AMETEK®
SENSORS, TEST & CALIBRATION

Reference manual
Compact Temperatur Calibrator
Jofra CTC-140/320/650 A/B
Jofra CTC-1200 A



Reference Manual

Temperature Calibrator

JOFRA CTC-140/320/650 A/B

JOFRA CTC-1200 A

About this manual….

- **The structure of the manual**

  This reference manual is aimed at users who are familiar with AMETEK calibrators, as well as those who are not. The manual is divided into 11 chapters which 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 multi-lingual 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 a number of safety symbols designed to draw your attention to instructions which must be followed when using the instrument, as well as any risks involved.

Warning

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

Caution…

Conditions and actions which 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.

List of contents

1.0 Introduction

Congratulations on your new AMETEK Jofra CTC Calibrator!

With the AMETEK Jofra calibrator, you have chosen an extremely effective instrument which we hope will live up to all your expectations. Over the past many years, we have acquired extensive knowledge of industrial temperature calibration. This expertise is reflected in our products which are all designed for daily use in an industrial environment. Please note that we would be very interested in hearing from you if you have any ideas or suggestions for changes to our products.

This reference manual applies to the following instruments:

- **Jofra CTC-140 A (with RS232)**
- **Jofra CTC-320 A (with RS232)**
- **Jofra CTC-320 B (with RS232)**
- **Jofra CTC-650 A (with RS232)**
- **Jofra CTC-650 B (with RS232)**
- **Jofra CTC-1200 A (with RS232)**

ISO-9001 certified

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

CE-label

Your new calibrator bears the CE label and conforms to the EMC directive and the Low-voltage Directive.

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.

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.

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:

- 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 a 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 clear within an area of 20 cm on all sides and 1 metre above the calibrator due to fire hazard.
- **Never** use heat transfer fluids such as silicone, oil, paste, etc. in the dry-block calibrators. These fluids 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!

About the frontpanel:

- The connectors, on the front panel of the calibrator, must **NEVER** be connected to a voltage source.
- Thermostats must **not** be connected to any other voltage source during a test.

About insertion tubes and insulation plugs:

- **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 aluminium carrying case after use, you **must** ensure that the instrument has cooled to a temperature **below**

100°C/212°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.
- **Never** try to modify the insulation plugs to make them fit the sensor (CTC-1200 A only).

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.

Caution – Hot surface

This symbol is engraved in 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 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 CTC-140 A 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 the well. This, in turn, may cause the material surfaces to oxidize

  To prevent this from happening, simply heat up the calibrator to 100°C/212°F and any water left will evaporate.
  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 fan is out of order.
- Before cleaning the calibrator, you **must** switch it off, allow it to cool down and remove all cables.

About the well, insertion tube and grid plate:

- The well and the insertion tube **must** be clean before use.
- **Do not** pour any form of liquids into the well. It might damage the well.
- 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 – 320°C(608°F) / 650°C (1202°F) / 1205°C (2201°F) - for a period of minimum 30 minutes (CTC-320/650/1200 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. If the insertion tube is not removed from the CTC-1200 A the ceramic well might crack.

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 unauthorised spare parts.

3.0 Setting up the calibrator

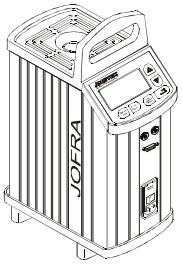
3.1 Receipt of the calibrator

When you receive the instrument…

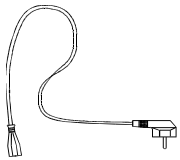
- Carefully unpack and check the calibrator and the accessories.
- Check the parts off against the list shown below.

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

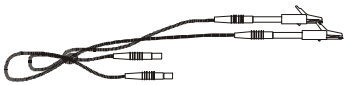
You should receive:



- 1 calibrator

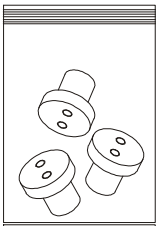


- 1 mains cable



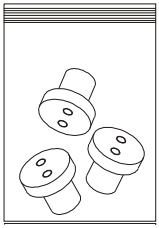
- 1 set of test cables (1 black, 1 red)

- 1 insertion tube

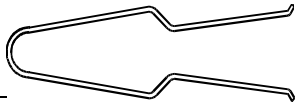


- 3 pcs. insulation plugs for 6, 10, 13 mm sensors (CTC-140 A only)

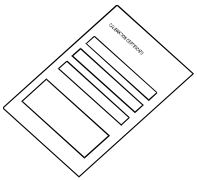
- 3 pcs. insulation plugs matching the sensor size. (CTC-1200 A only)



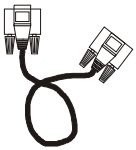
- 1 tool for insertion tube



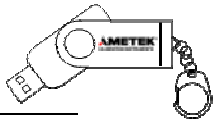
- 1 traceable certificate



- 1 RS 232 serial cable



- 1 USB key containing reference manual and software package “JOFRACAL”



When reordering, please specify the parts number found in the list of accessories, section 10.0.

3.2 Preparing the calibrator

Warning

- 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 a 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 clear within an area of 20 cm on all sides and 1 metre above the calibrator due to fire hazard.

Note…

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

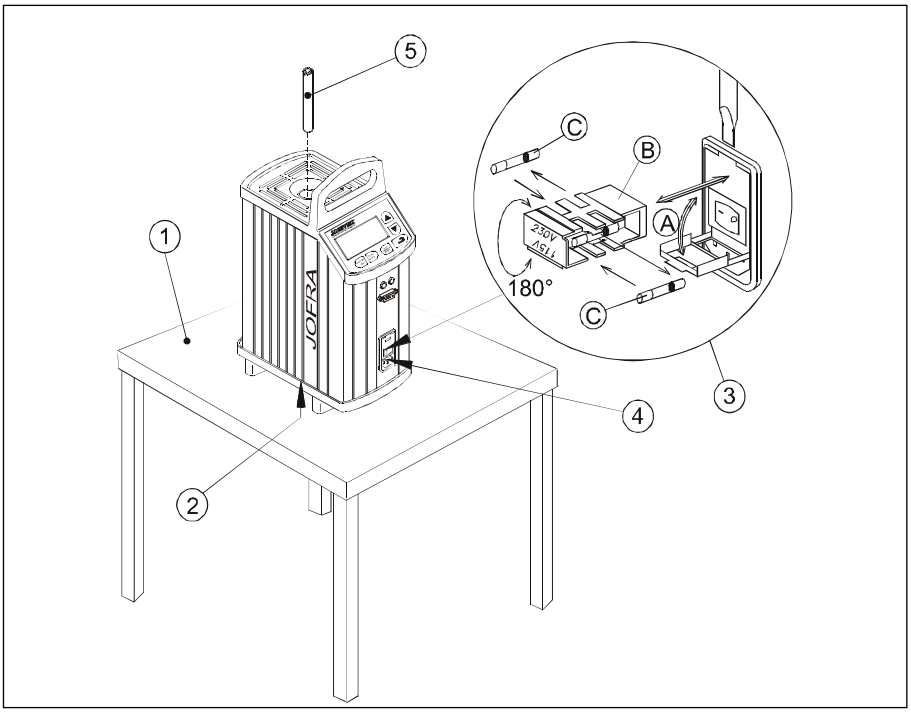


Fig. 1

When setting up the calibrator, you must…

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

Caution…

Do not use the instrument if the fan is out of order.

② Ensure a free supply of air to the fan located at the bottom of the instrument.

③ 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 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.

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 10.0.

B. Turn the fuse box 180° and slide it 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 3.3 for information on how to select insertion tubes.

The calibrator is now ready for use.

3.3 Choice of 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. Use of other insertion tubes may reduce performance of the calibrator and cause the insertion tube to get stuck.

Caution…

Before using new insertion tubes for the calibration in the CTC-320/650/1200 instruments the insertion tubes **must** be heated up to maximum temperature – 320°C(608°F) / 650°C (1202°F) / 1205°C (2201°F) - for a period of minimum 30 minutes.

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

Use the table for insertion tubes in section 10.0 to find the correct parts number.

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

- Sensor diameter $+0.2\ ^{+0.05}$ mm.
- Sensor diameter $+0.5 \pm 0.05$ mm (CTC-1200 A)

3.4 Inserting the sensor

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

Warning

- **Never** use heat transfer fluids such as silicone, oil, paste, etc. in the dry-block calibrator.
  These fluids may penetrate the calibrator and cause electrical hazard, damage or create poisonous fumes.
- Use only insulation plugs supplied by AMETEK Denmark A/S.

Caution…

- The well and the insertion tube **must** be clean before use.
- **Do not** pour any form of liquids in the well. It might damage the well.
- 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 as 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.

3.4.1 CTC-140/320/650 A/B

Insert the sensor as shown in Fig. 2.

