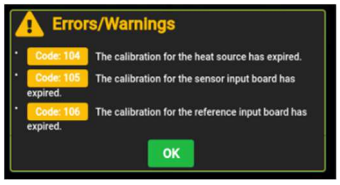
If the software detects an error during operation, the error will be shown in the display.

Make a note of the error message and contact your distributor or AMETEK Denmark's service department.

AMETEK Denmark's liability ceases if:

- parts are replaced/repaired using spare parts which are not identical to those recommended by the manufacturer.
- non-original parts are used in any way when operating the instrument. AMETEK Denmark's liability is restricted to errors which originated from the factory.

Pres the status indicator / in the status bar to see active warnings/errors.



Error messages are displayed in a dialog box with the following text:

Internal Error # xxx **Please read the manual for further information**

Error #	Error text	Category	Solution
0	**Read temperature lower than calibrator minimum temperature**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
1	**Read temperature higher than calibrator maximum temperature**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
2	**Read temperature higher than current SET-temperature**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
3	**Top Zone temperature deviation**	Warning	The calibrator could be stressed due to the insertion of too many sensors. Remove some of the sensors. If the error still occurs, please report the error to your local distributor or to AMETEK Denmark's service department
4	**Internal reference measuring circuit error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
5	**Internal reference sensor error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department

Error #	Error text	Category	Solution
6	**Zone 2 sensor error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
7	**Zone 1 sensor error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
8	**Heater 1 error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
9	**Heater 2 error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
10	**Heater 3 error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
11	**Heater 4 error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
12	**Heater control error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
13	**Temperature protection**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
14	**Temperature protection Stirling unit**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
15	**Stirling unit error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
16	**Stirling unit Temperature too high**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
17	**Top zone read temperature lower than calibrator minimum temperature**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
18	**Top zone read temperature higher than calibrator maximum temperature**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department.
19	**Bottom zone read temperature lower than calibrator minimum temperature**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
20	**Bottom zone read temperature higher than calibrator maximum temperature**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
21	**Bottom zone temperature deviation**	Error	The calibrator could be stressed due to the insertion of too many sensors. Remove some of the sensors. If the error still occurs, please report the error to your local distributor or to AMETEK Denmark's service department
22	**Ambient temperature sensor error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
23	**Stirling unit error**	Error	Check air inlet and outlet for obstructions. Replace air inlet filter if needed. If error persists, please report the error to your local distributor or to AMETEK Denmark's service department

Error #	Error text	Category	Solution
100	**Sensor input board error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
101	**The sensor input board has not been calibrated**	Error	The sensor inputs (mA/Ω/mV/V) need to be calibrated. Please report the error to your local distributor or to AMETEK Denmark's service department
102	**Reference input board error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
103	**The reference input board has not been calibrated**	Error	The reference input needs to be calibrated. Please report the error to your local distributor or to AMETEK Denmark's service department
104	**The calibration for the heat source has expired**	Warning	Calibrate the heat source
105	**The calibration for the sensor input board has expired**	Warning	Calibrate the sensor input (mA/Ω/mV/V)
106	**The calibration for the reference input board has expired**	Warning	Calibrate the reference input
107	**The calibration for the external reference sensor has expired**	Warning	Calibrate the external reference sensor
108	**The calibration for the DLC has expired**	Warning	The instrument needs to be calibrated
109	**Heat source not calibrated**	Error	The instrument needs to be calibrated
110	**DLC write error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
111	**External reference write error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
112	**Started simulation**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
113	**Control hardware error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
114	**Reference input hardware error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
115	**Sensor input hardware error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
116	**Unsupported DLC sensor**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
117	**Unsupported external reference sensor**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
118	**DLC read error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
119	**External reference read error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department

Error #	Error text	Category	Solution
120	**System memory low error**	Warning	Please report the error to your local distributor or to AMETEK Denmark's service department
121	**TEDS format error**	Error	Please report the error to your local distributor or to AMETEK Denmark's service department
151	**Cannot access the calibrator**	Error	Reboot the calibrator or manually run the engine
152	**Cannot access the calibrator**	Error	Reboot the calibrator or manually run the app server
255	**Failed to retrieve the calibrator information**	Error	Reboot the calibrator or manually run the app server

Note…

Errors that are critical to safety and the calibrator remain on the ABOUT/STATUS screen until the instrument has been switched off and on again.

8.0 Returning the calibrator for service

When returning the calibrator to the manufacturer for service, please enclose a fully completed service information form. Simply copy the form on the following page and fill in the required information.
The calibrator should be returned in the original packing.

The RTC^{t}-159 contains the flammable refrigerating gas R-1270 and the gas R-704. The amount of gas is less than 100g and it is considered not subject to the Dangerous Goods Regulations. However, this must be declared when shipping.

When dispatching the RTC^{t}-159 please mark the package and the shipping papers with this text:

*** NOT RESTRICTED , SPECIAL PROVISION A103 ***

Service info

Customer data: **Date:**

Customer name and address:_____

Attention and dept.:_____

Fax no./phone no.:_____

Your order no.:_____

Delivery address:_____

Distributor name:_____

Instrument data:

Model and serial no.:_____

Warranty claimed Yes:_____ No:_____ Original invoice no.:_____

Temp. calibration	Sensor input	**Service request:**	**This instrument is sent for (please check off):**
☐	☐	___ Calibration as left	___ Check
☐	☐	___ Calibration as found and as left	___ Service
☐	☐	___ Accredited calibration as left	___ Repair
☐	☐	___ Accredited calibration as found and as left.	

Diagnosis data/cause for return:

Diagnosis/fault description:_____

Special requests:_____

Safety precautions: if the product has been exposed to any hazardous substances, it must be thoroughly decontaminated before it is returned to AMETEK Denmark A/S. Details of the hazardous substances and any precautions to be taken must be enclosed.

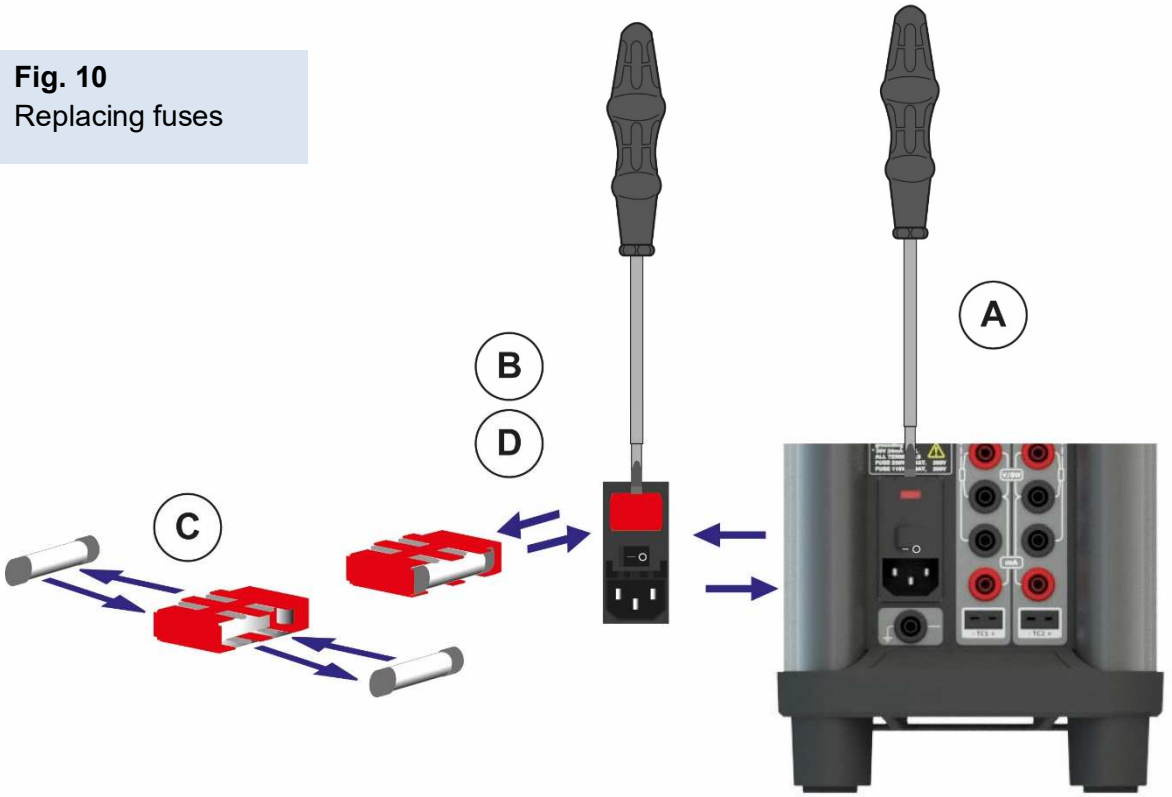
9.0 Maintenance

9.1 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. 10
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, T6A = 130972
- RTC^{t}-159: 115V/230V, F4A = 131195
- RTC^{t}-700: 115V, F10A = 131181 / 230V, F5A = 131180

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.

9.2 Cleaning



Caution…

- Before cleaning the calibrator, you **must** switch it off, allow it to cool down and remove all cables.
- 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.



Caution – Hot surface

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



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 aluminium 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.
- **Do not** touch the well or insertion tube when these are deep frozen – they might create frostbite.

Users should/must carry out the following cleaning procedures as and when required:

- **The exterior of the instrument –** Clean using water or isopropyl alcohol and a soft cloth. The cloth should be wrung out hard to avoid any water penetrating the calibrator and causing damage.
  The keyboard may be cleaned using isopropyl alcohol when heavily soiled.

- If hazardous material is spilled onto or into the calibrator, the user is responsible for appropriate decontamination.

- Before using any decontamination or cleaning agents other than those specified in this manual, the user should check with AMETEK to ensure compatibility with the calibrator. Use of decontamination or cleaning agents incompatible with the calibrator may damage the calibrator or cause hazard.

- **The insertion tube –** must **always** be clean and should be regularly wiped using a soft, lint-free, dry cloth.
  You must ensure there are no textile fibres on the insertion tube when it is inserted in the well. The fibres may adhere to the well and damage it.

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

  To prevent this from happening, the insertion tube 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 insertion tube is removed to prevent corrosion and frost expansion damages.

- **The well –** must **always** be clean.
  Dust and textile fibres in the well should be removed from the dry-block calibrator using e.g. compressed air.
  Remains of silicone oil in the well should be removed from the liquid bath calibrator by using special cleaning oil.



Warning

REMEMBER to wear goggles when using compressed air and cleaning oil.

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

To prevent this from happening, 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 is removed to prevent corrosion and frost expansion damages.

- **The stirring magnet and sensor basket (RTC^t -168 A/B/C only) –** When removed from the calibrator the items must be cleaned thoroughly with dry disposable paper towels to avoid spilling of liquid. Drops of silicone oil can be removed by using special cleaning oil.

- **The sensor-under-test (RTC^t -168 A/B/C only) –** When removed from the calibrator the sensor must be cleaned thoroughly with dry disposable paper towels to avoid spilling of liquid. Drops of silicone oil can be removed by using special cleaning oil.



Caution…

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

9.3 Adjusting and calibrating the instrument

You are advised to return the calibrator to AMETEK Denmark A/S or another accredited laboratory at least once a year for calibration.

