USER'S MANUAL

TC2000
PORTABLE TEMPERATURE CALIBRATOR



A universal stable and accurate temperature well for calibrating
and verifying temperature sensors

Thank you

for purchasing a Tek Know temperature calibrator.
The Tek Know products are manufactured by Scan-Sense AS in accordance with our high quality standards in design, choice of components and workmanship in order to achieve maximum customer satisfaction and to fulfil our vision to be our customers "First Choice".

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1 Introduction

1.1 Cerification

Scan-Sense AS certifies that the TC2000 complies with its published list of specifications at the time it was manufactured. Scan-Sense AS also certifies that its calibration measurements are traceable to Norwegian Accreditation and to the calibration facilities of other International Standards Organization (ISO) members. Scan-Sense AS confirms that the TC2000 complies with the following standards:



EMC EN61326-1:1997+A1:1998: APP.A, immunity test requirements for equipment intended for use in industrial locations, as amended by EC Directive 9 2/31/Eec and the European Low Voltage Directive IEC 61010-1:90 + A1:92 + A2:95, amended by 93/68/EEC. To ensure compliance, please use screened/shielded serial communication leads (RS232).

1.2 Warranty

This product is guaranteed free from defects in material and workmanship for one (1) year from the date of shipment. During this warranty period, Scan-Sense AS will, as its option, either repair or replace the TC2000 should it prove defective. The product must be returned to a service facility designated by Scan-sense AS for warranty service or repair (see our worldwide adress file http://www.scansense.no). The foregoing warranty will not apply to defects resulting from improper or inadequate maintenance by the purchaser, purchaser-supplied software or interfacing, unauthorized modification or misuse, operation exceeding the environmental specifications for the TC2000, or improper site preparation or maintenance. No other warranty is expressed or implied by Scan-Sense AS, and Scan-Sense AS shall not be liable for any direct, indirect, special, incidental or consequential damages, whether based on contract, tort, or any other legal theory.

1.3 Conventions used in this document

We have provided this section of the User's Manual to help you identify noteworthy symbols, terms and conventions used in this manual. Look for the following:

CAUTION:
Is used when a procedure may cause damage to equipment or affect operation

WARNING:
Is used when a procedure may cause personal injury to the reader or other persons



A SYMBOL USED AS A WARNING TO DENOTE A HAZARD



CONFORMITÉ EUROPÉENNE



GROUND OR EARTH

Terms and definitions:
The term **"insert"** is interchangable with **"insert adapter"** as an equipment identifier for the 2-inch diameter, 6-inch long aluminum insert pleced into the temperature well.

We define calibration as being able to compare the ability of the equipment to perform to a known standard. Temperature calibration provides a means of quantifying uncertainties in temperature measurement in order to optimize sensor and/or system accuracy.

LCD is a term meaning a quarter (1/4) VGA LCD screen.
CARE is a memory jogger to ensure best results and safe use of the equipment.
Connect only to the correct power voltage/frequency (read the label in the case).
Always clean the temperature well and insert before use, and always remove the insert from the temperature well before moving or transporting the TC2000.
Replace worm connection cables (only with approved connection cables).
Earthed (or grounded) power sources only should be used.

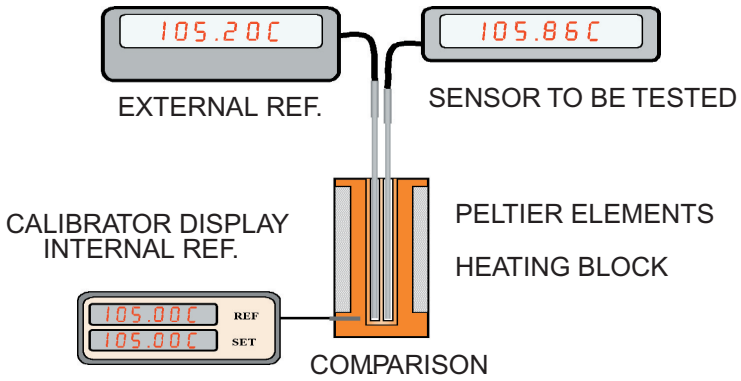
1.4 Introduction to dry-block calibrators