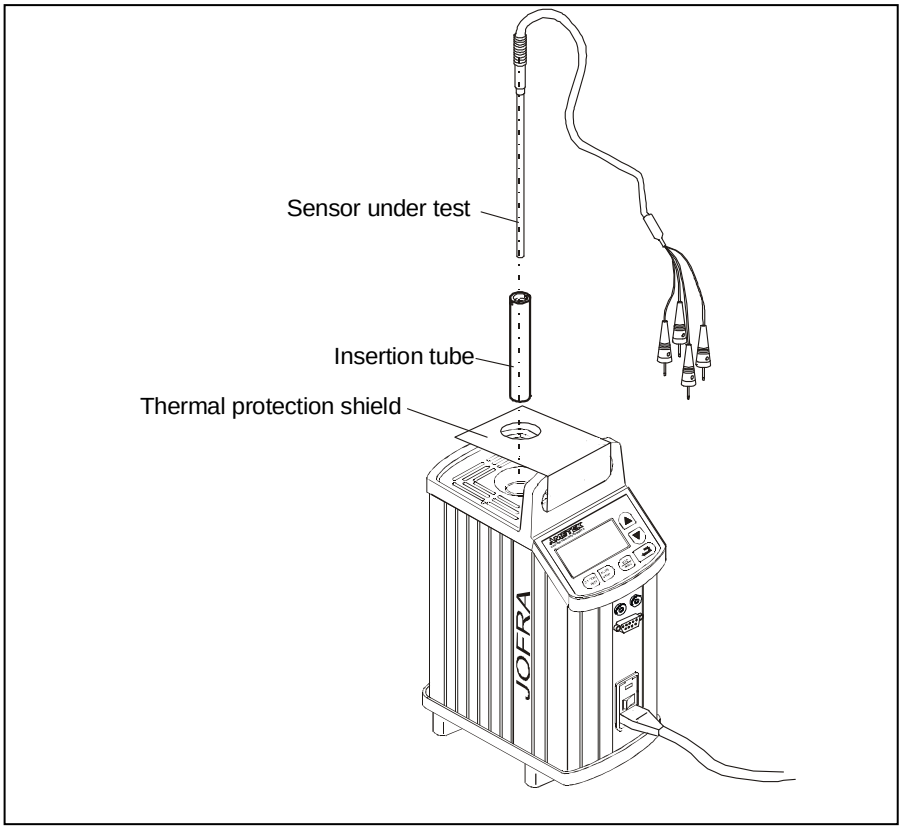


Fig. 2

In order to spare the sensor and its connections it is recommended to use a heat protection shield (104216) at high temperatures.

If the design of the sensor permits it, you are advised to use an insulation tube and insulation as shown in Fig. 3.

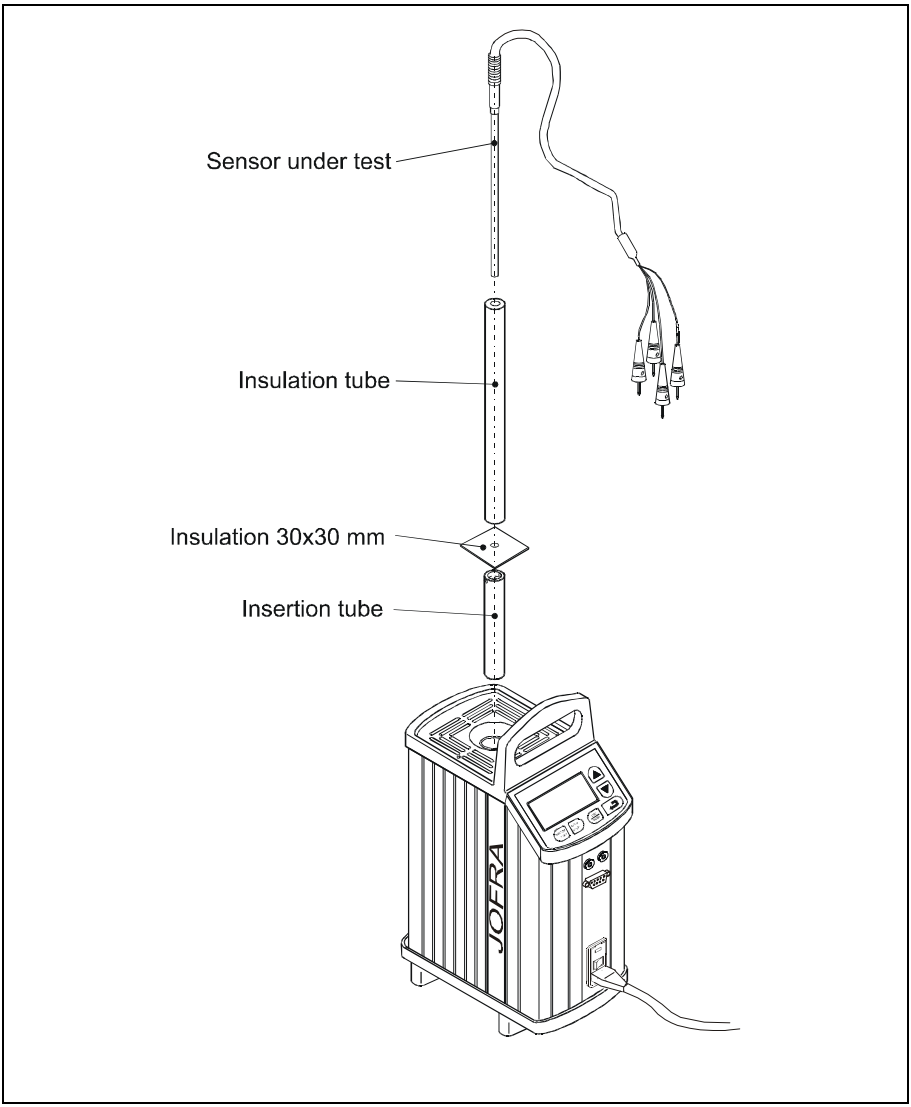


Fig. 3

3.4.2 CTC-1200 A

Insert the sensor as shown in Fig. 4.

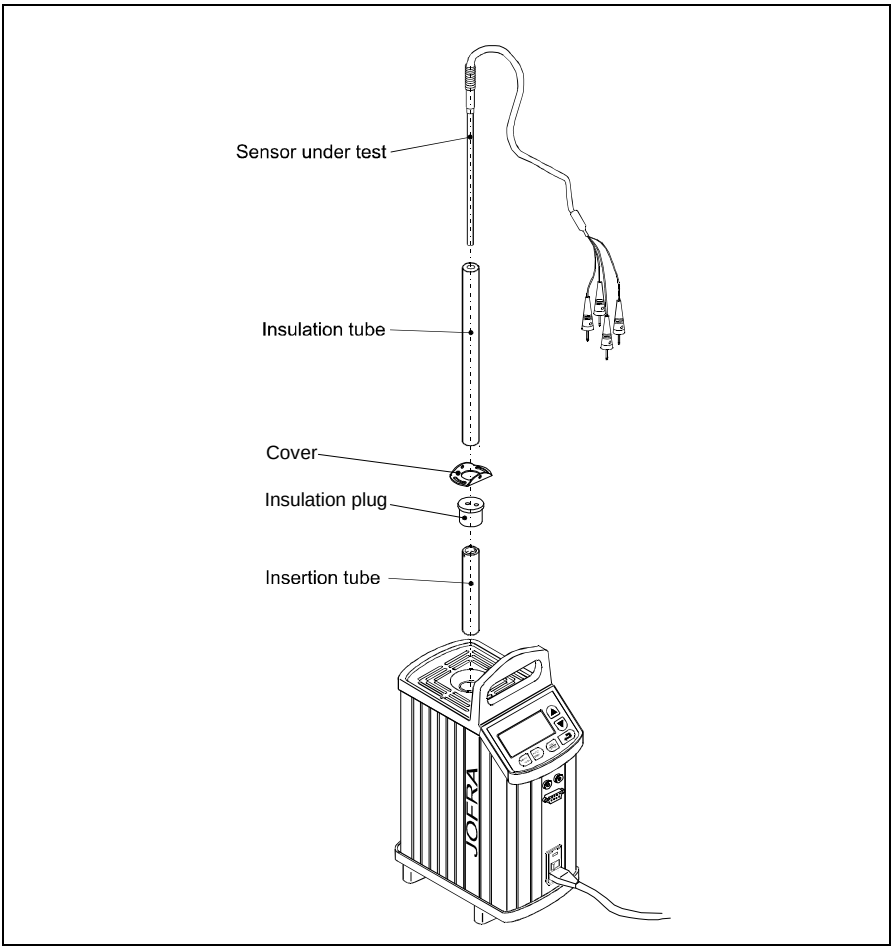


Fig. 4

Check that the insulation plug fits the diameter of the sensor. Otherwise replace it (see list of accessories, chapter 10.0 for available insulation plugs)

Warning

Never try to modify the insulation plugs to make them fit the sensor.

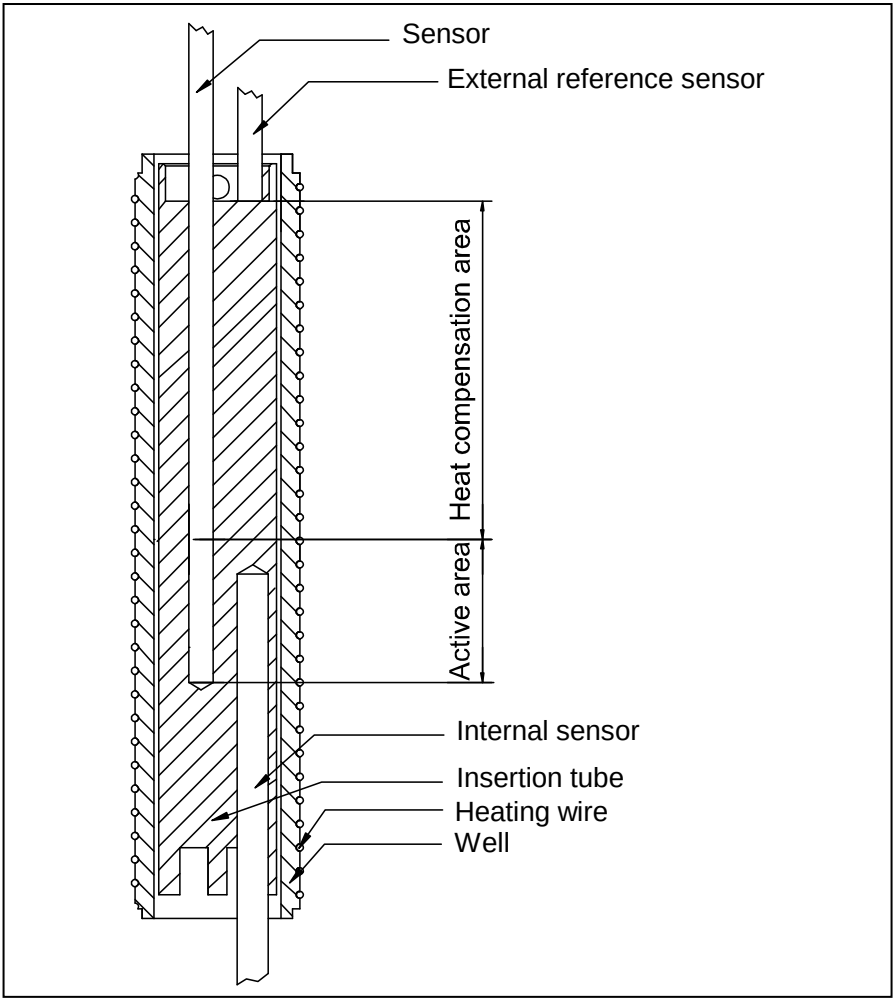


Fig. 5

The sensor is placed in the insert so that the active part of the sensor is inside the active area of the insertion tube. The active area is from the bottom of the insertion tube and 40 mm up.