Alternatively, you can calibrate/adjust the calibrator yourself using the AmeTrim Adjust and Calibration Software.

Please refer to the Ametrim User Manual also found on the installation USB memory stick.

9.4 Maintenance of STS-reference sensor

Use the configuration software CON050 supplied with the RTC^t to update calibration information in the intelligent reference sensor.

Read the STS- and CON050 manuals for instruction about calibration and up-/download procedure.

The following information in the sensor is used by the RTC^t and must be filled in correctly:

- Serial number
- Model number
- Sensor type
- Temperature range Min/Max
- Electrical output Min/Max
- RTD type (CvD or ITS-90)
- Calibration date
- Calibration initials
- Calibration period
- R0, A, B and C (RTD type = CvD)
- RTPW, A(LR), B(LR)C(LR)/C1(LR), C2(LR), C3(LR), C4(LR), C5(LR) A(HR), B(HR), C(HR), D(HR) and W(HR) (RTD type = ITS-90)

All other data are not used by the RTC^t.

On the sensor calibration certificates, the coefficients can be listed using the ITS-90 names for coefficients. The table below can be used to convert the ITS-90 coefficient names to RTC^t - coefficient names for the ITS-90 subranges used in the RTC^t -calibrator temperature range.

		ITS90 Subrange								
		3	4	5	6	7	8	9	10	11
RTC^t coefficient	A(LR)	a3	a4	0						
	B(LR)	b3	b4	0						
	C(LR)/C1(LR)	c3	0	0						
	A(HR)			a5	a6	a7	a8	a9	a10	a11
	B(HR)			b5	b6	b7	b8	b9	0	0
	C(HR)			0	c6	c7	0	0	0	0
	D(HR)			0	d	0	0	0	0	0
	W				w					

9.5 Maintenance of DLC-sensor

Use the configuration software CON050 supplied with the RTC^t to update calibration information in the intelligent reference sensor.

Read the DLC- and CON050 manuals for instruction about calibration and up-/download procedure.

The following information in the sensor is used by the RTC^t and must be filled in correctly:

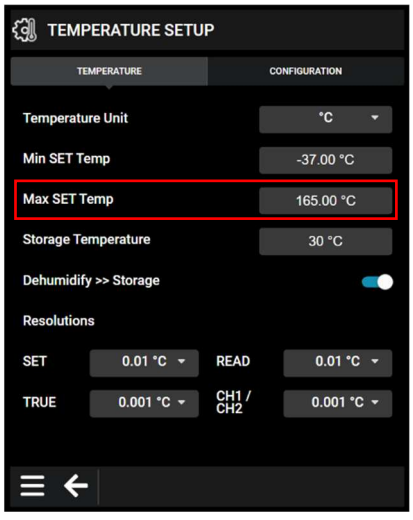
- Serial number
- Model number
- Sensor type
- Temperature range Min/Max
- Electrical output Min/Max
- TC-type (DLC-155/159/168 = T, DLC-700 = N)
- CJC (Must be set to "No compensation")
- Calibration date
- Calibration initials
- Calibration period
- Correction coefficients A, B and C

All other data are not used by the RTC^t.

9.6 Testing the overtemperature function

It is recommended to test the overtemperature function every 12 months. The test is carried out as follows:

1. Access the TEMPERATURE SETUP menu through the Temperature Configuration function on the Menu screen and set the “Max SET Temp” to the maximum temperature of the calibrator.



2. Let the calibrator heat and stabilize at the maximum temperature.

3. Set the “Max SET Temp” of the calibrator to 50°C below the maximum temperature of the calibrator.

If the Read temperature now starts decreasing, the overtemperature function is working properly.

4. Set the “Max SET Temp” back to the maximum temperature of the calibrator and turn off/on the calibrator.

5. When powered up again, the calibrator will operate normally.

10.0 Technical specifications

The list below shows the setup that forms the basis for the technical specifications for :

Dry-block calibrators

- Calibrator
- Ø 4.2 mm insertion tube
- Insulation plug with silicone plugs (RTC^t -156/157/159/168/ only)
- 4 mm STS-200 sensor
- Reference thermometer (e.g. DTI-1000)

The list below shows the setup that forms the basis for the technical specifications for :

Liquid bath calibrator

- Calibrator
- Bottom shield
- Stirring magnet
- Sensor basket
- Lid for calibration
- 4 mm STS-200 sensor
- Reference thermometer (e.g. DTI-1000)

TECHNICAL SPECIFICATIONS

All specifications are given with an ambient temperature of 23°C/73.4°F ± 3°C/5.4°F

MECHANICAL SPECIFICATIONS	**RTC^t -156 A/B/C**
Dimensions l × w × h	362 × 171 × 363 mm / 14.2 x 6.7 x 14.3 inch
Weight	RTC^t-156 A : 10.2 kg / 22.5 lb RTC^t-156 B/C : 10.3 kg / 22.7 lb
Shipping dimensions	520 x 320 x 460 mm / 20.5 x 12.6 x 18.1 inch (Cardboard box) 550 x 440 x 610mm / 21.7 x 17.3 x 24.0 inch (Carrying case in cardboard box)
Shipping weight	21.5 kg / 47.4 lb (in cardboard box) 33.0 kg / 72.8 lb (in carrying case in cardboard box)
Bore diameter/depth of well	ø30 mm / 150 mm – ø1.18 inch / 5.91 inch
Weight non-drilled insert	290 g / 10.2 oz
POWER SUPPLY	
Mains voltage/frequency	115 VAC (90-127 VAC) / 230 VAC (180-254 VAC), 50/60 Hz (45-65 Hz)
Power consumption	350 VA
Type of connection	IEC60320, C14 inlet for C13 connector
IEC 60664-1 Overvoltage category	OVC II
COMMUNICATION INTERFACES	
Type of connections	USB A (host), USB B (device), RJ45 (Ethernet), Wi-Fi 802-11ac (external USB device)
ENVIRONMENT	
Locations	Indoor use only Not for use in wet locations or in hazardous areas
Ambient operating temperature range	0-40°C / 32-104°F
Storage temperature range	-20-50°C / -4-122°F
Humidity range	0-90% RH.
Altitude	Up to 2000 m
Appliance protection class	Class I
Pollution degree	Pollution degree 2
Ingress protection class	IP10
Electromagnetic environment	Designed for use in basic electromagnetic environment as defined in EN 61326-1:2013. Length of test cables should not exceed 3 m.
READOUT SPECIFICATIONS	
Resolution	0.001°C / 0.001°F / 0.001 K
Temperature units	°C / °F / K

THERMAL SPECIFICATIONS	RTC^{t} -156 A/B/C
Maximum temperature	155°C / 311°F
Minimum temperature *	-46°C / -50.8°F @ ambient temperature 0°C / 32°F
	-32°C / -25.6°F @ ambient temperature 23°C / 73.4°F
	-17°C / -1.40°F @ ambient temperature 40°C / 104°F

THERMAL SPECIFICATIONS	RTC^t -156 A/B/C
Well specifications	Loaded with 2 x 3mm sensors:
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ -32°C/-25.6°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 100°C/212°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ -32°C/-25.6°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ 100°C/212°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ -32°C/-25.6°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.040°C/0.072°F @ 100°C/212°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.035°C/0.063°F @ -32°C/-25.6°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.040°C/0.072°F @ 50°C/122°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.050°C/0.09°F @ 100°C/212°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ -32°C/-25.6°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.040°C/0.072°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.045°C/0.081°F @ 50°C/122°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ 100°C/212°F to 155°C/311°F

THERMAL SPECIFICATIONS	RTC^{t} -156 A/B/C
Well specifications	<u>Loaded with 3 x 3mm sensors + 1 x 4mm sensors:</u>
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 100°C/212°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ 100°C/212°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.040°C/0.072°F @ 100°C/212°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.050°C/0.09°F @ -30°C/-22°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ 50°C/122°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.060°C/0.11°F @ 100°C/212°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.080°C/0.14°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.040°C/0.072°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.055°C/0.10°F @ 50°C/122°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.070°C/0.13°F @ 100°C/212°F to 155°C/311°F

THERMAL SPECIFICATIONS	RTC^{t} -156 A/B/C
Well specifications	Loaded with 3 x 3mm sensors + 1 x 4mm sensor + 1 x 6 mm sensor and DLC active (system calibration):
	40 mm / 1.57 inch axial uniformity: ±0.030°C/0.054°F @ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.035°C/0.063°F @ 100°C/212°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.035°C/0.063°F @ 100°C/212°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.035°C/0.063°F @ 100°C/212°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ -30°C/-22°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.040°C/0.072°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ 50°C/122°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ 100°C/212°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.060°C/0.11°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.055°C/0.10°F @ 50°C/122°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.060°C/0.11°F @ 100°C/212°F to 155°C/311°F

THERMAL SPECIFICATIONS	RTC^t -156 A/B/C
Well specifications	Difference between borings : 0.01°C/0.02°F Influence from load : 0.10°C/0.18°F Influence from load with Ext. Reference : 0.01°C/0.02°F Long term drift (1 year typical) : ±0.040°C/±0.07°F @ 155°C ±0.020°C/±0.07°F @ 23°C ±0.035°C/±0.07°F @ -32°C
Temperature coefficient	Internal reference : ±0.005°C/°C (0-20°C and 26-40°C) / ±0.009°F/°F (32-68°F and 79-104°F) External reference : ±0.0015°C/°C (0-20°C and 26-40°C) / ±0.0027°F/°F (32-68°F and 79-104°F)
Stability	±0.005°C/ ±0.009°F
Accuracy	Internal reference : ±0.10°C/±0.18°F External reference* : ±0.060°C/±0.11°F *System calibration with STS-200 A 915.
Heating time incl. insert	-30°C / -22.0°F to 23°C / 73.4°F : 4 min. 23°C / 73.4°F to 155°C / 311°F : 15 min. -30°C / -22.0°F to 155°C / 311°F : 19 min.
Time to stability	10 min.
Cooling time incl. insert	155°C / 311°F to 100°C / 212°F: 4 min. 100°C / 212°F to 23°C / 73.4°F: 8 min. 23°C / 73.4°F to –24°C / -11.2°F : 14 min. -24°C / -11.2°F to –32°C / -25.6°F: 10 min. 155°C / 311°F to –32°C / -25.6°F : 36 min.