Dry-block calibration units provide the reliable heat (or cold) source needed to verify the accuracy of industrial sensors such as RTDs, thermocouples, thermostats, bi-metal thermometers or liquid-in-glass thermostats. The TC2000 is designed to provide all the advantages offered by "dry well" temperature calibrators: Convenience of size, weight, speed, portability temperature range, stability and software interaction via RS232 communication port. It is also designed to be "user friendly".

The TC2000 has a numeric keypad, or softkey controls, for setting the well temperature. Menus are used to define other data for the TC2000. The display shows the defined "Set temperature" and the resulting "Reference temperature" for the well temperature. Connection points at Channel A and B allow a variety of sensor hook-ups and an RS232 connection for local PC or remote computer.

The dry well in the calibrator is heat or cold source, and a reference thermometer. That is, the thermometer (or sensor to be tested) is placed in the well and its reading is compared to the reading of the temperature in the calibrator's display. The calibrator's display shows both the defined temperature, as set by the operator, and the actual temperature that is measured by the internal reference sensor in the well.

Figure 1: Dryblockschematics



2 Preparation

2.1 Unpacking and inspection

* Inspect the packing container for any sign of damage. If the shipping cartong is damaged, contact the carrier/shipper.
* **Remove** the unit from its packing container and inspect it for visible signs of damage.
* **Check** that the equipment received matches the inventory. Report ny discrepancies to Scan-Sense AS's designated agent.
* Record any discrepancies from the inventory and/or visible damage to the unit; see Figure 3 TC2000 orientation and location of items.

2.2 Items supplied with the unit

The cables, insert etc. that are used with the TC2000 are located in compartments within the unit. The TC2000 Parts List identifies each by part name and part number.

TC2000 PARTS LIST

DESCRIPTION OF ITEM: (1 OF EACH ITEM)

* GLASS WOOL, 1 PACK
* TOOL, EXTRACTOR
* CABLE, MAINSPOWER, 100 VAC
  DETERMINE TYPE REQUIRED, JAPAN
* CABLE, MAINSPOWER, 110 VAC
  DETERMINE TYPE REQUIRED, USA
* CABLE, MAINSPOWER, 230 VAC
  DETERMINE TYPE REQUIRED, EUR
* CABLE, MAINSPOWER, 230 VAC,
  DETERMINE TYPE REQUIRED, UK
* CABLE, TEST, 1 SET
* USER'S MANUAL
* CALIBRATION CERTIFICATE
* RS232 CABLE
* CONNECTOR KIT

Aluminum inserts
- Dry Well
- Liquid filled (option)



Insert, aluminum, of 2“ x 6” or 50 mm x 150 mm diameter and lenght with:

2 holes of 6.5 mm bore,
2 holes of 3,5 mm bore,
2 holes of 4,5 mm bore,
1 hole of 8 mm bore,
1 hole of 10 mm bore and
1 hole of 12 mm bore.

OPTIONAL ITEMS

Liquid-filled Insert, aluminium, of 2” x 6” or 50 mm x 150 mm diameter and lenght with pop-off cap and impeller at bottom.
Insert, aluminum, blank of 2” x 6” or 50 mm x 150 mm ‘ diameter and lenght.
Oil to use with the Liquid-filled Insert.

CAUTION:
Care should be taken to avoid spillover into the temperature well when using Liquid-filled Inserts. Use only recommended oil/ liquids to fill the insert. Do not use glass wool with the Liquid-filled Insert.