4.0 Operating the calibrator

4.1 Keyboard, display and connections

Keyboard

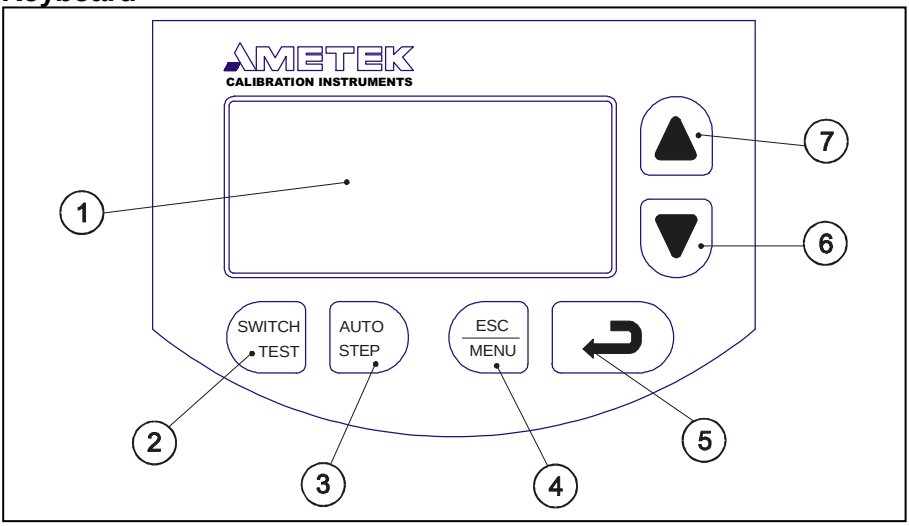


Fig. 6

Pos.	Description
①	LCD.
②	SWITCH TEST button used to activate SWITCH TEST. The function automatically detects the opening/closing temperatures for thermostats.
③	AUTO STEP button used to activate AUTO STEP. The function is used to switch between a series of set-temperatures automatically.
④	ESC/MENU button used as Escape key or to activate the menu system (hold button down for min. 2 seconds).
⑤	ENTER button used to accept chosen options.
⑥	DOWN ARROW button used to adjust temperature values (value decreases) and to select menu options.

⑦ UP ARROW button used to adjust temperature values (value increases) and to select menu options.

Display

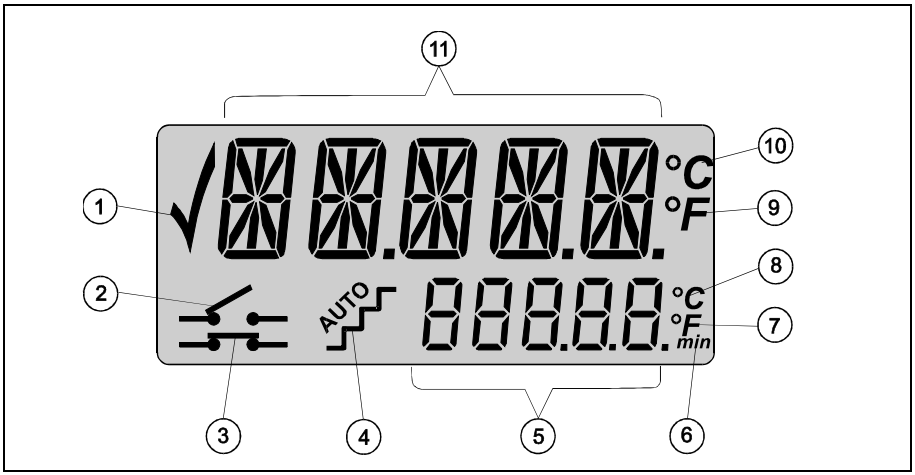


Fig. 7

Pos.	Description
①	CHECKMARK displayed when the calibrator is stable.
②	SWITCH TEST input open.
③	SWITCH TEST input closed.
④	AUTO STEP symbol used to indicate that the function is active (symbol flashes repeatedly).
⑤	Used to display set-temperatures, time-until-stable and parameter values in the menu system.
⑥	Minute time unit for bottom display.
⑦	Fahrenheit temperature unit for bottom display.
⑧	Celsius temperature unit for bottom display.
⑨	Fahrenheit temperature unit for top display.

⑩ Celsius temperature unit for top display.

⑪ Used to display Read-temperature and parameters in the menu system.

Connections

Warning

- The connectors, pos. 2 on the front panel, must **NEVER** be connected to a voltage source.
- Thermostats must **not** be connected to any other voltage source during a test.

All connections are located on the front panel.

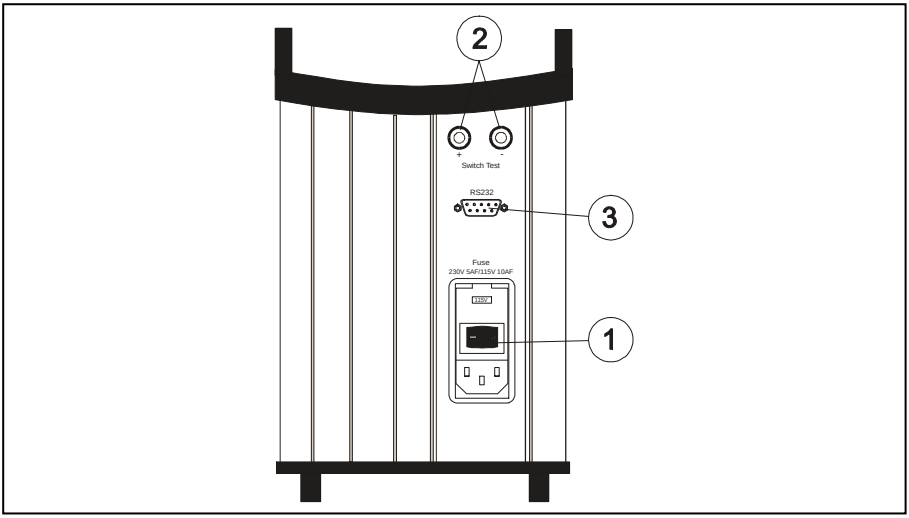


Fig. 8

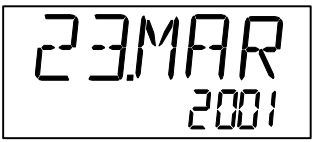
Pos.	Description
①	Power control switch with connection for cable and on/off switch. Also contains the main fuse. See section 7.0 for information on how to change the fuses and setting the mains voltage.
②	Connection for thermostat test.
③	Connection for RS232 cable.

Note that all PC-equipment, which are connected to the calibrator must observe the directive IEC950.

4.2 Starting the calibrator

☞ Switch the calibrator on using the power control switch (pos. 1 in Fig. 8).

The instrument is initialised and the last calibration date is displayed:



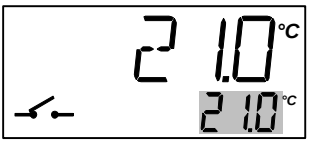
The calibration date will be displayed for approx. 2 seconds. The initialisation process has been completed and the calibrator is ready for use.

All settings are stored when the calibrator is switched off. When the instrument is switched back on again, the status will be the same as when it was switched off.

4.3 Selecting the set-temperature

☞ Press ▲ or ▼ to adjust the set-temperature.

The current selection flashes in the bottom display:

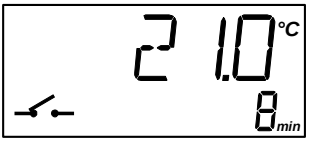


The starting point is the last chosen set-temperature (even if the instrument has been switched off).

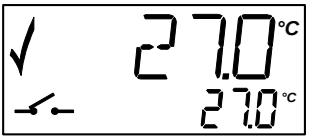
☞ Press ↵ to accept the change or ESC/MENU to cancel.

The calibrator will now heat up/cool down.

The top display continuously shows the read-temperature. The bottom display shows either the set-temperature or the estimated time in whole minutes until the calibrator will be stable:



When the calibrator is stable the display will show the ✓ checkmark symbol. The instrument will emit an audible alarm and the estimated time until stable will be replaced by the set-temperature:



4.4 Using the SWITCH TEST

SWITCH TEST automatically locates the switch temperature of a thermostat.

You must enter a temperature range T_{min} - T_{max}, within which the switch temperature is expected to be found. You must also specify the slope rate to be used during the test in SETUP (the smaller the value, the more accurate the results of the test and the longer the test will take).