MECHANICAL SPECIFICATIONS	RTC^t -157 A/B/C
Dimensions l × w × h	362 × 171 × 363 mm / 14.2 x 6.7 x 14.3 inch
Weight	RTC^t -157 A : 10.3 kg / 22.9 lb RTC^t -157 B/C : 10.4 kg / 23.1 lb
Shipping dimensions	520 x 320 x 460 mm / 20.5 x 12.6 x 18.1 inch (Cardboard box) 550 x 440 x 610 mm / 21.7 x 17.3 x 24.0 inch (Carrying case in cardboard box)
Shipping weight	21.6 kg / 47.6 lb (in cardboard box) 33.2 kg / 73.2 lb (in carrying case in cardboard box)
Bore diameter/depth of well	ø30 mm / 150 mm – ø1.18 inch / 5.91 inch
Weight non-drilled insert	290 g / 10.2 oz
POWER SUPPLY	
Mains voltage/frequency	115 VAC (90-127 VAC) / 230 VAC (180-254 VAC), 50/60 Hz (47-63 Hz)
Power consumption	350 VA
Type of connection	IEC60320, C14 inlet for C13 connector
IEC 60664-1 Overvoltage category	OVC II
COMMUNICATION INTERFACES	
Type of connections	USB A (host), USB B (device), RJ45 (Ethernet), Wi-Fi 802-11ac (external USB device)
ENVIRONMENT	
Locations	Indoor use only Not for use in wet locations or in hazardous areas
Ambient operating temperature range	0-40°C / 32-104°F
Storage temperature range	-20-50°C / -4-122°F
Humidity range	0-90% RH.
Altitude	Up to 2000 m
Appliance protection class	Class I
Pollution degree	Pollution degree 2
Ingress protection class	IP10
Electromagnetic environment	Designed for use in basic electromagnetic environment as defined in in EN 61326-1:2013. Length of test cables should not exceed 3 m.
READOUT SPECIFICATIONS	
Resolution	0.001°C / 0.001°F / 0.001 K
Temperature units	°C / °F / K

THERMAL SPECIFICATIONS	RTC^{t} -157 A/B/C
Maximum temperature	155°C / 311°F
Minimum temperature *	-57°C / -70.6°F @ ambient temperature 0°C / 32°F
	-45°C / -49°F @ ambient temperature 23°C / 73.4°F
	-31°C / -23.8°F@ ambient temperature 40°C / 104°F

THERMAL SPECIFICATIONS	RTC^t -157 A/B/C
Well specifications	Loaded with 2 x 3mm sensors:
	40 mm / 1.57 inch axial uniformity: ±0.030°C/0.054°F @ -45°C/-49°F to -30°C/-22°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.030°C/0.054°F @ 100°C/212°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.040°C/0.072°F @ -45°C/-49°F to -30°C/-22°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.035°C/0.063°F @ 100°C/212°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.045°C/0.081°F @ -45°C/-49°F to -30°C/-22°F
	60 mm / 2.36 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.040°C/0.072°F @ 100°C/212°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.055°C/0.099°F @ -45°C/-49°F to -30°C/-22°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ -30°C/-22°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.040°C/0.072°F @ 50°C/122°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.050°C/0.090°F @ 100°C/212°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.070°C/1.26°F @ -45°C/-49°F to -30°C/-22°F
	80 mm / 3.15 inch axial uniformity: ±0.060°C/1.08°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.040°C/0.072°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.90°F @ 50°C/122°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.070°C/1.26°F @ 100°C/212°F to 155°C/311°F

THERMAL SPECIFICATIONS	RTC^t -157 A/B/C
Well specifications	Loaded with 3 x 3mm sensors + 1 x 4mm sensors:
	40 mm / 1.57 inch axial uniformity: ±0.035°C/0.063°F @ -45°C/-49°F to -30°C/-22°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 50°C/122°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.035°C/0.063°F @ 100°C/212°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.050°C/0.090°F @ -45°C/-49°F to -30°C/-22°F
	50 mm / 1.97 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.040°C/0.072°F @ 50°C/122°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.060°C/0.108°F @ 100°C/212°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.070°C/0.126°F @ -45°C/-49°F to -30°C/-22°F
	60 mm / 2.36 inch axial uniformity: ±0.050°C/0.090°F @ -30°C/-22°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	60 mm / 2.36 inch axial uniformity: ±0.050°C/0.090°F @ 50°C/122°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.085°C/0.153°F @ 100°C/212°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.100°C/0.180°F @ -45°C/-49°F to -30°C/-22°F
	70 mm / 2.76 inch axial uniformity: ±0.070°C/0.126°F @ -30°C/-22°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.070°C/1.26°F @ 50°C/122°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.120°C/0.216°F @ 100°C/212°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.150°C/0.270°F @ -45°C/-49°F to -30°C/-22°F
	80 mm / 3.15 inch axial uniformity: ±0.100°C/0.180°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ 0°C/32°F to 50°C/122°F

THERMAL SPECIFICATIONS	RTC^t -157 A/B/C
Well specifications	80 mm / 3.15 inch axial uniformity: ±0.100°C/0.180°F @ 50°C/122°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.160°C/0.288°F @ 100°C/212°F to 155°C/311°F
	Difference between borings :
	0.010°C (0.018°F) @ 155°C / 311°F 0.005°C (0.009°F) @ 23°C / 73.4°F 0.010°C (0.018°F) @ -45°C / -49°F
	Influence from load :
	0.10°C (0.18°F)
	Influence from load with Ext. Reference :
	0.01°C / 0.02°F
	Long term drift (1 year typical) :
	±0.040°C / ±0.072°F @ 155°C / 311°F ±0.020°C / ±0.036°F @ 23°C / 73.4°F ±0.040°C / ±0.072°F @ -45°C / -49°F
Temperature coefficient	Internal reference : ±0.005°C/°C (0-20°C and 26-40°C) / ±0.009°F/°F (32-68°F and 79-104°F) External reference : ±0.0015°C/°C (0-20°C and 26-40°C) / ±0.0027°F/°F (32-68°F and 79-104°F)
Stability	±0.005°C / ±0.009°F
Accuracy	Internal reference : ±0.11°C/±0.20°F External reference* : ±0.060°C/±0.11°F *System calibration with STS-200 A 915.
Heating time incl. insert	-45°C / -49.0°F to 23°C / 73.4°F : 7 min. 23°C / 73.4°F to 100°C / 212°F : 8 min. 100°C / 212°F to 155°C / 311°F 9 min. -45°C / -49.0°F to 155°C / 311°F : 24 min.
Time to stability	10 min.
Cooling time incl. insert	155°C / 311°F to 100°C / 212°F: 5 min. 100°C / 212°F to 23°C / 73.4°F: 10 min. 23°C / 73.4°F to –0°C / 32°F : 5 min. 0°C / 32°F to –30°C / -22.0°F 12 min. -30°C / -22.0°F to –45°C / -49.0°F: 20 min. 155°C / 311°F to –45°C / -49.0°F : 52 min.

MECHANICAL SPECIFICATIONS	RTC^t -159 A/B/C
Dimensions l × w × h	531 × 169 × 432mm / 20.9 x 6.6 x 17 inch
Weight	RTC^t -159 A : 14.0 kg / 30.9 lb RTC^t -159 B : 14.2 kg / 31.3 lb RTC^t -159 C : 14.1 kg / 31.1 lb
Shipping dimensions	560 x 400 x 650mm / 22.0 x 15.7 x 25.6 inch (Cardboard box) 775 x 600 x 7000mm / 30.5 x 23.6 x 27.6 inch (Carrying case in cardboard box)
Shipping weight	23.5 kg / 51.8 lb (in cardboard box) 38.8 kg / 85.5 lb (in carrying case in cardboard box)
Bore diameter/depth of well	ø30 mm / 185 mm – ø1.18 inch / 7.28 inch
Insert dimensions	ø29.7 mm x 150 mm / ø1.17 inch / 5.91 inch
Sensor immersion depth : from top of insert from top of insulation plug	 140 mm / 5.51 inch 190 mm / 7.48 inch
Weight non-drilled insert	290 g / 10.2 oz
POWER SUPPLY	
Mains voltage/frequency	115 VAC (90-127 VAC) / 230 VAC (180-254 VAC), 50/60 Hz (47-63 Hz)
Power consumption	350 VA
Type of connection	IEC320
COMMUNICATION INTERFACES	
Type of connections	USB A (host), USB B (device), RJ45 (Ethernet), Wi-Fi 802-11ac (external USB device)
ENVIRONMENT	
Locations	Indoor use only Not for use in wet locations or in hazardous areas
Ambient operating temperature range	0-40°C / 32-104°F
Storage temperature range	-10-50°C / 14-122°F
Humidity range	0-90% RH.
Altitude	Up to 2000 m
Protection class	Class I
Pollution degree	Pollution degree 2
Protection class	IP10
Electromagnetic environment	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013. Length of test cables should not exceed 3 m.
READOUT SPECIFICATIONS	
Resolution	0.001°C / 0.001°F / 0.001 K
Temperature units	°C / °F / K

THERMAL SPECIFICATIONS	RTC^{t} -159 A/B/C
Maximum temperature	155°C / 311°F
Minimum temperature *	-100°C / -148°F @ ambient temperature 0°C / 32°F
	-100°C / -148°F @ ambient temperature 23°C / 73.4°F
	-83°C / -117.4°F@ ambient temperature 40°C / 104°F

*The minimum temperature will be affected by the number of sensors and the dimensions of the sensors being calibrated.

THERMAL SPECIFICATIONS	RTC^t -159 A/B/C
Well specifications	Loaded with 4 x 3mm + 1 x 4mm + 1 x 6mm sensors:
	40 mm / 1.57 inch axial uniformity: ±0.070°C/0.126°F @ -100°C/-148°F to 23°C/73.4°F
	40 mm / 1.57 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	40 mm / 1.57 inch axial uniformity: ±0.050°C/0.09°F @ 125°C/257°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.100°C/0.18°F @ -100°C/-148°F to 23°C/73.4°F
	50 mm / 1.97 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	50 mm / 1.97 inch axial uniformity: ±0.070°C/0.13°F @ 125°C/257°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.150°C/0.27°F @ -100°C/-148°F to 23°C/73.4°F
	60 mm / 2.36 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	60 mm / 2.36 inch axial uniformity: ±0.100°C/0.18°F @ 125°C/257°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.200°C/0.36°F @ -100°C/-148°F to 23°C/73.4°F
	70 mm / 2.76 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	70 mm / 2.76 inch axial uniformity: ±0.150°C/0.27°F @ 125°C/257°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.400°C/0.72°F @ -100°C/-148°F to 23°C/73.4°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	80 mm / 3.15 inch axial uniformity: ±0.200°C/0.36°F @ 125°C/257°F to 155°C/311°F
	Loaded with 3 x 3mm sensors + 1 x 4mm sensor and 1 x 6 mm sensor
	DLC active:
	40 mm / 1.57 inch axial uniformity: ±0.070°C/0.126°F @ -100°C/-148°F to 23°C/73.4°F
	40 mm / 1.57 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	40 mm / 1.57 inch axial uniformity: ±0.050°C/0.09°F @ 125°C/257°F to 155°C/311°F
	50 mm / 1.97 inch axial uniformity: ±0.100°C/0.18°F @ -100°C/-148°F to 23°C/73.4°F