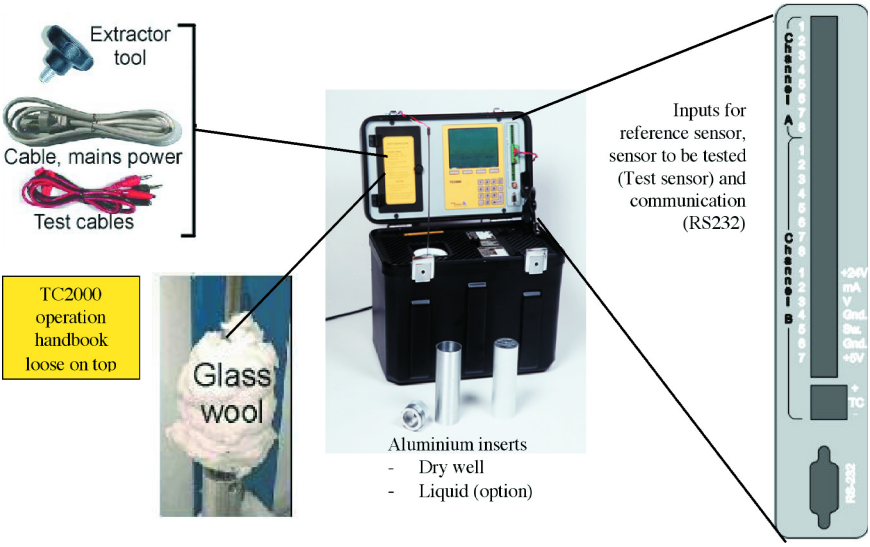


Figure 3. TC2000 Orientation and location of items.

2.3 Input power connection

The required power is either 110 VAC or 230 VAC, 50/60 Hz. Always connect the power cable supplied with your unit to a grounded or earthed power outlet.

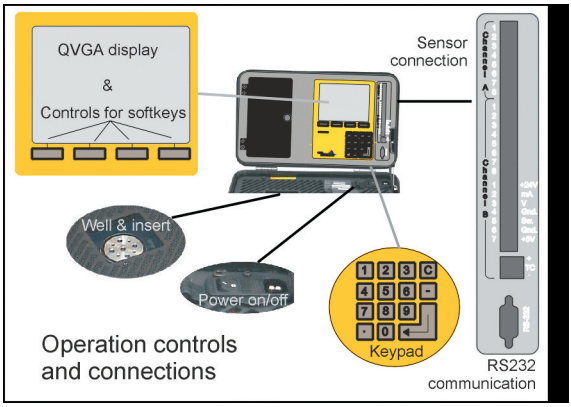
3 Getting started

This section contains a description of the TC2000 operator control and connection points to help you get started quickly. The section also provides instructions for pre-calibration cleaning of the well and inserts (essential to the process) and step-by-step guidance for performing a calibration.

3.1 Operation controls and connections

Very little operator interaction is required to begin calibration. The main operator interaction is via unit's softkeys (or keypad) and LCD display, or via a (local) PC or other remote computer. Communication with the PC is via the unit's RS232 serial port connector. To begin a calibration, you must:

* Fit the insert into the well.
* Place the sensor(s) into the well and use glass wool to insulate the sensor.
* Power on the unit ON.
* Connect the sensor leads in Channel B.
* Configure the sensor to be tested.
* Set the temperature using the TC2000's LCD display, softkeys or numeric keypad.



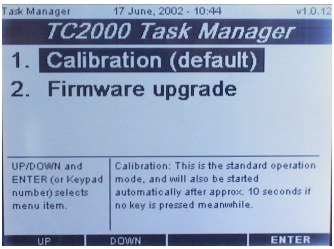
Operation controls and connections

3.1.1 Software startup



When switching on the calibrator the first screen that is shown is a startup display while the internal computer loads the operating system Windows CE 2.12.

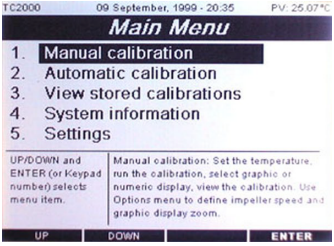
A Tast manager program will apear after the CE 2.12 is loaded.
The task manager gives two choises
1. Calibration (which is default) or
2. Firmware upgrade.