The function can be illustrated using the following example:

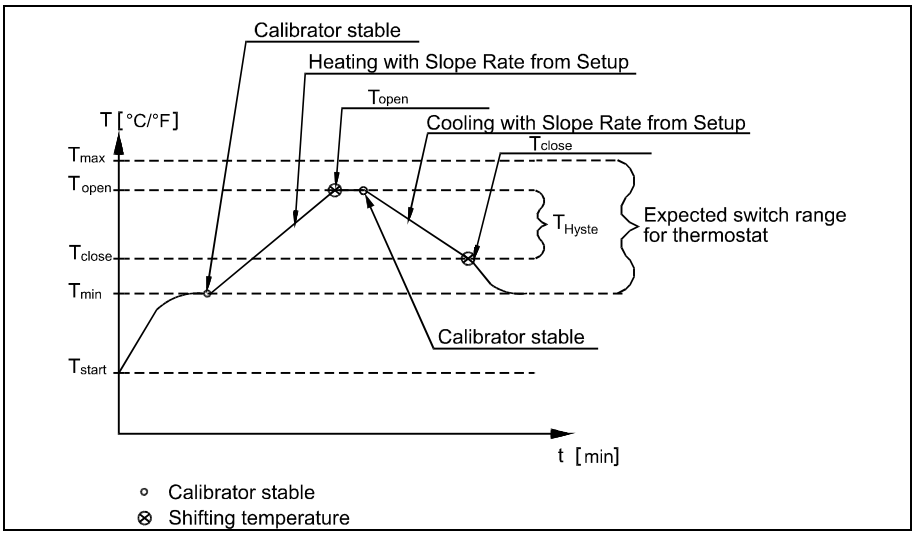


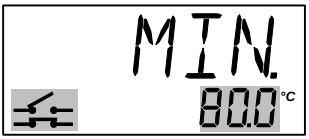
Fig. 9

☞ Press SWITCH TEST.

The symbols for SWITCH TEST will flash to indicate that the function is active.

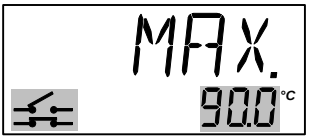
☞ The function can be cancelled at any time by pressing ESC MENU.

☞ Press ▲ or ▼ to select the required T_{min}:



☞ Press ↵ to accept your selection.

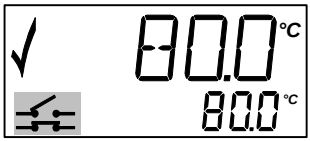
☞ Press ▲ or ▼ to select the required T_{max}:



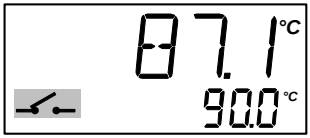
☞ Press ↵ to accept your selection.

The calibrator will now start working towards the T_{min}:

Once the T_{min} has been reached and the calibrator is stable, the instrument will emit an audible alarm and display the status for one second:

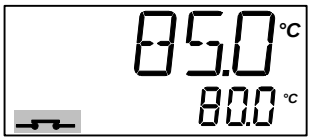


The calibrator will now start working towards the T_{max} using the slope rate selected in SETUP. The flashing SWITCH TEST symbol indicates the current status:



The instrument will check for changes in the SWITCH TEST. If no change has been detected by the time T_{max} is reached, the instrument will register an ERROR.

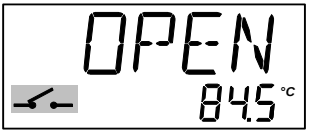
The calibrator will stabilise at this temperature, and then work towards the T_{min} using the slope rate selected in SETUP.
The flashing SWITCH TEST symbol indicates the current status:



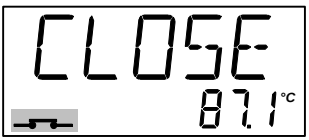
The instrument will check for changes in the SWITCH TEST input once again. If no change has been detected by the time the T_{min} has been reached, the instrument will register an ERROR.

The results of the test will be displayed as 3 values: an “Open” temperature, a “Close” temperature and a “Hyste” hysteresis temperature (the difference between the two temperatures).

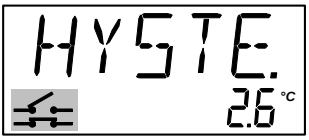
The open temperature is shown first:



☞ Press ▼ to display the close temperature:



Press ▼ to display the hysteresis temperature:



If a temperature has not been found, the instrument will display an “Error” (the “Hyste” temperature will also be shown as an “Error”):

Press ESC/MENU or ↵ to end the SWITCH TEST. The instrument will store the T_{min} and T_{max} until the next time the SWITCH TEST is activated.

Note…

you can activate ▲ or ▼ during the test to display the temporary results.

4.5 Using the AUTO STEP

AUTO STEP is used to step automatically between a range of different calibration temperatures. This is useful when calibrating sensors in places which are hard to reach, and when calibrating sensors for which the output is displayed in a different location.

The function can be illustrated using the following example:

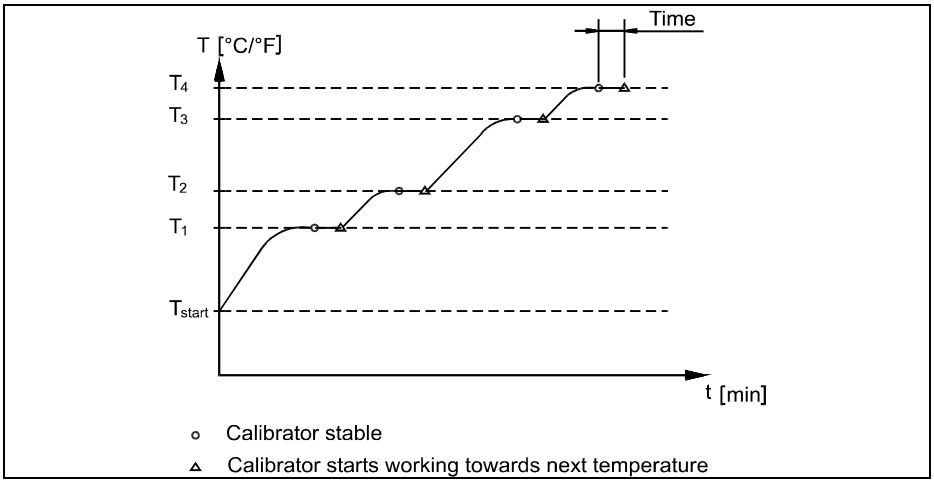


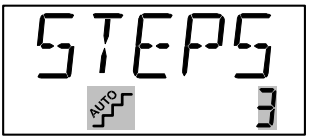
Fig. 10

☞ Press AUTO STEP.

The AUTO symbol for AUTO STEP flashes to indicate that the function is active.

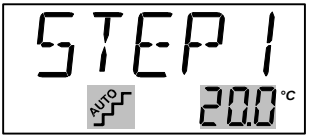
☞ The function can be cancelled at any time by pressing ESC MENU

☞ Press ▲ or ▼ to select the required number of steps (minimum 2 steps, maximum 9 steps):



☞ Press ↵ to accept your selection.

☞ Press ▲ or ▼ to select the required set-temperature for step 1:

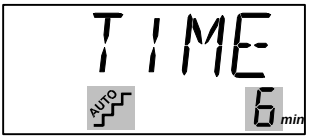


☞ Press ↵ to accept your selection.

Repeat the above procedure for all temperature steps.

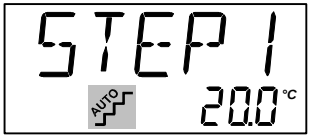
☞ Press ↵ to accept your choices once you have adjusted the last temperature step.

☞ Press ▲ or ▼ to set the amount of extra time you wish the calibrator to remain at every step:

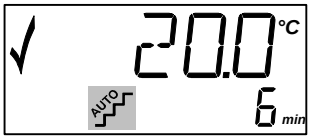


☞ Press ↵ to accept your selection.

The following will be displayed for one second to indicate that the calibrator is ready to work towards the set-temperature:



The calibrator will now work towards the given set-temperature. An audible alarm will be emitted once the calibrator is stable.
The calibrator will wait the specified amount of extra time. The instrument indicates this by counting down the amount of time remaining:



The calibrator will then go to the next step. The procedure is the same as for the first step. This process will be repeated until the last step has been executed and the function has been completed.

4.6 Using the MENU

☞ Hold down ESC MENU for more than approx. 2 seconds:

☞ Press ↵ to select SETUP.

☞ Press ▲ or ▼ to switch between the adjustable parameters:

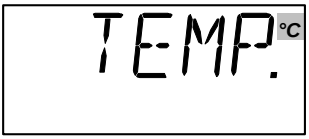
☞ If you wish to exit SETUP, simply press ESC MENU .

☞ The instrument will ignore all changes if you press ESC MENU when adjusting any of the parameters.

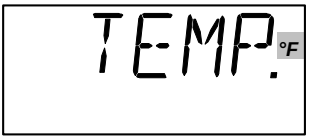
☞ Press ↵ to adjust the parameter.

4.6.1 Adjusting the temperature unit

☞ Press ▲ or ▼ to switch between °C and °F:



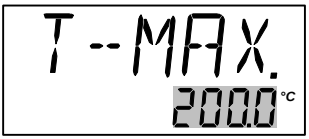
- and



☞ Press ↵ to accept your selection.

4.6.2 Adjusting the max-temperature

☞ Press ▲ or ▼ to set the max-temperature in steps of 0.1°C or 0.1°F:



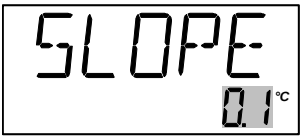
If the current set-temperature is higher than the new max-temperature, you will need to adjust the set-temperature. The instrument will immediately begin to cool (if required) as soon as the new max-temperature is accepted.

☞ Press ↵ to accept your selection.

☞ If you wish to exit SETUP, simply press ESC MENU .