THERMAL SPECIFICATIONS	RTC^t -159 A/B/C
Well specifications	50 mm / 1.97 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	50 mm / 1.97 inch axial uniformity: ±0.050°C/0.09°F @ 125°C/257°F to 155°C/311°F
	60 mm / 2.36 inch axial uniformity: ±0.150°C/0.27°F @ -100°C/-148°F to 23°C/73.4°F
	60 mm / 2.36 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	60 mm / 2.36 inch axial uniformity: ±0.050°C/0.09°F @ 125°C/257°F to 155°C/311°F
	70 mm / 2.76 inch axial uniformity: ±0.200°C/0.36°F @ -100°C/-148°F to 23°C/73.4°F
	70 mm / 2.76 inch axial uniformity: ±0.050°C/0.09°F @ 23°C/73.4°F to 125°C/257°F
	70 mm / 2.76 inch axial uniformity: ±0.060°C/0.11°F @ 125°C/257°F to 155°C/311°F
	80 mm / 3.15 inch axial uniformity: ±0.400°C/0.72°F @ -100°C/-148°F to 23°C/73.4°F
	80 mm / 3.15 inch axial uniformity: ±0.070°C/0.13°F @ 23°C/73.4°F to 125°C/257°F
	80 mm / 3.15 inch axial uniformity: ±0.100°C/0.18°F @ 125°C/257°F to 155°C/311°F
	Difference between borings : 0.01°C / 0.02°F
	Influence from load : 0.20°C / 0.36°F @ -100°C / -148°F 0.05°C / 0.09°F @ 155°C / 311°F
	Influence from load with Ext. Reference : 0.01°C / 0.02°F
	Long term drift (1 year typical) ±0.070°C / ±0.13°F @ -100°C / -148°F ±0.050°C / ±0.09°F @ 23°C / 73.4°F ±0.070°C / ±0.13°F @ 155°C / 311°F
Temperature coefficient	Internal reference : ±0.005°C/°C (0-20°C and 26-40°C)/ ±0.009°F/°F (32-68°F and 79-104°F) External reference: ±0.0015°C/°C (0-20°C and 26-40°C) / ±0.0027°F/°F (32-68°F and 79-104°F)
Stability	±0.020°C / ±0.036°F

THERMAL SPECIFICATIONS	RTC^t -159 A/B/C
Accuracy	Internal reference : ±0.25°C/0.45°F @ -100°C/-148°F to 155°C/311°F External reference *: ±0.110°C / ±0.20°F @ -100°C/-148°F to 23°C/ 73.4°F ±0.090°C / ±0.16°F @ 23°C/ 73.4°F to 155°C/311°F *System calibration with STS-200 A 917.
Heating time incl. insert	-100°C / -148.0°F to 23°C / 73.4°F :12 min. 23°C / 73.4°F to 155°C / 311°F : 14 min. -100°C / -148°F to 155°C / 311°F 26 min.
Time to stability	10 min.
Cooling time incl. insert	155°C / 311°F to 23°C / 73.4°F: 40 min. 155°C / 311°F to -100°C / -148°F: 175 min. 23°C / 73.4°F to –80°C / -112°F : 65 min. -80°C / -112°F to –90°C / -130°F 20 min. -90°C / -130°F to –100°C / -148°F: 50 min. 23°C / 73.4°F to –100°C / -148°F : 135 min.
Refrigerants	R-704 (Helium) : 3 g / 0.1 oz R-1270 (Propylene) : 8 g / 0.3 oz

MECHANICAL SPECIFICATIONS	RTC^t -168 A/B/C
Dimensions l × w × h	366 × 171 × 363 mm / 14.4 x 6.7 x 14.3 inch
Weight	RTC^t -168 A : 10.9 kg / 24.0 lb RTC^t -168 B/C : 11.0 kg / 24.3 lb
Shipping dimensions	520 x 320 x 460 mm / 20.5 x 12.6 x 18.1 inch (Cardboard box) 550 x 430 x 660mm / 21.7 x 16.9 x 26.0 inch (Carrying case in cardboard box)
Shipping weight	23.0 kg / 50.7 lb (in cardboard box) 34.2 kg / 75.4 lb (in carrying case in cardboard box)
Bore diameter/depth of well	Ø63.8 mm / 160 mm – ø2.5 inch / 6.3 inch
Weight non-drilled insert	1200 g / 42.3 oz
POWER SUPPLY	
Mains voltage/frequency	115 VAC (90-127 VAC) / 230 VAC (180-254 VAC), 50/60 Hz (47-63 Hz)
Power consumption	400 VA
Type of connection	IEC60320, C14 inlet for C13 connector
IEC 60664-1 Overvoltage category	OVC II
COMMUNICATION INTERFACES	
Type of connections	USB A (host), USB B (device), RJ45 (Ethernet), Wi-Fi 802-11ac (external USB device)
ENVIRONMENT	
Locations	Indoor use only Not for use in wet locations or in hazardous areas
Ambient operating temperature range	0-40°C / 32-104°F
Storage temperature range	-20-50°C / -4-122°F
Humidity range	0-90% RH.
Altitude	Up to 2000 m
Appliance protection class	Class I
Pollution degree	Pollution degree 2
Ingress protection class	IP10
Electromagnetic environment	Designed for use in basic electromagnetic environment as defined in EN 61326-1:2013. Length of test cables should not exceed 3 m.
READOUT SPECIFICATIONS	
Resolution	0.001°C / 0.001°F / 0.001 K
Temperature units	°C / °F / K

THERMAL SPECIFICATIONS – DRY BLOCK	RTC^{t} -168 A/B/C
Maximum temperature	165°C / 329°F
Minimum temperature*	-30°C / -22°F @ ambient temperature 0°C / 32°F
	-30°C / -22°F @ ambient temperature 23°C / 73.4°F
	-17°C / 1.4°F @ ambient temperature 40°C / 104°F
Well specifications	Loaded with 2 x 3mm sensors:
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F@ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 165°C/329°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 165°C/329°F
	60 mm / 2.36 inch axial uniformity: ±0.025°C/0.045°F@ -30°C/-22°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	60 mm /2.36 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 165°C/329°F
	70 mm / 2.76 inch axial uniformity: ±0.025°C/0.045°F@ -30°C/-22°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.025°C/0.045°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.050°C/0.09°F @ 50°C/122°F to 165°C/329°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.040°C/0.072°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.075°C/0.135°F @ 50°C/122°F to 165°C/329°F

*The minimum temperature will be affected by the number of sensors and the dimensions of the sensors being calibrated.

THERMAL SPECIFICATIONS – DRY BLOCK	RTC^t -168 A/B/C
Well specifications	Loaded with 3 x 3mm sensors + 1 x 4mm sensor and 1 x 6 mm sensor
	DLC active:
	40 mm / 1.57 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.025°C/0.045°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.035°C/0.063°F @ 50°C/122°F to 165°C/329°F
	50 mm / 1.97 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.025°C/0.045°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.035°C/0.063°F @ 50°C/122°F to 165°C/329°F
	60 mm / 2.36 inch axial uniformity: ±0.035°C/0.063°F @ -30°C/-22°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	60 mm / 2.36 inch axial uniformity: ±0.035°C/0.063°F @ 50°C/122°F to 165°C/329°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ -30°C/-22°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.040°C/0.072°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.045°C/0.081°F @ 50°C/122°F to 165°C/329°F
	80 mm / 3.15 inch axial uniformity: ±0.060°C/0.11°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.060°C/0.11°F @ 50°C/122°F to 165°C/329°F
	Difference between borings:
	0.03°C / 0.054°F @165°C/329°F 0.02°C / 0.036°F @-30°C/-22°F
	Influence from load:
	0.12°C / 0.22°F @165°C/329°F 0.07°C / 0.13°F @-30°C/-22°F
	Influence from load with Ext. Reference :
	0.025°C / 0.045°F @165°C/329°F 0.025°C / 0.045°F @-30°C/-22°F

THERMAL SPECIFICATIONS – DRY BLOCK	RTC^{t} -168 A/B/C
Well specifications	Long term drift (1 year typical): ±0.040°C / ±0.072°F @ 165°C / 329°F ±0.020°C / ±0.036°F @ 23°C / 73.4°F ±0.040°C / ±0.072°F @ -30°C / -22°F
Temperature coefficient	Internal reference : ±0.010°C/°C (0-20°C and 26-40°C) / ±0.018°F/°F (32-68°F and 79-104°F) External reference : ±0.0015°C/°C (0-20°C and 26-40°C) / ±0.0027°F/°F (32-68°F and 79-104°F)
Stability	±0.01°C / ±0.02°F
Total accuracy	Internal reference : ±0.18°C/±0.32°F External reference*: ±0.070°C/±0.126°F *System calibration with STS-200 A 919.
Heating time incl. insert	-30°C / -22°F to 23°C / 73.4°F : 5 min. 23°C / 73.4°F to 100°C / 212°F: 10 min. 100°C / 212°F to 165°C / 329°F: 12 min. -30°C / -22°F to 165°C / 329°F : 27 min.
Time to stability	20-30 min.
Cooling time incl. insert	165°C / 329°F to 100°C / 212°F : 12 min 100°C / 212°F to 23°C / 73.4°F: 22 min. 23°C / 73.4°F to 0°C / 32°F: 13 min. 0°C / 32°F to –15°C / 5°F: 17 min. -15°C / -5°F to –25°C / -13°F : 22 min. –25°C / -13°F to –30°C / -22°F : 25 min. 165°C / 329° to –30°C / -22°F : 111 min.

THERMAL SPECIFICATIONS – LIQUID BATH	RTC^{t} -168 A/B/C
Maximum temperature	165°C / 329°F
Minimum temperature*	-30°C / -22°F @ ambient temperature 0°C / 32°F -30°C / -22°F @ ambient temperature 23°C / 73.4°F -17°C / 1.4°F @ ambient temperature 40°C / 104°F

THERMAL SPECIFICATIONS – LIQUID BATH	RTC^t -168 A/B/C
Well specifications	40 mm / 1.57 inch axial uniformity: ±0.010°C/0.018°F@ -30°C/-22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.010°C/0.018°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.010°C/0.018°F @ 50°C/122°F to 165°C/329°F
	50 mm / 1.97 inch axial uniformity: ±0.015°C/0.027°F @ -30°C/-22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.010°C/0.018°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.010°C/0.018°F @ 50°C/122°F to 165°C/329°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F@ -30°C/-22°F to -20°C/-4°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F@ -20°C/-4°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.010°C/0.018°F @ 0°C/32°F to 50°C/122°F
	60 mm /2.36 inch axial uniformity: ±0.020°C/0.036°F @ 50°C/122°F to 165°C/329°F
	70 mm / 2.76 inch axial uniformity: ±0.035°C/0.045°F@ -30°C/-22°F to -20°C/-4°F
	70 mm / 2.76 inch axial uniformity: ±0.020°C/0.036°F@ --20°C/-4°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.020°C/0.036°F @ 50°C/122°F to 165°C/329°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ -30°C/-22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 165°C/329°F
	Radial uniformity: 0.015°C/0.027°F @ 165°C/329°F 0.015°C/0.027°F @ -20°C/-4°F 0.029°C/0.027°F @ -30°C/-22°F
	Influence from load: 0.10°C/0.18°F @ 165°C/329°F 0.04°C/0.07°F @ -30°C/-22°F
	Influence from load with ext. reference: 0.02°C/0.04°F @ 165°C/329°F 0.02°C/0.04°F @ -30°C/-22°F
	Difference between insert/oil: 0.10°C/0.18°F

THERMAL SPECIFICATIONS – LIQUID BATH	RTC^t -168 A/B/C
Well specifications	Long term drift (1 year typical) : ±0.040°C / ±0.072°F @ 165°C / 329°F ±0.020°C / ±0.036°F @ 23°C / 73.4°F ±0.040°C / ±0.072°F @ -30°C / -22°F
Temperature coefficient	Internal reference : ±0.010°C/°C (0-20°C and 26-40°C) / ±0.018°F/°F (32-68°F and 79-104°F) External reference : ±0.0015°C/°C (0-20°C and 26-40°C) / ±0.0027°F/°F (32-68°F and 79-104°F)
Stability	±0.01°C / ±0.02°F
Total accuracy (std. cal. with insert)	Internal reference : ±0.21°C / ±0.38°F External reference : ±0.070°C/±0.126°F (system calibration with STS-200 A 919)
Total accuracy (Optional calibration with liquid)	Internal reference : ±0.14°C/±0.25°F External reference*: ±0.060°C/±0.108°F *System calibration with STS-200 A 919
Time to stability	15 min.