Choise 1. calibration is the normal start and will automatically be selected after 10 sec. of the Task manager appearing.
Choise 2. is used when a new software or modification upgrade is to be entered into the CE computer.
See seperate section for upgrade...



After choise 1. Calibration is selected either by pressing enter when 1. is highlighted or by default the computer will load the TC2000 application software This will take a couple of miniutes and the status wil be shown at the lower part of the screen viewing a countdown proceedure. After loading is complete the main menu screen will be displayed and the calibrator is ready for calibration tasks.



3.1.2 LCD display

The menus and softkey-controls and information you need to define para-meters during a calibration are displyed in the unit's LCD (1/4VGA) display.

3.1.3 Well and insert





The well is an aluminum block with a reference sensor placed at its base. The well heats or cools to the temperature you set. The insert has holes bored to accommodate most sensors.The insert is aluminum and is precision-turned to fit the well opening. An extractor tool is provided to remove the insert from the well.

IMPORTANT:

The calibrator is calibrated with the external reference sensor being insulated with supplied insulation material. to acheive the same result use insulation round the sensor undergoing test or calibration.

WARNING:

Handle carefully when extracting a Liquid-filled Insert because the liquid in the insert will be hot and may cause burns to any skin surfaces in contact with it.

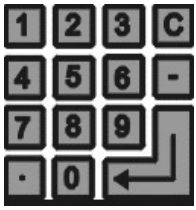
CAUTION:

Care should be taken to avoid spillover into the temperature well when using Liquid filled Inserts. Use only recommended oil / liquids to fill the insert. Do not use glass wool with Liquid-filled Insert.



3.1.4 Numeric keypad

The numeric keypad is used for entering data into the menus. It can also be used instead of the UP or DOWN softkeys when setting temperatures.

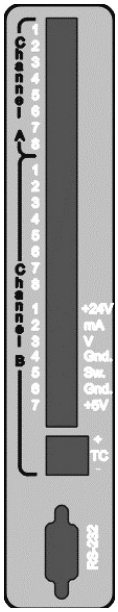


3.1.5 Power on/off

The power cable connection and the power ON or OFF control is provided by a swich-and-plug connector.

3.1.6 RS232 communication

The RS232 serial communication port is used to connect the TC2000 to a PC during re-calibration and for remote operation when calibrating a sensor.



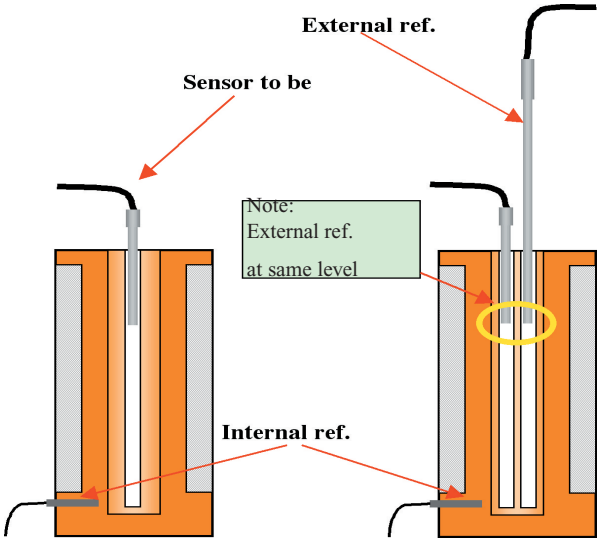
3.1.7 Sensor connection

Different types of sensors can be connected for testing. Channel A is for the external reference sensor. Channel B is for the sensor under test (test sensor).

3.2 Sensor positioning, connection and calibration accuracy

The calibrator well is always the source for heat or cold for the sensor. However, it is possible to connect the sensor such that the calibrator is the reference and the temperature reading is shown at the QVGA display, or the sensor can be connected to an external measurement device for the readnig.