4.6.3 Adjusting the SWITCH TEST slope rate

☞ Press ▲ or ▼ to set the SWITCH TEST slope rate to a temperature between 0.1°C and 9.9°C/minutes in steps of 0.1°C (if your chosen temperature unit is °F, the range will change to between 0.1°F and 9.9°F/minutes in steps of 0.1°F):

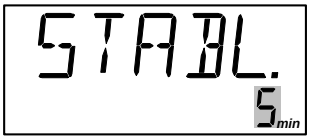


☞ Press ↵ to accept your selection.

4.6.4 Adjusting the extra stability time

The extra stability time is the amount of extra time you wish to elapse before the checkmark symbol ✓ is displayed after the calibrator has stabilised.

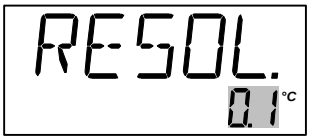
☞ Press ▲ or ▼ to set the time to anywhere between 0 and 20 minutes:



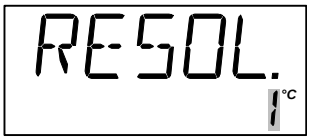
☞ Press ↵ to accept your selection.

4.6.5 Adjusting the temperature resolution

☞ Press ▲ or ▼ to select the required number of decimals:



- and



☞ Press ↵ to accept your selection.

4.7 Simulation/training

☞ Hold down the ▲ and ▼ buttons while you switch on the calibrator.

The instrument will display the following screen:

The instrument will then revert to the standard display.

The calibrator's simulation mode is used to train personnel in the use of the instrument, etc. The simulation setting differs from the standard setting as follows:

- The instrument will not actually heat up or cool down the well.
- The heating and cooling processes are simulated at around 10 times the normal speed of these operations.

The calibrator will remain in simulation mode until it is switched off.

5.0 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.

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.

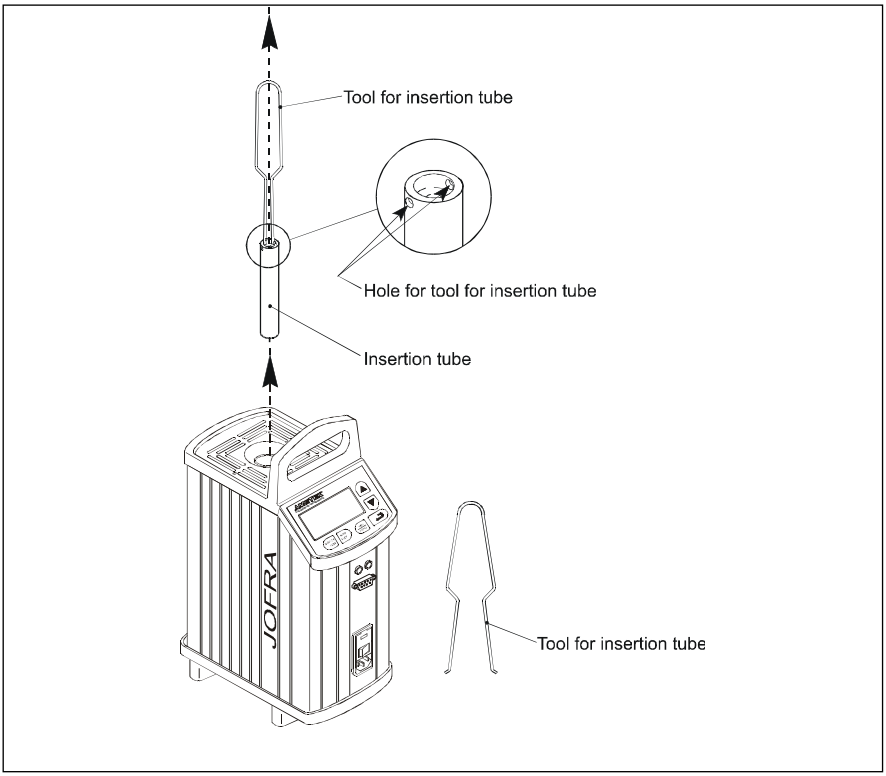


Fig. 11

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

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.

Caution – Cold surface

Below 0°C/32°F (applies only to the CTC-140 A 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 the well. This, in turn, may cause the material surfaces to oxidize
  To prevent this from happening, simply heat up the calibrator to 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.

Remove the insertion tube from the calibrator using the tool for insertion tube supplied with the instrument as shown in Fig. 11.

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.
- If the calibrator is to be transported, the insertion tube **must** be removed to avoid damage to the instrument. If the insertion tube is not removed from the CTC-1200 A the ceramic well might crack.

Warning

- **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 aluminium carrying case after use, you **must** ensure that the instrument has cooled to a temperature **below 100°C/212°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 can create frostbite.

6.0 Errors

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…

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.

If the calibrator detects an error during operation, the instrument will terminate all functions and display an error code:

ERROR 0001

Likely cause: Defective RTD-sensor or excessively high temperature measured by the instrument's internal sensor.

Solution: The calibrator should be returned to the manufacturer for service.

ERROR 0002

Likely cause: The calibration coefficients have not been accepted.

Solution: Try again. If the error message returns, the calibrator should be returned to the manufacturer for service.

ERROR 0003

Likely cause: An error has occurred in the control circuit.

Solution: The calibrator should be returned to the manufacturer for service.

ERROR 0004

Likely cause: Incorrect mains frequency setting.

Solution: Mains frequency not compatible with instrument configuration.

Please contact AMETEK Denmark A/S for guidance.

Nothing happens when the power control switch (on/off switch) is pressed.

Likely cause: There is no power to the calibrator.

Solution: Check that the calibrator is correctly connected.
Check the fuse.
If there are no problems with the mains cable or the fuse, the calibrator should be returned to the manufacturer for service.

7.0 Setting the mains voltage and replacing the 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.

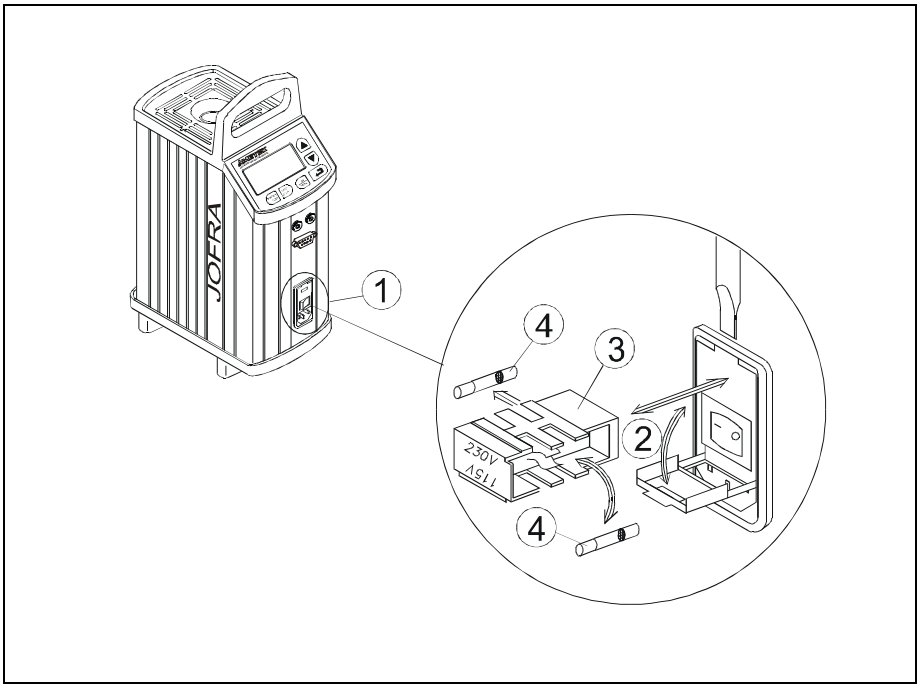


Fig. 12

① 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.

② Open the lid of the fuse box using a screwdriver.

③ Remove the fuse box.

④ Remove both fuses and insert two new fuses. These must be identical and should correspond to the line voltage.

- **CTC-140:** 115V, 2AT = 105014 / 230V, 1AT = 105007
- **CTC-320/650:** 115V, 10AF = 60B302 / 230V, 5AF = 60B301
- **CTC-1200 A:** 115V, 6.3AT = 60B313 / 230V, 3.15AT = 60B312

⑤ If the fuses blow immediately after you have replaced them, the calibrator should be returned to the manufacturer for service.

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

7.1 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.
Furthermore please follow the guidelines for transportation described in chapter 5.0 – Storing and transporting the calibrator.

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. Details of the hazardous substances and any precautions to be taken must be enclosed.

8.0 Maintenance

8.1 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 versions)

- **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 100°C/212°F** before placing it in the carrying case.
- **Do not** touch the well or insertion tube when these are deep frozen – they can create frostbite.

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

- **The exterior of the instrument -** Clean using water 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.

- **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 (CTC-140 A only).
  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 should be removed from the well using e.g. compressed air.

Warning

REMEMBER! Wear goggles when using compressed air!

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 (CTC-140 A only).
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.

8.2 Adjusting and calibrating the instrument

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

Alternatively, you can calibrate/adjust the calibrator yourself. You will need a reference thermometer and a reference sensor with a traceable certificate. Please follow the instructions given below.