THERMAL SPECIFICATIONS – LIQUID CONTAINER	RTC^t -168 A/B/C
Maximum temperature	160°C / 320°F
Minimum temperature	-30°C / -22°F @ ambient temperature 0°C / 32°F -26°C / -14.8°F @ ambient temperature 23°C / 73.4°F -13°C / 9°F @ ambient temperature 40°C / 104°F
Well specifications	40 mm / 1.57 inch axial uniformity: ±0.010°C/0.018°F@ -30°C / -22°F to 0°C/32°F
	40 mm / 1.57 inch axial uniformity: ±0.010°C/0.018°F @ 0°C/32°F to 50°C/122°F
	40 mm / 1.57 inch axial uniformity: ±0.010°C/0.018°F @ 50°C/122°F to 165°C/329°F
	50 mm / 1.97 inch axial uniformity: ±0.015°C/0.027°F @ -30°C / -22°F to 0°C/32°F
	50 mm / 1.97 inch axial uniformity: ±0.010°C/0.018°F @ 0°C/32°F to 50°C/122°F
	50 mm / 1.97 inch axial uniformity: ±0.010°C/0.018°F @ 50°C/122°F to 165°C/329°F
	60 mm / 2.36 inch axial uniformity: ±0.030°C/0.054°F@ -30°C / -22°F to -20°C/-4°F
	60 mm / 2.36 inch axial uniformity: ±0.020°C/0.036°F@ -20°C/-4°F to 0°C/32°F
	60 mm / 2.36 inch axial uniformity: ±0.010°C/0.018°F @ 0°C/32°F to 50°C/122°F

THERMAL SPECIFICATIONS – LIQUID CONTAINER	RTC^t -168 A/B/C
Well specifications	60 mm /2.36 inch axial uniformity: ±0.020°C/0.036°F @ 50°C/122°F to 165°C/329°F
	70 mm / 2.76 inch axial uniformity: ±0.035°C/0.045°F@ -30°C / -22°F to -20°C/-4°F
	70 mm / 2.76 inch axial uniformity: ±0.020°C/0.036°F@ -20°C/-4°F to 0°C/32°F
	70 mm / 2.76 inch axial uniformity: ±0.020°C/0.036°F @ 0°C/32°F to 50°C/122°F
	70 mm / 2.76 inch axial uniformity: ±0.020°C/0.036°F @ 50°C/122°F to 165°C/329°F
	80 mm / 3.15 inch axial uniformity: ±0.050°C/0.09°F @ -30°C / -22°F to 0°C/32°F
	80 mm / 3.15 inch axial uniformity: ±0.030°C/0.054°F @ 0°C/32°F to 50°C/122°F
	80 mm / 3.15 inch axial uniformity: ±0.030°C/0.054°F @ 50°C/122°F to 165°C/329°F
	Radial uniformity: 0.015°C/0.027°F @ 165°C/329°F 0.015°C/0.027°F @ -20°C/-4°F 0.029°C/0.027°F @ -30°C / -22°F
	Influence from load: 0.25°C/0.18°F @ 160°C/320°F 0.10°C/0.07°F @ -26°C/-14.8°F
	Influence from load with ext. reference: 0.02°C/0.04°F @ 160°C/320°F 0.02°C/0.04°F @ -26°C/-14.8°F
	Long term drift (1 year) : ±0.04°C/±0.072°F
Temperature coefficient	Internal reference : ±0.010°C/°C (0-20°C and 26-40°C) / ±0.018°F/°F (32-68°F and 79-104°F) External reference : ±0.0015°C/°C (0-20°C and 26-40°C) / ±0.0027°F/°F (32-68°F and 79-104°F)
Stability	±0.01°C / ±0.02°F
Total accuracy (std. cal. with insert)	Internal reference : N/A External reference : ±0.070°C/±0.126°F (system calibration with STS-200 A 919)
Total accuracy (Optional calibration with liquid)	Internal reference : N/A External reference* : ±0.060°C/±0.108°F *system calibration with STS-200 A 919) **Always use external reference with liquid container**
Time to stability	35 min.

*The minimum temperature will be affected by the number of sensors and the dimensions of the sensors being calibrated.

MECHANICAL SPECIFICATIONS	RTC^t -700 A/B/C
Dimensions l × w × h	362 × 171 × 421 mm (14.3 x 6.7 x 16.6 inch)
Weight	RTC^t -700 A : 11.2 kg / 24.1 lb RTC^t -700 B/C : 11.3 kg / 24.2 lb
Shipping dimensions	580 x 250 x 500mm / 22.8 x 9.8 x 19.7 inch (Cardboard box) 550 x 430 x 660mm / 21.7 x 16.9 x 26.0 inch (Carrying case in cardboard box)
Shipping weight	16.0 kg / 35.3 lb (in cardboard box) 27.3 kg / 60.2 lb (in carrying case in cardboard box)
Bore diameter/depth of well	ø30 mm / 210 mm – ø1.18 inch / 8.3 inch
Weight non-drilled insert	1060 g / 37.3 oz
POWER SUPPLY	
Mains voltage/frequency	90-127VAC / 180-254VAC 47-63 Hz
Power consumption	1150 VA
Type of connection	IEC320
COMMUNICATION INTERFACES	
Type of connection	USB A (host), USB B (device), RJ45 (Ethernet), Wi-Fi 802-11ac (external USB device)
ENVIRONMENT	
Locations	Indoor use only Not for use in wet locations or in hazardous areas
Ambient operating temperature range	0-40°C / 32-104°F
Storage temperature range	-20-50°C / -4-122°F
Humidity range	0-90% RH.
Altitude	Up to 2000 m
Protection class	Class I
Pollution degree	Pollution degree 2
Protection class	IP10
Electromagnetic environment	Designed for use in basic electromagnetic environment as defined in EN61326-1 : 2013. Length of test cables should not exceed 3 m.
READOUT SPECIFICATIONS	
Resolution	0.001°C / 0.001°F / 0.001 K
Temperature units	°C / °F / K

THERMAL SPECIFICATIONS	RTC^{t} -700 A/B/C
Maximum temperature	700°C / 1292°F
Minimum temperature	10°C / 50°F @ ambient temperature 0°C / 32°F 33°C / 91°F @ ambient temperature 23°C / 73.4°F 50°C / 122°F@ ambient temperature 40°C / 104°F

THERMAL SPECIFICATIONS	RTC^t -700 A/B/C
Well specifications	Loaded with 4 x 4mm sensors:
	40 mm / 1.57 inch axial uniformity: ±0.100°C/0.18°F @ 33°C/91°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.200°C/0.36°F @ 100°C/212°F to 420°C/788°F
	40 mm / 1.57 inch axial uniformity: ±0.250°C/0.45°F@420°C/788°F to 700°C/1292°F
	50 mm / 1.97 inch axial uniformity: ±0.100°C/0.18°F @ 33°C/91°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.200°C/0.36°F @ 100°C/212°F to 420°C/788°F
	50 mm / 1.97 inch axial uniformity: ±0.300°C/0.54°F@420°C/788°F to 700°C/1292°F
	60 mm / 2.36 inch axial uniformity: ±0.100°C/0.18°F @ 33°C/91°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.250°C/0.45°F @ 100°C/212°F to 420°C/788°F
	60 mm / 2.36 inch axial uniformity: ±0.400°C/0.72°F@420°C/788°F to 700°C/1292°F
	70 mm / 2.76 inch axial uniformity: ±0.100°C/0.18°F @ 33°C/91°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.250°C/0.45°F @ 100°C/212°F to 420°C/788°F
	70 mm / 2.76 inch axial uniformity: ±0.500°C/0.9°F @ 420°C/788°F to 700°C/1292°F
	80 mm / 3.15 inch axial uniformity: ±0.150°C/0.27°F @ 33°C/91°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.300°C/0.54°F @ 100°C/212°F to 420°C/788°F
	80 mm / 3.15 inch axial uniformity: ±0.600°C/1.08°F@420°C/788°F to 700°C/1292°F
	Loaded with 4 x 4mm sensor and 1 x 6 mm sensor
	DLC active:
	40 mm / 1.57 inch axial uniformity: ±0.120°C/0.22°F @ 33°C/91°F to 100°C/212°F
	40 mm / 1.57 inch axial uniformity: ±0.200°C/0.36°F @ 100°C/212°F to 420°C/788°F
	40 mm / 1.57 inch axial uniformity: ±0.250°C/0.45°F@420°C/788°F to 700°C/1292°F
	50 mm / 1.97 inch axial uniformity: ±0.120°C/0.22°F @ 33°C/91°F to 100°C/212°F
	50 mm / 1.97 inch axial uniformity: ±0.200°C/0.36°F @ 100°C/212°F to 420°C/788°F

THERMAL SPECIFICATIONS	RTC^t -700 A/B/C
Well specifications	50 mm / 1.97 inch axial uniformity: ±0.350°C/0.63°F@420°C/788°F to 700°C/1292°F
	60 mm / 2.36 inch axial uniformity: ±0.150°C/0.27°F @ 33°C/91°F to 100°C/212°F
	60 mm / 2.36 inch axial uniformity: ±0.250°C/0.45°F @ 100°C/212°F to 420°C/788°F
	60 mm / 2.36 inch axial uniformity: ±0.400°C/0.72°F@420°C/788°F to 700°C/1292°F
	70 mm / 2.76 inch axial uniformity: ±0.150°C/0.27°F @ 33°C/91°F to 100°C/212°F
	70 mm / 2.76 inch axial uniformity: ±0.250°C/0.45°F @ 100°C/212°F to 420°C/788°F
	70 mm / 2.76 inch axial uniformity: ±0.400°C/0.72°F@420°C/788°F to 700°C/1292°F
	80 mm / 3.15 inch axial uniformity: ±0.200°C/0.36°F @ 33°C/91°F to 100°C/212°F
	80 mm / 3.15 inch axial uniformity: ±0.250°C/0.45°F @ 100°C/212°F to 420°C/788°F
	80 mm / 3.15 inch axial uniformity: ±0.400°C/0.72°F@420°C/788°F to 700°C/1292°F
	Difference between borings :
	±0.01°C/0.02°F @ 33°C/91.4°F to 100°C/212°F
	±0.025°C/0.045°F @ 100°C/212°F to 420°C/788°F
	±0.040°C/0.072°F @ 420°C/788°F to 600°C/1112°F
	±0.050°C/0.09°F @ 600°C/1112°F to 660°C/1220°F
	±0.060°C/0.108°F @ 660°C/1220°F to 700°C/1292°F
	Influence from load :
	0.01°C/0.02°F @ 33°C/91.4°F to 100°C/212°F
	0.05°C/0.09°F @ 100°C/212°F to 420°C/788°F
	0.15°C/0.27°F @ 420°C/788°F to 700°C/1292°F
	Influence from load with ext. reference :
	0.01°C/0.02°F @ 33°C/91.4°F to 100°C/212°F
	0.02°C/0.04°F @ 100°C/212°F to 420°C/788°F
	0.03°C/0.05°F @ 420°C/788°F to 700°C/1292°F