You must place the sensor and the reference sensor as close to each other as possible to ensure an accurant reading, regardless of what reference and connections you use. To make the calculation accurate when the sensors are placed at some distance from each other; you can use a previously determined offset value to define the correction factor you need to adjust for the difference-in-distance between sensors.



3.3 Procedure to run calibration

1. To obtain the best temperature transfer, clean the temperature well and insert before each use. Instructions are provided in section 3.7.

2. Select the insert to be used and lower it into the temperature well.

3. Lower the temperature sensor into the insert. Use glass wool if it is necessary to close off the top of the insert to prevent heat or cold loss. (Glass wool is not to be used in liquid inserts).

4. Power ON the TC2000. The opening menu will appear. If necessary, refere to the chapter 4 Operation menus, controls and indicators.

5. Connect the temperature sensor to your indicating instrument.

6. Select 2 **Configuration** to select the type of sensor to be tested.

7. On the Configuration menu, select 4. **Test Sensor**.

8. On the Configuration menu, select the CONFIG softkey to obtain wiring information for Channel B.

9. If you are using an external reference sensor, select 2. **Reference sensor**.

10. Select the **CONFIG** softkey to obtain wiring information for Channel A (refernse sensor).

11. If you are using sensor-correction values, select 3. **Sensor correction** and **Table**.

12. Select the **CONFIG** softkey to define the Read value, True value and tag identifier in the table.

13. The default temperature setpoint is 25º Celcius (C). If you want the temperature denored in F or K, see the Settings menu.

14. Press the **MAIN MENU** softkey to exit the Configuration menu and save the new data.

15. Select 1. **Calibration mode** and use the UP or DOWN softkeys to define the temperature.

3.4 Procedure to run a liquid bath calibration

1. Follow 1-15 in chapter 3.3
2. Choose the right liquid for the temperature range:
   Water: 0 °C to 98ºC
   Oil : 40 °C to 150ºC



   NOTE:
   Insulation pad has to be used at the top of the insert during the calibration.

   WARNING:
   Use eye protection if you are using oil or water above 70ºC to avoide eye injury caused by splashing oil or water bubbles.

   WARNÌNG:
   Be sure that you are using oil (liquid) which is approved for the temperature range that you are working at.

3. Select 1. Calibration mode to select the Impeller speed.
4. On the Calibration menu, select OPTIONS and use the numeric keys to set the impeller speed in %.
5. Impeller speed:
   In order to get the best circulation in the liquid and thereby avoiding gradients, it's of great importance to select the correct impeller speed. For example circulated water at too high speed will produce air bubbles and turbulence, which could lead to gradients in the liquid.
   Gradients may also occur if the circulation is too low. The amount of sensors to be tested at the same time in the liquid insert will also have a significant impact on the circulation.
   As a general rule start with the following values if you are testing a single sensor:

   Water: 15% and up depending on amount of sensors. Viscosity in the range 0 to 98ºC is almost the same.
   Oil: 50% and up depending on amount of sensors and temperature range since the viscosity changes a lot over the range - 40 to 150ºC.

6. TIPS! You will get an extreme stability (typically +/- 0.001ºC) and accuracy as a stirred ice bath (0ºC). Just set the impeller speed to 100% and set point to -3ºC and wait for the freezing point to come.

3.4.1 Calibrating a thermostat:

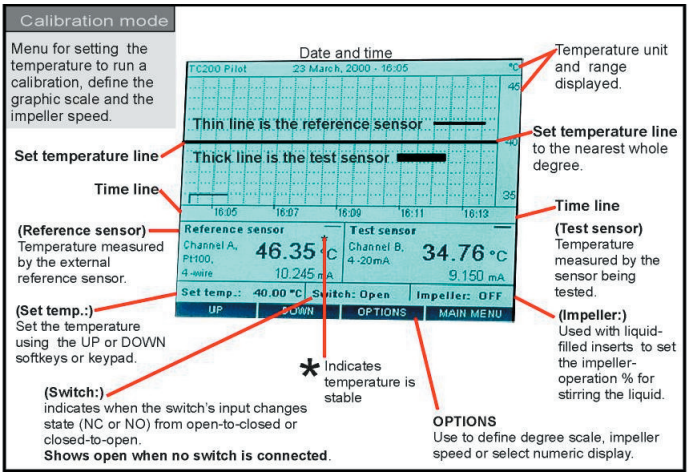
Use the test cables to connect the thermostat to Channel B according to the wiring information provided in the unit's QVGA display. Use the UP or DOWN softkeys to define the temperature, then watch for the display indicator to show if the switch is closed or open.