Connect the calibrator to an external precision instrument (e.g. a DTI) as shown in Fig. 13:

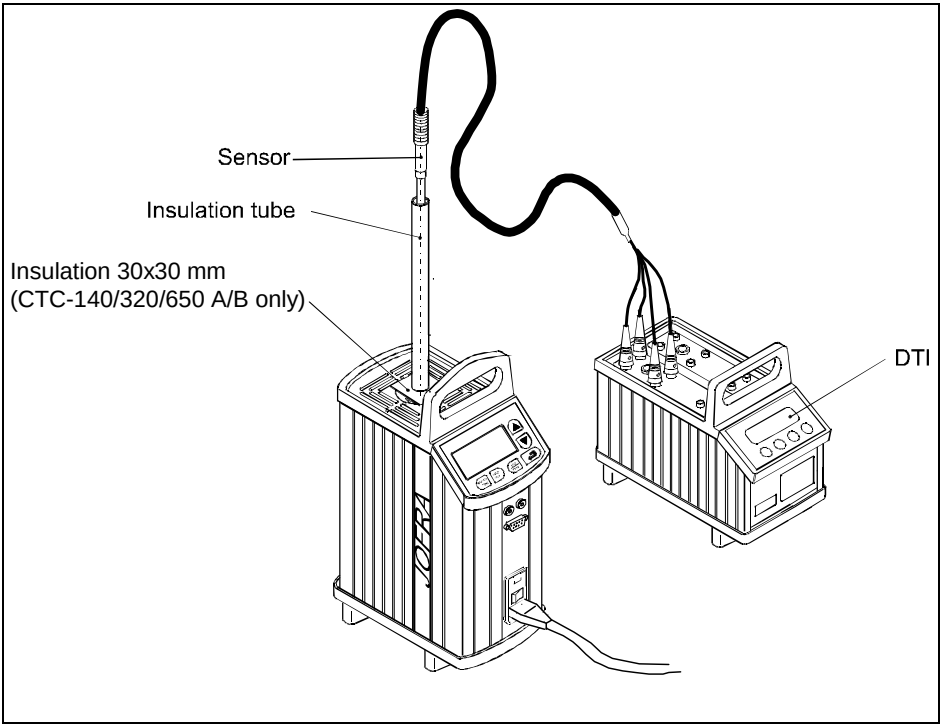
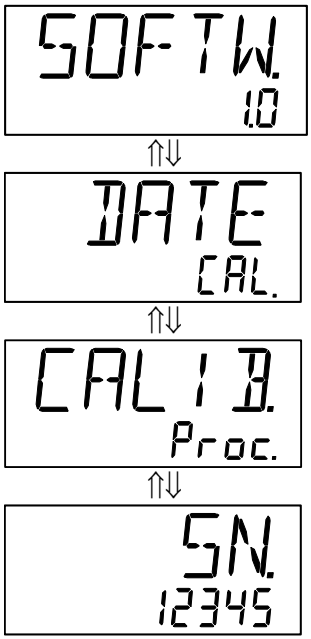


Fig. 13

☞ Hold down the ESC MENU button while pressing the on/off power control switch.

The instrument is now in adjustment/service mode.

☞ Press ▲ or ▼ to toggle between the different options:



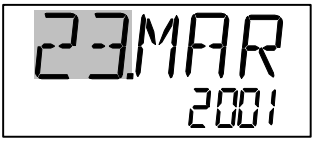
☞ Press ↵ to accept your selection.

To exit the adjustment/service mode, switch the instrument off and on again using the power control switch.

8.2.1 Adjusting the calibration date

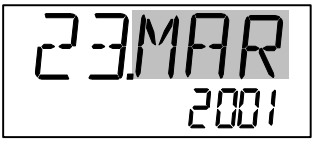
Adjust the date by toggling through the available days, months and years. Begin by selecting the required day as shown below:

☞ Press ▲ or ▼ to select the required day in the interval 1-31.



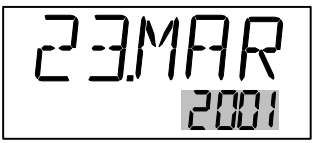
☞ Press ↵ to accept your selection.

☞ Press ▲ or ▼ to select the required month from JAN / FEB / MAR / APR / MAY / JUN / JUL / AUG / SEP / OCT / NOV / DEC.

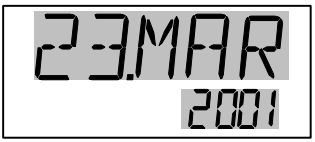


☞ Press ↵ to accept your selection.

☞ Press ▲ or ▼ to select a year between 2001–2025.



☞ Press ↵ to accept your selection. The day will be adjusted if necessary to ensure the legality of the date. Finally, the day, month and year will flash:



☞ Press ↵ to accept the date.

or

☞ press ESC MENU to cancel the whole selection.

8.2.2 Calibrating/adjusting the instrument

The internal calibration/adjustment is a complex function which is divided into a number of different steps:

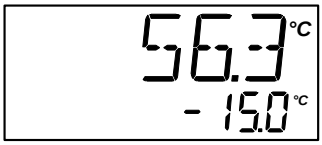
The instrument will disclose the first calibration temperature by displaying the text “TEMP.1 XXX°C” for approx. 1 second:

Calibration temperature for calibrators:

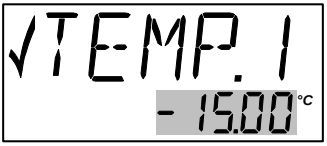
CTC-140 A	1.	-15°C / 5°F
	2.	20°C / 68°F
	3.	60°C / 140°F
	4.	100°C / 212°F
	5.	140°C / 284°F

CTC-320 A/B	1.	50°C / 122°F
	2.	120°C / 248°F
	3.	180°C / 356°F
	4.	250°C / 482°F
	5.	320°C / 608°F
CTC-650 A/B	1.	50°C / 122°F
	2.	200°C / 392°F
	3.	350°C / 662°F
	4.	500°C / 932°F
	5.	650°C / 1202°F
CTC-1200 A	1.	50°C / 122°F
	2.	300°C / 572°F
	3.	600°C / 1112°F
	4.	900°C / 1652°F
	5.	1200°C / 2192°F

The instrument will now heat up/cool down to reach the first calibration temperature:



☞ Once the calibrator is stable, you need to enter the reference temperature found using the reference thermometer. The calibration temperature is suggested as a reference point:



This procedure is repeated for TEMP.2, TEMP.3, TEMP.4 and TEMP.5.

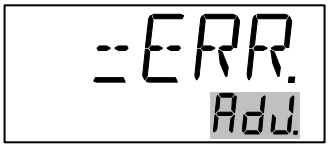
All five calibration temperatures and associated reference temperatures have now been entered.

The instrument will now check whether the reference temperatures which have been entered are within the permitted tolerances.

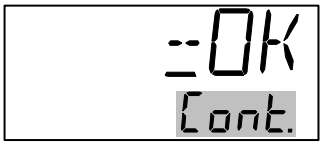
Permitted tolerances:

- CTC-140 A, CTC-320 A / B : ±0,15°C / 0.27°F
- CTC-650 A : ±0,25°C / 0.45°F
- CTC-650 B : ±0,35°C / 0.63°F
- CTC-1200 A: ±0,8°C / 1.44°F

If the instrument detects excessive deviations for one or more steps, it will show a screen reading =ERR. in the top of the display. The text AdJ. will flash in the bottom of the display to indicate that an adjustment is required (accept by pressing ↵):



If the calibrator is found to be within the permitted tolerances, the instrument will display the text =OK at the top of the display. The text Cont. will flash in the bottom of the display to indicate that you may continue without adjustments:



☞ Press ESC/MENU to cancel the adjustment function.

☞ Press ▲ to go back to a previous screen and press ↵ to repeat an adjustment step when it is shown on the display.

☞ Press ▼ to toggle between AdJ. and Cont. on the display.

☞ Press ⮌ when AdJ. is flashing to calculate a new set of coefficients. Next, repeat the entire calibration/adjustment procedure.

If the new coefficients deviate by more than 4% from the standard values, the instrument will display an ERROR 2 in the display. The calculated coefficients will be ignored:

☞ Press ⮌ to repeat the entire calibration/adjustment procedure.

☞ Press ⮌ when Cont. is flashing to end the calibration/adjustment procedure and enter a new calibration date (see section 8.2.1).

9.0 Technical specifications

The illustrations below show the setup which forms the basis for the technical specifications.