THERMAL SPECIFICATIONS	RTC^t -700 A/B/C
Well specifications	Long term drift (1 year typical): ±0.05°C / ±0.09 @ 100°C/212°F ±0.10°C / ±0.18 @ 420°C/788°F ±0.13°C / ±0.23 @ 660°C / 1220°F ±0.14°C / ±0.25 @ 700°C / 1292°F
Temperature coefficient	Internal reference : ±0.015°C/°C (0-20°C and 26-40°C) / ±0.027°F/°F (32-68°F and 79-104°F) External reference: ±0.005°C/°C (0-20°C and 26-40°C) / ±0.009°F/°F (32-68°F and 79-104°F)
Stability	±0.008°C/0.014°F@33°C/91.4°F to 125°C/257°F ±0.015°C/0.027°F@125°C/257°F to 425°C/797°F ±0.020°C/0.36°F@425°C/797°F to 700°C/1292°F
Accuracy	Internal reference: ±0.29°C/0.52°F @ 33°C/91.4°F to 420°C/788°F ±0.32°C/0.58°F@ 420°C/788°F to 600°C/1112°F ±0.34°C/0.61°F@ 600°C/1112°F to 660°C/1220°F ±1.2°C/2.2°F@ 660°C/1220°F to 700°C/1292°F External reference*: ±0.14°C/0.25°F @ 33°C/91.4°F to 100°C/212°F ±0.19°C/0.34°F@ 100°C/212°F to 420°C/788°F ±0.21°C/0.38°F@ 420°C/788°F to 600°C/1112°F ±0.22°C/0.40°F@ 660°C/1220°F to 700°C/1292°F ±1.1°C/2.0°F@ 660°C/1220°F to 700°C/1292°F *System calibration with STS-200 A 970.
Heating time incl. insert	33°C/91.4°F to 700°C/1292°F : 45 min.
Time to stability	10 min.
Cooling time incl. insert	700°C / 1292°F to 100°C / 212°F : 43 min. 100°C / 212°F to 50°C / 122°F : 17 min. 50°C / 212°F to 33°C / 91.4°F : 20 min.

TECHNICAL SPECIFICATIONS – B MODELS ONLY

INPUT SPECIFICATIONS

mA input	
Signal range	0 – 24 mA
Internal power supply	24 V, max. 28 mA
Resolution	0.0001mA / 0.001°C / 0.001°F
Accuracy	±(0.005% of RDG. + 0.010% of F.S.)
Temperature coefficient	±5 ppm RDG + 2 ppm F.S./°C (0-20°C and 26-40°C) / (32-68°F and 79-104°F)
Input impedance	< 12 Ω
Type of connection	4 mm safety sockets
Voltage input	
Signal range	0 – 12 V
Resolution	0.0001V / 0.001°C / 0.001°F
Accuracy	±(0.005% of RDG. + 0.010% of F.S.)
Temperature coefficient	±3 ppm RDG + 2 ppm F.S./°C (0-20°C and 26-40°C) / (32-68°F and 79-104°F)
Input impedance	> 1 MΩ
Type of connection	4 mm safety sockets
Thermocouple input	
Signal range	-10mV – 78 mV (E, J, K, N, R, S, T, U, B)
Resolution	0.0001mV / 0.001°C / 0.001°F (E, J, K, N, R, S, T, U, B)
Accuracy	±(0.005% of RDG. + 0.005% of F.S.), see page 139 – 141 for accuracy in °C/°F
Temperature coefficient	±3 ppm RDG + 2 ppm F.S./°C (0-20°C and 26-40°C) / (32-68°F and 79-104°F)
Input impedance	> 1 MΩ
Type of connection	Mini TC-connector
RTD-input (2-, 3- or 4-wire)	
Signal range	0-400 Ω (P10(90)386/P50(90)385/P100(90)385/P50(90)391/P100(90)391/P100(90)392/ M50(90)428/ M100(90)428/H100(90)617/H120(90)672/Pt-100 MILL) 0-4000 Ω (P200(90)385/P500(90)385/P1000(90)385/YSI-400)
Internal power supply	Excitation current 400Ω range 0.75 mA Excitation current 4000Ω range 0.3 mA

INPUT SPECIFICATIONS	
Resolution	0.0001Ω / 0.001°C / 0.001°F (P10(90)386/P50(90)385/P100(90)385/P50(90)391/P100(90)391/P100(90)392/ M50(90)428/ M100(90)428/H100(90)617/H120(90)672/Pt-100 MILL) 0.001Ω / 0.001°C / 0.001°F (P200(90)385/P500(90)385/P1000(90)385/YSI-400)
Accuracy	±(0.002% of RDG + 0.001% of F.S.), (0-400Ω range), see page 147 - 147 for accuracy in °C/°F ±(0.003% of RDG + 0.003% of F.S.), (0-4000Ω range), see page 142 - 143 + 147 for accuracy in °C/°F
Temperature coefficient	±1 ppm RDG + 1 ppm F.S./°C (0-20°C and 26-40°C) / (32-68°F and 79-104°F)
Type of connection	4 mm safety sockets
Switch test input	
Signal range	on : 0-1kΩ / off : >1kΩ
Internal power supply	2 V (open) / 0.3mA (closed)
Type of connection	4 mm safety sockets
Reference input (4 wire true ohm Pt100)	**B and C models only**
Signal range	0Ω – 400Ω
Internal power supply	Excitation current 0.75 mA
Resolution	0.0001Ω / 0.001°C / 0.001°F
Accuracy	±(0.0012% of RDG + 0.0005% of F.S.), see page 147 for accuracy in °C/°F
Temperature coefficient	±1 ppm RDG + 1 ppm F.S./°C (0-20°C and 26-40°C) / (32-68°F and 79-104°F)
Type of connection	LEMO Redell 6-pole-connector
DLC (TC input)	**B and C models only**
Signal range	-10mV – 78mV
Resolution	0.01°C / 0.01°F
Accuracy	0.010% RDG + 0.0005% F.S.= 0.014°C @ 0.00°C readout
Temperature coefficient	±4 ppm RDG. + 1 ppm F.S./°C (0-20°C and 26-40°C) / (32-68°F and 79-104°F)
Type of connection	LEMO Redell 4-pole-connector

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy thermocouple type E input	±0.18°C(±0.32°F) @ -200°C(-328°F)
-270°C to 1000°C	±0.10°C(±0.18°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.08°C(±0.14°F) @ -50°C(-58°F)
	±0.07°C(±0.12°F) @ 0°C(32°F)
	±0.07°C(±0.12°F) @ 155°C(311°F)
	±0.07°C(±0.12°F) @ 320°C(608°F)
	±0.08°C(±0.14°F) @ 660°C(1220°F)
	±0.11°C(±0.20°F) @ 1000°C(1832°F)
Accuracy thermocouple type J input	±0.23°C(±0.41°F) @ -210°C(-346°F)
-210°C to 1200°C	±0.11°C(±0.20°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.09°C(±0.16°F) @ -50°C(-58°F)
	±0.08°C(±0.14°F) @ 0°C(32°F)
	±0.08°C(±0.14°F) @ 155°C(311°F)
	±0.09°C(±0.16°F) @ 320°C(608°F)
	±0.10°C(±0.18°F) @ 660°C(1220°F)
	±0.13°C(±0.23°F) @ 1200°C(2192°F)
Accuracy thermocouple type K input	±0.28°C(±0.50°F) @ -200°C(-328°F)
-270°C to 1372°C	±0.14°C(±0.25°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.12°C(±0.22°F) @ -50°C(-58°F)
	±0.10°C(±0.18°F) @ 0°C(32°F)
	±0.11°C(±0.20°F) @ 155°C(311°F)
	±0.11°C(±0.20°F) @ 320°C(608°F)
	±0.13°C(±0.23°F) @ 600°C(1112°F)
	±0.14°C(±0.25°F) @ 800°C(1472°F)
	±0.18°C(±0.32°F) @ 1200°C(2192°F)
Accuracy thermocouple type T input	±0.27°C(±0.49°F) @ -200°C(-328°F)
-270°C to 400°C	±0.15°C(±0.26°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.12°C(±0.22°F) @ -50°C(-58°F)
	±0.11°C(±0.2°F) @ 0°C(32°F)
	±0.09°C(±0.16°F) @ 155°C(311°F)
	±0.09°C(±0.16°F) @ 200°C(392°F)
	±0.08°C(±0.14°F) @ 320°C(608°F)
	±0.08°C(±0.14°F) @ 400°C(752°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy thermocouple type R input	±1.06°C(±1.91°F) @ -50°C(-58°F)
-50°C to 1768°C	±0.74°C(±1.33°F) @ 0°C(32°F)
(excluding sensor accuracy)	±0.48°C(±0.86°F) @ 155°C(311°F)
	±0.46°C(±0.82°F) @ 200°C(392°F)
	±0.40°C(±0.72°F) @ 400°C(752°F)
	±0.37°C(±0.66°F) @ 660°C(1220°F)
	±0.40°C(±0.72°F) @ 1768°C(3214°F)
Accuracy thermocouple type S input	±0.98°C(±1.76°F) @ -50°C(-58°F)
-50°C to 1768°C	±0.73°C(±1.31°F) @ 0°C(32°F)
(excluding sensor accuracy)	±0.50°C(±0.90°F) @ 155°C(311°F)
	±0.47°C(±0.85°F) @ 200°C(392°F)
	±0.43°C(±0.77°F) @ 400°C(752°F)
	±0.41°C(±0.73°F) @ 660°C(1220°F)
	±0.47°C(±0.85°F) @ 1768°C(3214°F)
Accuracy thermocouple type B	±1.57°C(±2.83°F) @ 250°C(482°F)
250°C to 1820°C	±0.97°C(±1.73°F) @ 400°C(752°F)
(excluding sensor accuracy)	±0.60°C(±1.07°F) @ 700°C(1292°F)
	±0.41°C(±0.73°F) @ 1820°C(3308°F)
Accuracy thermocouple type N	±0.42°C(±0.76°F) @ -200°C(-328°F)
-270°C to 1300°C	±0.20°C(±0.35°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.17°C(±0.30°F) @ -50°C(-58°F)
	±0.16°C(±0.28°F) @ 0°C(32°F)
	±0.14°C(±0.25°F) @ 155°C(311°F)
	±0.13°C(±0.23°F) @ 400°C(752°F)
	±0.14°C(±0.25°F) @ 700°C(1292°F)
	±0.15°C(±0.27°F) @ 1000°C(1832°F)
	±0.17°C(±0.30°F) @ 1200°C(2192°F)
	±0.18°C(±0.32°F) @ 1300°C(2372°F)
Accuracy thermocouple type L	±0.14°C(±0.25°F) @ -200°C(-328°F)
-200°C to 900°C	±0.09°C(±0.16°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.08°C(±0.14°F) @ 0°C(32°F)
	±0.08°C(±0.14°F) @ 155°C(311°F)
	±0.09°C(±0.16°F) @ 320°C(608°F)
	±0.10°C(±0.18°F) @ 650°C(1202°F)
	±0.10°C(±0.18°F) @ 900°C(1652°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy thermocouple type BP	±0.33°C(±0.59°F) @ 0°C(32°F)
0°C to 2500°C	±0.26°C(±0.47°F) @ 200°C(392°F)
(excluding sensor accuracy)	±0.25°C(±0.45°F) @ 320°C(608°F)
	±0.27°C(±0.49°F) @ 660°C(1220°F)
	±0.28°C(±0.50°F) @ 800°C(1472°F)
	±0.31°C(±0.56°F) @ 1000°C(1832°F)
	±0.34°C(±0.61°F) @ 1200°C(2192°F)
	±0.41°C(±0.73°F) @ 1600°C(2912°F)
	±0.52°C(±0.94°F) @ 2000°C(3632°F)
	±0.73°C(±1.31°F) @ 2500°C(4532°F)
Accuracy thermocouple type XK	±0.17°C(±0.30°F) @ -200°C(-328°F)
-200°C to 800°C	±0.09°C(±0.16°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.07°C(±0.12°F) @ 0°C(32°F)
	±0.06°C(±0.11°F) @ 155°C(311°F)
	±0.06°C(±0.11°F) @ 320°C(608°F)
	±0.07°C(±0.12°F) @ 420°C(788°F)
	±0.08°C(±0.14°F) @ 660°C(1220°F)
	±0.09°C(±0.16°F) @ 800°C(1472°F)
Accuracy thermocouple type U	±0.21°C(±0.38°F) @ -200°C(-328°F)
-80°C to 600°C	±0.15°C(±0.27°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.12°C(±0.22°F) @ -50°C(-58°F)
	±0.10°C(±0.18°F) @ 0°C(32°F)
	±0.09°C(±0.16°F) @ 155°C(311°F)
	±0.08°C(±0.14°F) @ 320°C(608°F)
	±0.08°C(±0.14°F) @ 420°C(788°F)
	±0.08°C(±0.14°F) @ 600°C(1112°F)
Accuracy automatic cold junction compensation	±0.30°C (±0.54°F) @ ambient temperature 0°C to 40°C (32°F to 104°F).