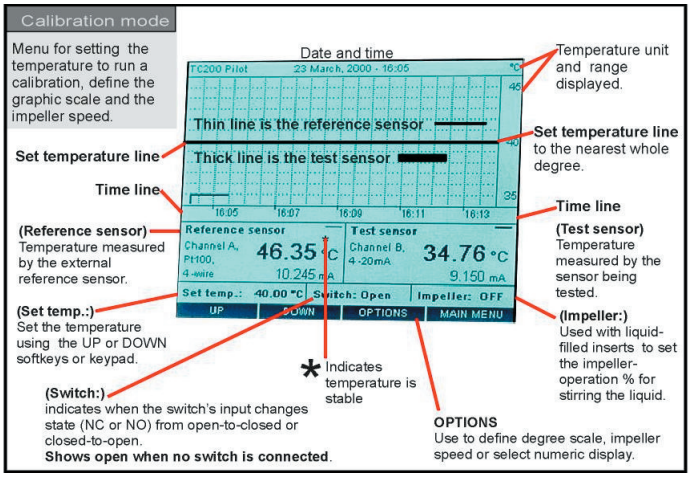
3.4.2 Calibrating a sensor:

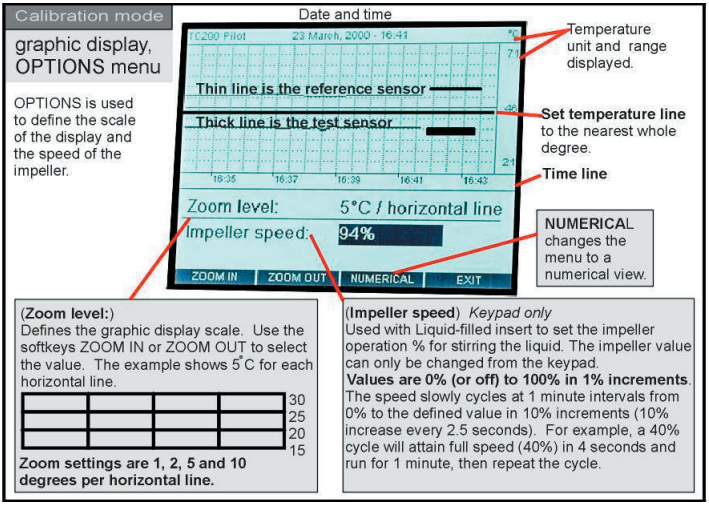
Use the numeric keypad or UP or DOWN softkeys to define the temperature. The displayed Reference sensor temperature (the temperature measured at the center of the temperature well) will increase to the set value. When the Reference sensor temperature has been stable at +/- 0.2ºC for at least 17 minutes (default), a * will appear in the display to indicate that you can take the reading.

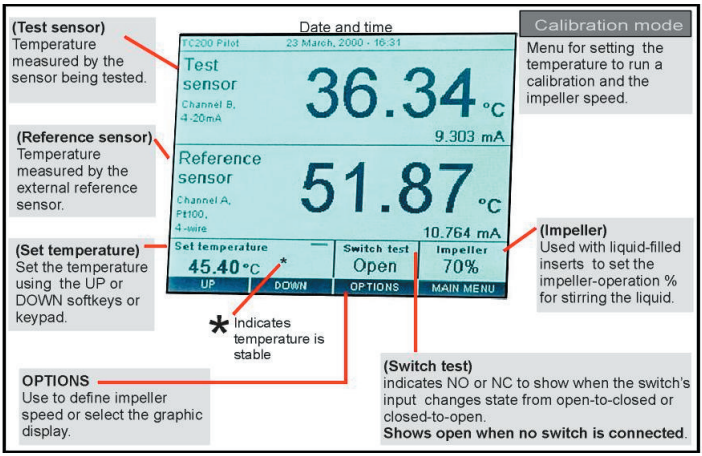
If you require a new setting:
Change the tempterature to the new value and wait for the * in the display to indicate that you can take the reading.