CTC-140/320/650 A/B

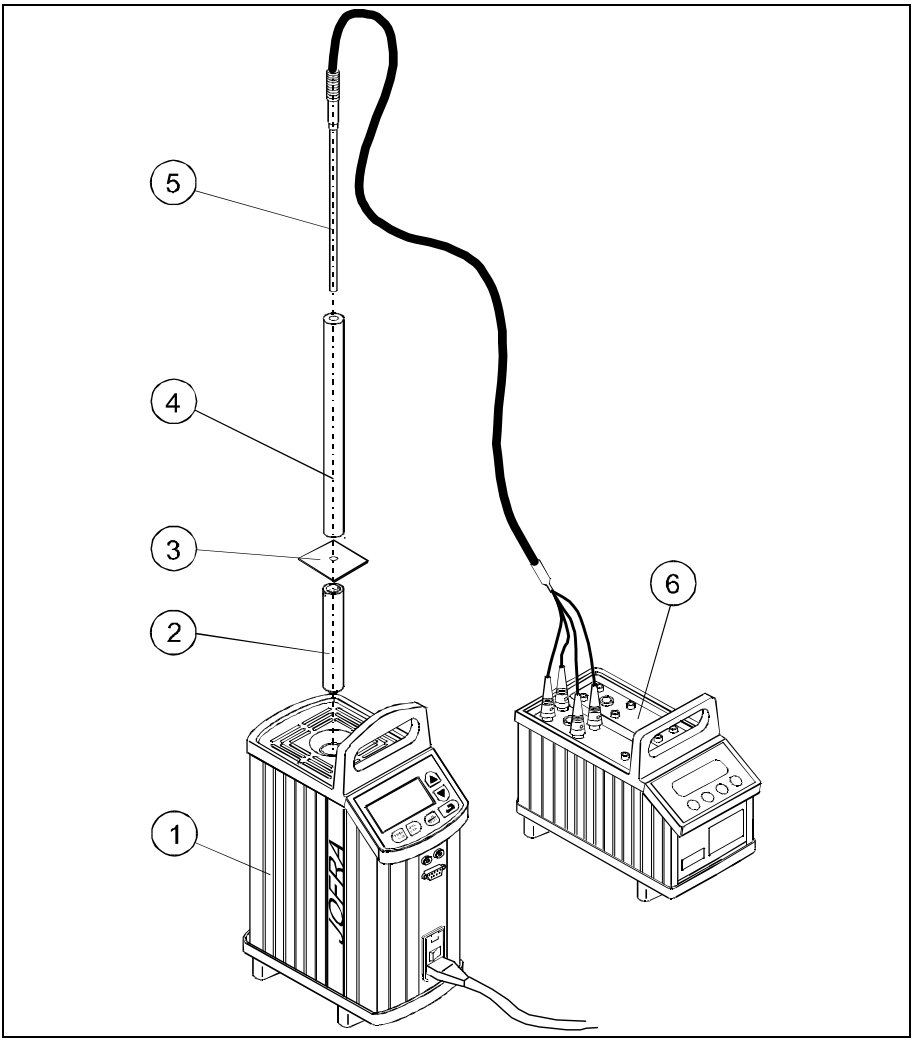


Fig. 14

Pos.	Description
①	Calibrator
②	Ø4.2 mm insertion tube
③	Insulation 30 x 30 mm
④	Insulation tube for Ø4 mm sensor
⑤	Ø4 mm Pt 100 sensor with traceable certificate
⑥	DTI 1000 reference precision thermometer with traceable certificate

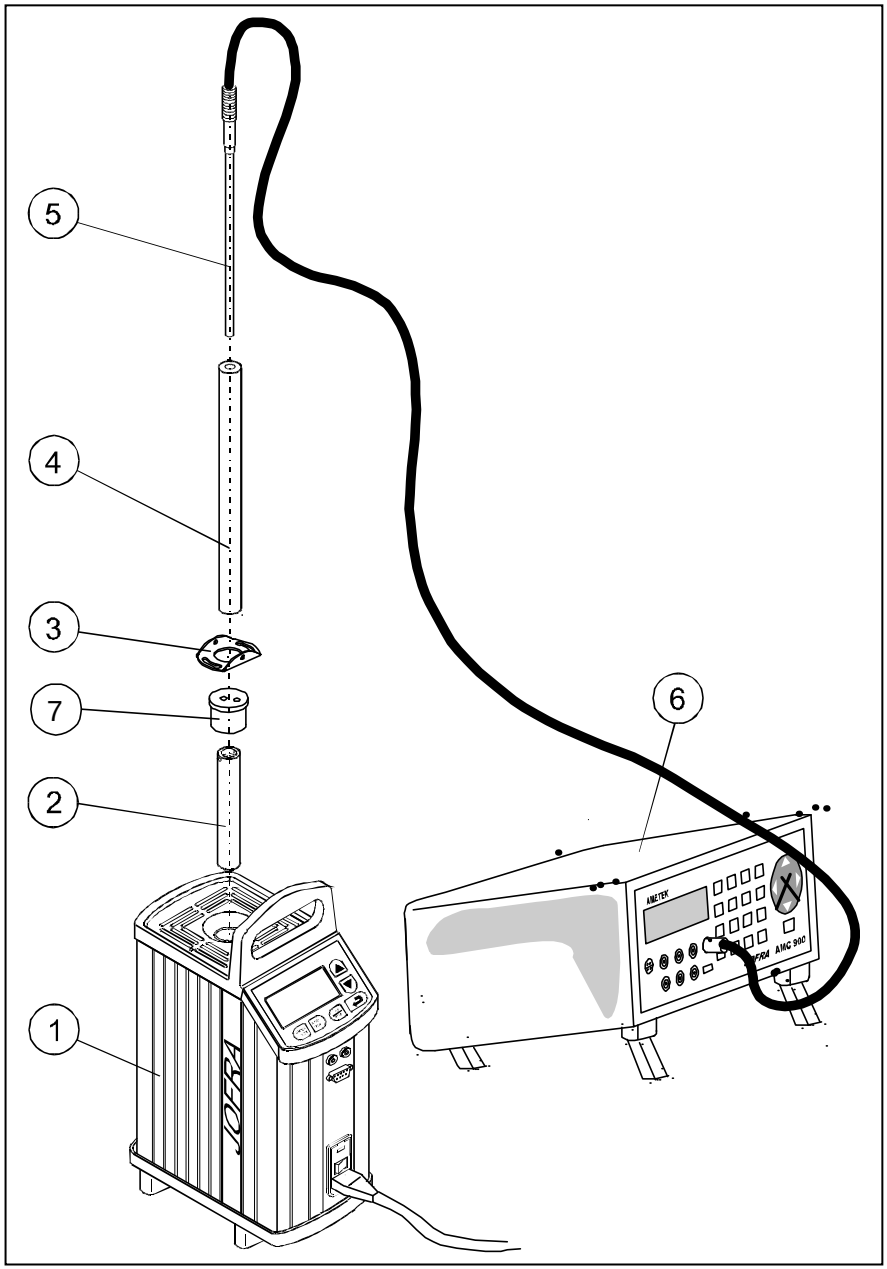


Fig. 15

CTC-1200 A

Pos.	Description
①	Calibrator
②	Ø5.0 mm insertion tube
③	Cover
④	Insulation tube for Ø5 mm sensor
⑤	Ø5.0 mm thermocouple type R with traceable certificate
⑥	AMC 900 or multimeter incl. cold junction compensation
⑦	Insulation plug

Thermal specifications [1]

[1] All specifications are given with an ambient temperature of 23°C/73.4°F ± 3°C/5.4°F
[2] Specified at 115V / 230V

Specifications	Model
	CTC-140 A
Max. Temperature :	140°C/284°F
Min. Temperature :	-30°C/-22°F @ ambient temperature 0°C/32°F -17°C/1°F @ ambient temperature 23°C/73°F -2°C/28°F @ ambient temperature 40°C/104°F
Display resolution :	0.1°C/ 0.1°F
Stability :	±0.05°C/±0.09°F
Accuracy :	±0.4°C/±0.72°F

Specifications		Model
Heating, [2] 23°C to max.	:	15 min.
Time to stability	:	5 min.
Cooling time		
100 to 0°C / 212 to 32°F:		10 min.
0 to –15°C / 32 to 5°F:		16 min.
140 to 100°C / 284 to 212°F:		2 min.
		CTC-320 A
Max. Temperature	:	320°C/608°F
Min. Temperature	:	50°C/122°F @ ambient temperature 40°C/104°F 33°C/91°F @ ambient temperature 23°C/73°F 10°C/50°F @ ambient temperature 0°C/32°F
Display resolution	:	0.1°C/ 0.1°F
Stability	:	±0.1°C/±0.18°F
Accuracy	:	±0.5°C/±0.9°F
Heating, [2] 23°C to max.	:	4 min.
Time to stability	:	8 min.
Cooling time		
320 to 100°C / 608 to 212°F:		16 min.
		CTC-650 A
Max. Temperature	:	650°C/1202°F
Min. Temperature	:	50°C/122°F @ ambient temperature 40°C/104°F 33°C/91°F @ ambient temperature 23°C/73°F 10°C/50°F @ ambient temperature 0°C/32°F
Display resolution	:	0.1°C/ 0.1°F

Specifications		Model
Stability	:	±0.1°C/±0.18°F
Accuracy	:	±0.9°C/±1.62°F
Heating, [2] 23°C to max.	:	10 min.
Time to stability	:	8 min.
Cooling time		
650 to 100°C / 1202 to 212°F:		28 min.

		CTC-320 B
Max. Temperature	:	320°C/608°F
Min. Temperature	:	50°C/122°F @ ambient temperature 40°C/104°F 33°C/91°F @ ambient temperature 23°C/73°F 10°C/50°F @ ambient temperature 0°C/32°F
Display resolution	:	0.1°C/ 0.1°F
Stability	:	±0.1°C/±0.18°F
Accuracy	:	±0.5°C/±0.9°F
Heating, [2] 23°C to max.	:	20 min.
Time to stability	:	8 min.
Cooling time		
320 to 100°C / 608 to 212°F:		22 min.

		CTC-650 B
Max. Temperature	:	650°C/1202°F
Min. Temperature	:	50°C/122°F @ ambient temperature 40°C/104°F 33°C/91°F @ ambient temperature 23°C/73°F 10°C/50°F @ ambient temperature 0°C/32°F

Specifications		Model
Display resolution	:	0.1°C/ 0.1°F
Stability	:	±0.05°C/±0.09°F
Accuracy	:	±0.6°C/±1.08°F
Heating, [2] 23°C to max.	:	39 min.
Time to stability	:	8 min.
Cooling time		
650 to 100°C / 1202 to 212°F:		65 min.

		CTC-1200 A
Max. Temperature	:	1205°C/2201°F
Min. Temperature	:	300°C/572°F
Display resolution	:	0.1°C/ 0.1°F
Stability	:	±0.1°C/±0.18°F
Accuracy	:	±2.0°C/±35.6°F
Heating, [2] 23°C to max.	:	45 min.
Time to stability	:	20 min.
Cooling time		
1205 to 300°C / 2200 to 572°F:		120 min.