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy RTD Pt1000 385	±0.030°C(±0.053°F) @ -200°C(-328°F)
Pt1000(90)385: -200°C to 850°C	±0.035°C(±0.062°F) @ -100°C(-148°F)
* Pt1000(68)385: -200°C to 850°C	±0.037°C(±0.066°F) @ -50°C(-58°F)
(excluding sensor accuracy)	±0.039°C(±0.070°F) @ 0°C(32°F)
	±0.043°C(±0.077°F) @ 100°C(212°F)
	±0.045°C(±0.081°F) @ 155°C(311°F)
	±0.053°C(±0.095°F) @ 320°C(608°F)
	±0.058°C(±0.104°F) @ 420°C(788°F)
	±0.070°C(±0.126°F) @ 660°C(1220°F)
	±0.073°C(±0.130°F) @ 700°C(1292°F)
	±0.082°C(±0.146°F) @ 850°C(1562°F)
Accuracy RTD	±0.057°C(±0.103°F) @ -200°C(-328°F)
Pt500(90)385: -200°C to 850°C	±0.064°C(±0.115°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.067°C(±0.120°F) @ -50°C(-58°F)
	±0.070°C(±0.125°F) @ 0°C(32°F)
	±0.075°C(±0.134°F) @ 100°C(212°F)
	±0.078°C(±0.139°F) @ 155°C(311°F)
	±0.087°C(±0.156°F) @ 320°C(608°F)
	±0.092°C(±0.165°F) @ 400°C(752°F)
	±0.109°C(±0.195°F) @ 660°C(1220°F)
	±0.111°C(±0.200°F) @ 700°C(1292°F)
	±0.123°C(±0.220°F) @ 850°C(1562°F)
Accuracy RTD	±0.071°C(±0.128°F) @ -200°C(-328°F)
* Pt400(90)385: -200°C to 850°C	±0.079°C(±0.142°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.082°C(±0.147°F) @ -50°C(-58°F)
	±0.085°C(±0.153°F) @ 0°C(32°F)
	±0.091°C(±0.163°F) @ 100°C(212°F)
	±0.094°C(±0.168°F) @ 155°C(311°F)
	±0.104°C(±0.187°F) @ 320°C(608°F)
	±0.110°C(±0.198°F) @ 420°C(788°F)
	±0.128°C(±0.229°F) @ 660°C(1220°F)
	±0.131°C(±0.235°F) @ 700°C(1292°F)
	±0.143°C(±0.257°F) @ 850°C(1562°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy RTD	±0.141°C(±0.253°F) @ -200°C(-328°F)
Pt200(90)385: -200°C to 850°C	±0.153°C(±0.275°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.158°C(±0.283°F) @ -50°C(-58°F)
	±0.162°C(±0.291°F) @ 0°C(32°F)
	±0.0170°C(±0.305°F) @ 100°C(212°F)
	±0.174°C(±0.313°F) @ 155°C(311°F)
	±0.189°C(±0.339°F) @ 320°C(608°F)
	±0.198°C(±0.356°F) @ 420°C(788°F)
	±0.223°C(±0.401°F) @ 660°C(1220°F)
	±0.228°C(±0.409°F) @ 700°C(1292°F)
	±0.246°C(±0.442°F) @ 850°C(1562°F)
Accuracy RTD	±0.011°C(±0.02°F) @ -200°C(-328°F)
Pt100(90)385: -200°C to 850°C	±0.013°C(±0.023°F) @ -100°C(-148°F)
* Pt100(68)385: -200°C to 850°C	±0.015°C(±0.026°F) @ -50°C(-58°F)
(excluding sensor accuracy)	±0.016°C(±0.028°F) @ 0°C(32°F)
	±0.018°C(±0.032°F) @100°C(212°F)
	±0.020°C(±0.035°F) @ 155°C(311°F)
	±0.024°C(±0.043°F) @ 320°C(608°F)
	±0.027°C(±0.049°F) @ 420°C(788°F)
	±0.034°C(±0.061°F) @ 660°C(1220°F)
	±0.036°C(±0.064°F) @ 700°C(1292°F)
	±0.041°C(±0.073°F) @ 850°C(1562°F)
Accuracy RTD	±0.020°C(±0.035°F) @ -200°C(-328°F)
Pt50(90)385: -200°C to 850°C	±0.023°C(±0.041°F) @ -100°C(-148°F)
* Pt50(68)385: -200°C to 850°C	±0.025°C(±0.045°F) @ -50°C(-58°F)
(excluding sensor accuracy)	±0.026°C(±0.047°F) @ 0°C(32°F)
	±0.029°C(±0.052°F) @ 100°C(212°F)
	±0.030°C(±0.054°F) @ 155°C(311°F)
	±0.036°C(±0.065°F) @ 320°C(608°F)
	±0.039°C(±0.070°F) @ 420°C(788°F)
	±0.047°C(±0.085°F) @ 660°C(1220°F)
	±0.049°C(±0.088°F) @ 700°C(1292°F)
	±0.055°C(±0.099°F) @ 850°C(1562°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy RTD	±0.094°C(±0.169°F) @ -200°C(-328°F)
Pt10(90)385: -200°C to 850°C	±0.102°C(±0.184°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.105°C(±0.189°F) @ -50°C(-58°F)
	±0.108°C(±0.194°F) @ 0°C(32°F)
	±0.113°C(±0.204°F) @ 100°C(212°F)
	±0.119°C(±0.214°F) @ 200°C(392°F)
	±0.126°C(±0.226°F) @ 320°C(608°F)
	±0.132°C(±0.238°F) @ 420°C(788°F)
	±0.149°C(±0.267°F) @ 660°C(1220°F)
	±0.152°C(±0.273°F) @ 700°C(1292°F)
	±0.164°C(±0.295°F) @ 850°C(1562°F)
Accuracy RTD	±0.030°C(±0.054°F) @ -200°C(-328°F)
Pt1000(06)391: -200°C to 850°C	±0.035°C(±0.063°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.037°C(±0.067°F) @ -50°C(-58°F)
	±0.039°C(±0.070°F) @ 0°C(32°F)
	±0.043°C(±0.077°F) @ 100°C(212°F)
	±0.045°C(±0.081°F) @ 155°C(311°F)
	±0.053°C(±0.095°F) @ 320°C(608°F)
	±0.058°C(±0.104°F) @ 420°C(788°F)
	±0.070°C(±0.126°F) @ 660°C(1220°F)
	±0.073°C(±0.131°F) @ 700°C(1292°F)
	±0.082°C(±0.148°F) @ 850°C(1562°F)
Accuracy RTD	±0.056°C(±0.101°F) @ -200°C(-328°F)
Pt500(06)391: -200°C to 850°C	±0.062°C(±0.112°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.065°C(±0.117°F) @ -50°C(-58°F)
	±0.068°C(±0.122°F) @ 0°C(32°F)
	±0.073°C(±0.131°F) @ 100°C(212°F)
	±0.076°C(±0.137°F) @ 150°C(302°F)
	±0.085°C(±0.153°F) @ 320°C(608°F)
	±0.091°C(±0.164°F) @ 420°C(788°F)
	±0.106°C(±0.191°F) @ 660°C(1220°F)
	±0.109°C(±0.196°F) @ 700°C(1292°F)
	±0.120°C(±0.216°F) @ 850°C(1562°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy RTD	±0.272°C(±0.490°F) @ -200°C(-328°F)
Pt100(90)391: -200°C to 1100°C	±0.295°C(±0.531°F) @ -100°C(-148°F)
* Pt100(68)391: -200°C to 1100°C	±0.303°C(±0.545°F) @ -50°C(-58°F)
* Pt100(06)391: -200°C to 850°C	±0.309°C(±0.556°F) @ 0°C(32°F)
(excluding sensor accuracy)	±0.328°C(±0.590°F) @ 150°C(302°F)
	±0.351°C(±0.632°F) @ 320°C(608°F)
	±0.366°C(±0.659°F) @ 420°C(788°F)
	±0.406°C(±0.731°F) @ 660°C(1220°F)
	±0.413°C(±0.743°F) @ 700°C(1292°F)
	±0.442°C(±0.796°F) @ 850°C(1562°F)
	±0.498°C(±0.896°F) @ 1100°C(2012°F)
Accuracy RTD	±0.019°C(±0.034°F) @ -200°C(-328°F)
Pt50(90)391: -200°C to 1100°C	±0.023°C(±0.041°F) @ -100°C(-148°F)
* Pt50(68)391: -200°C to 1100°C	±0.024°C(±0.043°F) @ -50°C(-58°F)
* Pt50(06)391: -200°C to 850°C	±0.025°C(±0.045°F) @ 0°C(32°F)
(excluding sensor accuracy)	±0.030°C(±0.054°F) @ 150°C(302°F)
	±0.035°C(±0.063°F) @ 320°C(608°F)
	±0.038°C(±0.068°F) @ 420°C(788°F)
	±0.046°C(±0.083°F) @ 660°C(1220°F)
	±0.048°C(±0.086°F) @ 700°C(1292°F)
	±0.054°C(±0.097°F) @ 850°C(1562°F)
	±0.065°C(±0.117°F) @ 1100°C(2012°F)
Accuracy RTD	±0.010°C(±0.018°F) @ -200°C(-328°F)
Pt100(90)392: -200°C to 630°C	±0.013°C(±0.023°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.014°C(±0.025°F) @ -50°C(-58°F)
	±0.015°C(±0.026°F) @ 0°C(32°F)
	±0.019°C(±0.034°F) @ 150°C(302°F)
	±0.024°C(±0.043°F) @ 320°C(608°F)
	±0.026°C(±0.047°F) @ 420°C(788°F)
	±0.033°C(±0.059°F) @ 630°C(1166°F)
Accuracy RTD	±0.011°C(±0.02°F) @ -200°C(-328°F)
M100(90)428: -200°C to 200°C	±0.012°C(±0.022°F) @ -100°C(-148°F)
* M100(68)428: -200°C to 200°C	±0.013°C(±0.023°F) @ -50°C(-58°F)
* M100(06)428: -180°C to 200°C	±0.014°C(±0.025°F) @ 0°C(32°F)
(excluding sensor accuracy)	±0.017°C(±0.030°F) @ 150°C(302°F)
	±0.018°C(±0.032°F) @ 200°C(392°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy RTD	±0.02°C(±0.036°F) @ -200°C(-328°F)
M50(90)428 : -200°C to 200°C	±0.021°C(±0.038°F) @ -100°C(-148°F)
* M50(68)428 : -200°C to 200°C	±0.022°C(±0.04°F) @ -50°C(-58°F)
* M50(06)428 : -180°C to 200°C	±0.024°C(±0.043°F) @ 0°C(32°F)
(excluding sensor accuracy)	±0.027°C(±0.049°F) @ 150°C(302°F)
	±0.028°C(±0.050°F) @ 200°C(392°F)
Accuracy RTD	±0.014°C(±0.025°F) @ -50°C(-58°F)
* M100(90)426: -50°C to 200°C	±0.014°C(±0.025°F) @ -25°C(-13°F)
(excluding sensor accuracy)	±0.015°C(±0.026°F) @ 0°C(32°F)
	±0.016°C(±0.028°F) @ 50°C(122°F)
	±0.017°C(±0.030°F) @ 100°C(212°F)
	±0.018°C(±0.032°F) @ 150°C(302°F)
	±0.019°C(±0.034°F) @ 200°C(392°F)
Accuracy RTD	±0.022°C(±0.04°F) @ -50°C(-58°F)
* M53(68)426: -50°C to 200°C	±0.022°C(±0.04°F) @ -25°C(-13°F)
(excluding sensor accuracy)	±0.023°C(±0.041°F) @ 0°C(32°F)
	±0.024°C(±0.043°F) @ 50°C(122°F)
	±0.025°C(±0.045°F) @ 100°C(212°F)
	±0.026°C(±0.047°F) @ 150°C(302°F)
	±0.027°C(±0.049°F) @ 200°C(392°F)
Accuracy RTD	±0.023°C(±0.041°F) @ -50°C(-58°F)
* M50(90)426: -50°C to 200°C	±0.023°C(±0.041°F) @ -25°C(-13°F)
(excluding sensor accuracy)	±0.024°C(±0.043°F) @ 0°C(32°F)
	±0.025°C(±0.045°F) @ 50°C(122°F)
	±0.026°C(±0.047°F) @ 100°C(212°F)
	±0.027°C(±0.049°F) @ 150°C(302°F)
	±0.028°C(±0.05°F) @ 200°C(392°F)
Accuracy RTD	±0.012°C(±0.022°F) @ -60°C(-76°F)
* H100(90)617: -60°C to 180°C	±0.012°C(±0.022°F) @ -30°C(-22°F)
(excluding sensor accuracy)	±0.011°C(±0.020°F) @ 0°C(32°F)
	±0.011°C(±0.020°F) @ 50°C(122°F)
	±0.011°C(±0.020°F) @ 100°C(212°F)
	±0.011°C(±0.020°F) @ 150°C(302°F)
	±0.010°C(±0.018°F) @ 180°C(356°F)