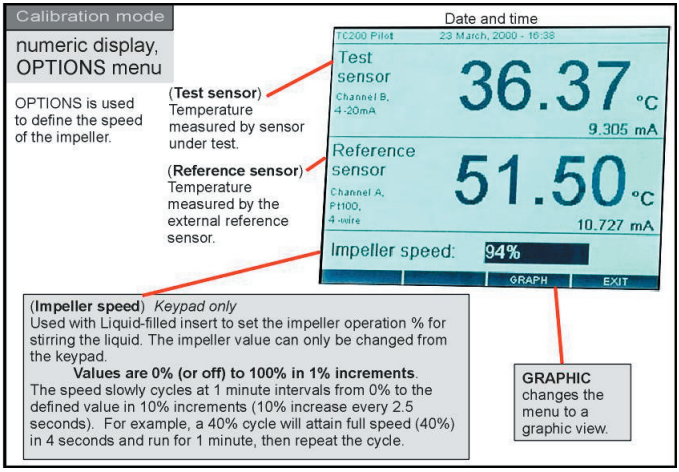
Calibration mode graphical:



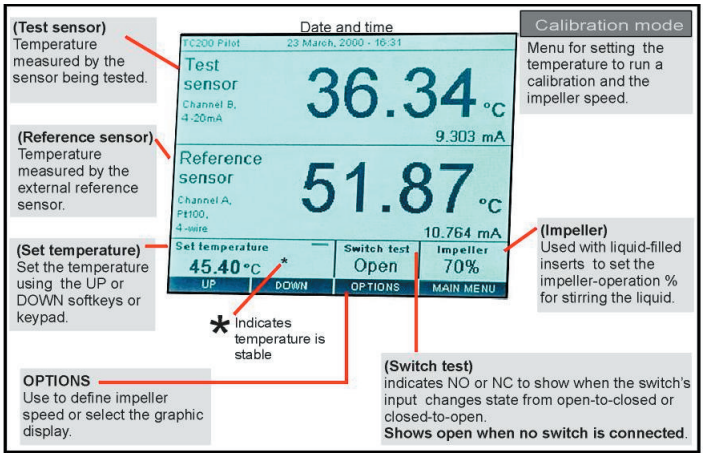

Calibration mode
Menu for setting the temperature to run a calibration, define the graphic scale and the impeller speed.
Date and time
TC200 Pilot
23 March, 2000 - 16:05
Thin line is the reference sensor
Thick line is the test sensor
Set temperature line
Time line
(Reference sensor)
Temperature measured by the external reference sensor.
Reference sensor
Channel A, Pt100, 4-wire
46.35 °C
10.245 mA
Test sensor
Channel B, 4-20mA
34.76 °C
9.150 mA
Set temp.: 40.00 °C
Switch: Open
Impeller: OFF
UP
DOWN
OPTIONS
MAIN MENU
(Set temp.:)
Set the temperature using the UP or DOWN softkeys or keypad.
(Switch:)
indicates when the switch's input changes state (NC or NO) from open-to-closed or closed-to-open.
Shows open when no switch is connected.
* Indicates temperature is stable
OPTIONS
Use to define degree scale, impeller speed or select numeric display.
Temperature unit and range displayed.
Set temperature line to the nearest whole degree.
Time line
(Test sensor)
Temperature measured by the sensor being tested.
(Impeller:)
Used with liquid-filled inserts to set the impeller-operation % for stirring the liquid.