Electrical specifications

Specifications		Model
		CTC-140 A
Power supply [VAC],		
115VAC, 45-65Hz	:	90-127
230VAC, 45-65Hz	:	180-254
Power consumption, [VA]	:	150
Test voltage, switch test [V]	:	5
		CTC-320 A
Power supply [VAC],		
115VAC, 45-65Hz	:	90-127
230VAC, 45-65Hz	:	180-254
Power consumption, [VA]	:	1150
Test voltage, switch test [V]	:	5
		CTC-650 A
Power supply [VAC],		
115VAC, 45-65Hz	:	90-127
230VAC, 45-65Hz	:	180-254
Power consumption, [VA]	:	1150
Test voltage, switch test [V]	:	5

Specifications		Model
		CTC-320 B
Power supply [VAC],		
115VAC, 45-65Hz	:	90-127
230VAC, 45-65Hz	:	180-254
Power consumption, [VA]	:	600
Test voltage, switch test [V]	:	5
		CTC-650 B
Power supply [VAC],		
115VAC, 45-65Hz	:	105-127
230VAC, 45-65Hz	:	210-254
Power consumption, [VA]	:	1150
Test voltage, switch test [V]	:	5
		CTC-1200 A
Power supply [VAC],		
115VAC, 45-65Hz	:	90-127
230VAC, 45-65Hz	:	180-254
Power consumption, [VA]	:	725
Test voltage, switch test [V]	:	5

Mechanical specifications

Specifications		Model
		CTC-140 A
Weight	:	7.0 Kg. / 15.5 Lbs.
Dimensions HxWxL	:	325 x 139 x 241 mm / 12.80 x 5.47 x 9.49 inch
Operating temp.	:	0 - 40°C/ 32 - 104°F
Storage temp.	:	-20 - 50°C/ -4 - 122°F
Humidity range	:	0-90% Rh
Protection class	:	IP10
Electromagnetic environment	:	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013
		CTC-320 A
Weight	:	5.0 Kg. / 11.0 Lbs.
Dimensions HxWxL	:	325 x 139 x 241 mm / 12.80 x 5.47 x 9.49 inch
Operating temp.	:	0 - 40°C/ 32 - 104°F
Storage temp.	:	-20 - 50°C/ -4 - 122°F
Humidity range	:	0-90% Rh
Protection class	:	IP10
Electromagnetic environment	:	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013

Specifications		Model
		CTC-650 A
Weight	:	6.0 Kg. / 13.0 Lbs.
Dimensions HxWxL	:	325 x 139 x 241 mm / 12.80 x 5.47 x 9.49 inch
Operating temp.	:	0 - 40°C/ 32 - 104°F
Storage temp.	:	-20 - 50°C/ -4 - 122°F
Humidity range	:	0-90% Rh
Protection class	:	IP10
Electromagnetic environment	:	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013
		CTC-320 B
Weight	:	7.0 Kg. / 15.5 Lbs.
Dimensions HxWxL	:	408 x 139 x 241 mm / 16.06 x 5.47 x 9.49 inch
Operating temp.	:	0 - 40°C/ 32 - 104°F
Storage temp.	:	-20 - 50°C/ -4 - 122°F
Humidity range	:	0-90% Rh
Protection class	:	IP10
Electromagnetic environment	:	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013

Specifications		Model
		CTC-650 B
Weight	:	10.5 Kg. / 23.0 Lbs.
Dimensions HxWxL	:	408 x 139 x 241 mm / 16.06 x 5.47 x 9.49 inch
Operating temp.	:	0 - 40°C/ 32 - 104°F
Storage temp.	:	-20 - 50°C/ -4 - 122°F
Humidity range	:	0-90% Rh
Protection class	:	IP10
Electromagnetic environment	:	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013
		CTC-1200 A
Weight	:	12.0 Kg. / 26.5 Lbs.
Dimensions HxWxL	:	408 x 139 x 241 mm / 16.06 x 5.47 x 9.49 inch
Operating temp.	:	0 - 40°C/ 32 - 104°F
Storage temp.	:	-20 - 50°C/ -4 - 122°F
Humidity range	:	0-90% Rh
Protection class	:	IP10
Electromagnetic environment	:	Designed for use in basic and industrial electromagnetic environment as defined in EN61326-1 : 2013

STANDARDS – ALL MODELS

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 : Safety requirements for electrical equipment for measurement, control and laboratory use, part 1: General requirement EN61010-2-030:2010 : Safety requirements for electrical equipment for measurement, control and laboratory use, part 2-03: Particular requirements for testing and measuring circuits

10.0 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	Part no.
Fuse 115V, 6.3AT (CTC-1200 A)	60B313
Fuse 230V, 3.15AT (CTC-1200 A)	60B312
Fuse 115V, 10AF (CTC-320/650 A/B)	60B302
Fuse 230V, 5AF (CTC-320/650 A/B)	60B301
Fuse 115V, 2AT (CTC-140 A)	105014
Fuse 230V, 1AT (CTC-140 A)	105007
Alu. carrying case incl. carton (A-models)	123408
Alu. carrying case incl. carton (B-models / 1200 A)	123409
User manual	123199
Reference manual	123198
Tool for insertion tube	60F170
Heat protection shield	104216
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
Insulation tube, 100 mm	65-F100
Insulation tube, 150 mm	65-F101
Insulation tube, 200 mm	65-F102
Insulation tube, 250 mm	65-F103

List of accessories

Accessories	Part no.
Insulation tube, 300 mm	65-F104
Insulation tube, 350 mm	65-F105
Insulation tube, 400 mm	65-F106
Insulation tube, 450 mm	65-F107
Insulation 30 x 30 mm (CTC-320/650 A/B only)	105173
Set of test cables	104203
Cleaning brush, 4 mm	122832
Cleaning brush, 6 mm	60F174
Cleaning brush, 8 mm	122822
Set of insulation plugs - 6, 10, 13 mm (CTC-140 A only)	123469
Set of insulation plugs - 3, 4 mm + 1/8” (CTC-1200 A only)	124415
Set of insulation plugs - 5, 6 mm + 3/16”, 1/4” (CTC-1200 A only)	124416
Set of insulation plugs - 12 mm + 1/2” (CTC-1200 A only)	124414
Set of insulation plugs - 7, 8, 9 mm + 5/16” (CTC-1200 A only)	124518
Set of insulation plugs - 10, 11 mm + 3/8”, 7/16” (CTC-1200 A only)	124519
Certificate, National	99-C-T
RS232 serial cable	105366
JofraCal PC software	124915
Reference sensor Ø4.5 mm type N for CTC-1200 A	124528
Suspension holder for sensor (CTC 1200 A only)	124520

11.0 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 STANDARD INSERTION TUBES					
Sensor size	**CTC-140 A**	**CTC-320 A**	**CTC-650 A**	**CTC-320 B**	**CTC-650 B**	**CTC-1200 A**
undrilled	60F448	100175	100194	60F356	60F420	124403
1/8”	60F450	100176	100195	60F358	60F422	124511
3/16”	60F452	100178	100197	60F360	60F424	124512
1/4”	60F454	100180	100199	60F362	60F426	124404
5/16”	60F456	100181	100200	60F364	60F428	124513
3/8”	60F458	100184	100203	60F366	60F430	124514
7/16”	60F460	100187	100205	60F368	60F432	124515
1/2”	60F462	100189	100207	60F370	60F434	124405
9/16”	60F464	60F344	60F408	60F372	60F436	-
5/8”	60F466	100192	100210	60F374	60F438	-
11/16”	-	60F348	60F412	60F376	60F440	-
13/16”	-	60F352	60F416	105184	60F444	-
3/4”	-	100193	100211	60F378	60F442	-
7/8”	-	60F354	60F418	60F377	60F446	-

	PARTS NO. FOR STANDARD INSERTION TUBES					
Sensor size	**CTC-140 A**	**CTC-320 A**	**CTC-650 A**	**CTC-320 B**	**CTC-650 B**	**CTC-1200 A**
3 mm	123428	123436	123444	-	-	124503
4 mm	60F451	100177	100196	60F359	60F423	124406
5 mm	123429	123437	123445	123452	123460	124504
6 mm	60F453	100179	100198	60F361	60F425	124407
7 mm	123430	123438	122516	123453	123461	124505
8 mm	105185	100182	100201	105190	105195	124506
9 mm	105186	100183	100202	105191	105196	124507
10 mm	105187	100185	105188	105192	105197	124508
11 mm	123431	100188	100204	105193	105198	124509
12 mm	123432	100186	100206	105194	105199	124510
13 mm	123433	60F339	105189	123454	123462	-
14 mm	-	100190	100208	123455	123463	-
15 mm	-	100191	100209	123456	123464	-
16 mm	-	123439	123446	123457	123465	-
18 mm	-	123440	122517	123458	123466	-
20 mm	-	123441	122518	123459	123467	-

	PART NO. FOR STANDARD INSERTION TUBES – MULTI-HOLE					
Description	**CTC-140 A**	**CTC-320 A**	**CTC-650 A**	**CTC-320 B**	**CTC-650 B**	**CTC-1200 A**
Metric Type 1	123479	123475	123476	-	-	-
Inch Type 2	123480	123477	123478	-	-	-

Note: All multi-hole insertion tubes are delivered with a matching insulation plug (CTC-140 only).

AMETEK Sensors, Test & Calibration
A business unit of AMETEK Measurement & Calibration Technologies Division offering the following industry leading brands for test and calibration instrumentation.

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Temperature Calibrators
Portable dry-block calibrators, precision thermometers and liquid baths. Temperature sensors for industrial and marine use.
Pressure Calibrators
Convenient electronic systems ranging from -25 mbar to 1000 bar - fully temperature-compensated for problem-free and accurate field use.
Signal Instruments
Process signal measurement and simulation for easy control loop calibration and measurement tasks.

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Materials testing machines and software that guarantees expert materials testing solutions. Also covering Texture Analysers to perform rapid, general food testing and detailed texture analysis on a diverse range of foods and cosmetics.

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Allows measurement and characterization of moisture-sensitive PET polymers and polymer density.

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