INPUT SPECIFICATIONS	ACCURACY IN °C/°F
Accuracy RTD	±0.012°C(±0.022°F) @ -60°C(-76°F)
H120(90)672: -80°C to 260°C	±0.012°C(±0.022°F) @ -30°C(-22°F)
(excluding sensor accuracy)	±0.011°C(±0.020°F) @ 0°C(32°F)
	±0.011°C(±0.020°F) @ 50°C(122°F)
	±0.011°C(±0.020°F) @ 100°C(212°F)
	±0.011°C(±0.020°F) @ 150°C(302°F)
	±0.010°C(±0.018°F) @ 180°C(356°F)
Accuracy RTD	±0.011°C(±0.020°F) @ -200°C(-328°F)
Pt100 MILL: -200°C to 850°C	±0.013°C(±0.023°F) @ -100°C(-148°F)
(excluding sensor accuracy)	±0.014°C(±0.025°F) @ -50°C(-58°F)
	±0.016°C(±0.029°F) @ 0°C(32°F)
	±0.018°C(±0.032°F) @ 100°C(212°F)
	±0.019°C(±0.034°F) @ 155°C(311°F)
	±0.024°C(±0.043°F) @ 320°C(608°F)
	±0.027°C(±0.049°F) @ 420°C(788°F)
	±0.034°C(±0.061°F) @ 660°C(1220°F)
	±0.035°C(±0.063°F) @ 700°C(1292°F)
	±0.040°C(±0.072°F) @ 850°C(1562°F)
Accuracy RTD YSI-400	±0.002°C(±0.004°F) @ 15°C(59°F)
15°C to 50°C	±0.005°C(±0.009°F) @ 50°C(122°F)
(excluding sensor accuracy)	
Accuracy Pt100 reference input	±0.006°C(±0.011°F) @ -200°C(-328°F)
(excluding sensor accuracy)	±0.007°C(±0.013°F) @ -100°C(-148°F)
	±0.008°C(±0.014°F) @ -50°C(-58°F)
	±0.009°C(±0.016°F) @ 0°C(32°F)
	±0.011°C(±0.020°F) @ 155°C(311°F)
	±0.014°C(±0.025°F) @ 320°C(608°F)
	±0.015°C(±0.027°F) @ 420°C(788°F)
	±0.020°C(±0.036°F) @ 660°C(1220°F)
	±0.020°C(±0.036°F) @ 700°C(1292°F)
	±0.023°C(±0.041°F) @ 850°C(1562°F)

* Available upon request on selected markets.

STANDARDS / APPROVALS

The following standards are observed according to the EMC-Directive (2014/30/EU)	EN 61326-1: 2013: Electrical equipment for measurement, control and laboratory use – EMC requirements
The following standards are observed according to the low voltage-directive (2014/35/EU)	EN61010-1:2010/A1:2019: Safety requirements for electrical equipment for measurement, control and laboratory use, part 1: General requirement EN61010-2-010:2020 : Safety requirements for electrical equipment for measurement, control and laboratory use, part 2-010: particular requirements for laboratory equipment for the heating of materials
External LM842 USB Wifi dongle certification/compliance	

PATENTS

<u>All RTC^{t} models B and C</u>	
Patented DLC system	Patent No.: EP2350588 / US8801271 / CN102177425
<u>RTC^{t} -159</u>	
Patented heating technology	Patent No.: EP2399107 / US8721173
<u>RTC^{t}-168</u>	
Patented calibration system	Patent No.: EP4148405
<u>RTC^{t} -700</u>	
Patented fast cooling technology	Patent No.: EP2399107 / US8721173

11.0 List of accessories

All parts listed in the list of accessories can be obtained from the factory through our dealers.

Please contact your dealer for assistance if you require parts, which do not appear on the list.

List of accessories

Accessories / Replacement Parts	Parts no.
Fuse 115V/230V mains: 250V, T6A (RTC^t -156/157/168)	130972
Fuse 115V mains: 250V, F10A (RTC^t -700)	131181
Fuse 230V mains: 250V, F5A (RTC^t -700)	131180
Fuse 115V/230V mains: 250V, F4A (RTC^t -159)	131195
Tool for insertion tube	60F170
Tool for insertion tube (with hook) (RTC^t -700 only)	127543
Insulation collar (RTC^t -156 only)	123652
Set of Rubber Cones for insulation plug (RTC^t -156/157/159/168 only)	126280
Thermal protection shield (RTC^t -700 only)	127375
Carrying case (RTC^t -156/157)	127292
Carrying case (RTC^t -168)	127782
Carrying case (RTC^t -159)	128524
Carrying case (RTC^t -700)	127552
Mains cable, 115V, US, type B	60F135
Mains cable, 240V, UK, type C	60F136
Mains cable, 220V, South Africa, type D	60F137
Mains cable, 220V, Italy, type E	60F138
Mains cable, 240V, Australia, type F	60F139
Mains cable, 230V, Europe, type A	60F140
Mains cable, 230V, Denmark, type G	60F141
Mains cable, 220V, Switzerland, type H	60F142
Mains cable, 230V, Israel, type I	60F143
Thermocouple male plug type K	120517
Thermocouple male plug type N	120514
Thermocouple male plug type T	120515
Thermocouple male plug type Cu-Cu	120519
Thermocouple male plug type J	120516
Thermocouple male plug type R/S	120518
Cable for USB, length 2 meter	127278
USB cpl. + JOFRACAL PC software	124915
Dust filter (RTC^t -159 only)	128222
Application kit for calibration of sanitary sensors (RTC^t -168 only)	127279
Liquid bath kit (RTC^t -168 only)	130403
Container & Lid with Safety Valve (RTC^t -168 only)	130507
Lid with Safety Valve for RTC-168 (RTC^t -168 only)	130232
Covering/Insulation Plug for Liquid Calibration (RTC^t -168 only)	130246
Insulating ring for spill tray (RTC^t -168 only)	130252

Accessories	Parts no.
Silicone oil for RTC^t -168, 10 cSt (0.75 l.)	125033
Support rod set for sensors	127277
Extra fixture for sensor grip	125066
Extra sensor grip	125067
Set of test cables	104203
Cable for STS-200, LEMO/REDEL 6-pol, 650 mm.	127131
Wifi USB Dongle for RTCt	130817
Reference probe STS-200 90°, with accredited certificate, diameter 4mm, (-45°C to 155°C) (RTC^t -156/157)	STS200A915EH
Reference probe STS-200 90°, with accredited certificate, diameter ¼", (-45°C to 155°C) (RTC^t -156/157)	STS200B915EH
Reference probe STS-200 90°, with accredited certificate, diameter 4mm, (-100°C to 155°C) (RTC^t -159)	STS200A917EH
Reference probe STS-200 90°, with accredited certificate, diameter ¼", (-100°C to 155°C) (RTC^t -159)	STS200B917EH
Reference probe STS-200 90°, with accredited certificate, diameter 4mm, (-45°C to 165°C) (RTC^t -168)	STS200A919EH
Reference probe STS-200 90°, with accredited certificate, diameter ¼", (-45°C to 165°C) (RTC^t -168)	STS200B919EH
Reference probe STS-102, with accredited certificate, diameter 4mm, (-50°C to 155°C) (RTC^t -156/157)	STS102A030EH
Reference probe STS-102, with accredited certificate, diameter 4mm, (-50°C to 165°C) (RTC^t -168)	STS102A035EH
Reference probe STS-200 90°, with accredited certificate, diameter 4mm, (0°C to 700°C) (RTC^t -700)	STS200A970EH
Reference probe STS-200 90°, with accredited certificate, diameter ¼", (0°C to 700°C) (RTC^t -700)	STS200B970EH

11.1 Contact information

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