Calibration mode
graphic display, OPTIONS menu
OPTIONS is used to define the scale of the display and the speed of the impeller.
Date and time
TC200 Pilot
23 March, 2000 - 16:41
Thin line is the reference sensor
Thick line is the test sensor
Zoom level: 5°C / horizontal line
Impeller speed: 94%
ZOOM IN
ZOOM OUT
NUMERICAL
EXIT
Temperature unit and range displayed.
Set temperature line to the nearest whole degree.
Time line
NUMERICAL changes the menu to a numerical view.
(Zoom level:)
Defines the graphic display scale. Use the softkeys ZOOM IN or ZOOM OUT to select the value. The example shows 5°C for each horizontal line.
30
25
20
15
Zoom settings are 1, 2, 5 and 10 degrees per horizontal line.
(Impeller speed) Keypad only
Used with Liquid-filled insert to set the impeller operation % for stirring the liquid. The impeller value can only be changed from the keypad.
Values are 0% (or off) to 100% in 1% increments.
The speed slowly cycles at 1 minute intervals from 0% to the defined value in 10% increments (10% increase every 2.5 seconds). For example, a 40% cycle will attain full speed (40%) in 4 seconds and run for 1 minute, then repeat the cycle.


(Test sensor)
Temperature measured by the sensor being tested.
Date and time
Calibration mode
Menu for setting the temperature to run a calibration and the impeller speed.
TC200 Pilot
23 March, 2000 - 16:31
Test sensor
Channel B, 4-20mA
36.34 °C
9.303 mA
(Reference sensor)
Temperature measured by the external reference sensor.
Reference sensor
Channel A, Pt100, 4-wire
51.87 °C
10.764 mA
(Impeller)
Used with liquid-filled inserts to set the impeller-operation % for stirring the liquid.
(Set temperature)
Set the temperature using the UP or DOWN softkeys or keypad.
Set temperature
45.40 °C *
Switch test
Open
Impeller
70%
UP
DOWN
OPTIONS
MAIN MENU
* Indicates temperature is stable
OPTIONS
Use to define impeller speed or select the graphic display.
(Switch test)
indicates NO or NC to show when the switch's input changes state from open-to-closed or closed-to-open.
Shows open when no switch is connected.


Calibration mode
numeric display, OPTIONS menu
Date and time
OPTIONS is used to define the speed of the impeller.
(Test sensor)
Temperature measured by sensor under test.
TC200 Pilot
23 March, 2000 - 16:38
Test sensor
Channel B, 4-20mA
36.37 °C
9.305 mA
(Reference sensor)
Temperature measured by the external reference sensor.
Reference sensor
Channel A, Pt100, 4-wire
51.50 °C
10.727 mA
Impeller speed:
94%
GRAPH
EXIT
(Impeller speed) Keypad only
Used with Liquid-filled insert to set the impeller operation % for stirring the liquid. The impeller value can only be changed from the keypad.
Values are 0% (or off) to 100% in 1% increments.
The speed slowly cycles at 1 minute intervals from 0% to the defined value in 10% increments (10% increase every 2.5 seconds). For example, a 40% cycle will attain full speed (40%) in 4 seconds and run for 1 minute, then repeat the cycle.
GRAPHIC
changes the menu to a graphic view.

Calibration mode numerial:



3.5 Finishing the calibration

7. When finished, adjust temperature to ambient and allow the temperature well to cool to temperature below 70ºC.

8. Pull the temperature sensor(s) out of the insert.

9. Attach the extractor tool to the insert and pull the insert out of the temperature well.

10. Switch power OFF.

11. Allow the unit to attain temperature below 70ºC before stowing accessories.

3.6 Defaults values

It is possible to change some of the parameter values displayed in the menus.

Default set temperature = 25ºC (not changeable)
Default temperatre units = °C
Default reference sensor = Internal sensor
(located in the TC2000 well)
Default stabilization time = 17 minutes
Default stabilization ∆ T = ±0.2°C

Information is given in chapter's 4.4 , 4.5 and 4.6 on how to alter some of these parameters.

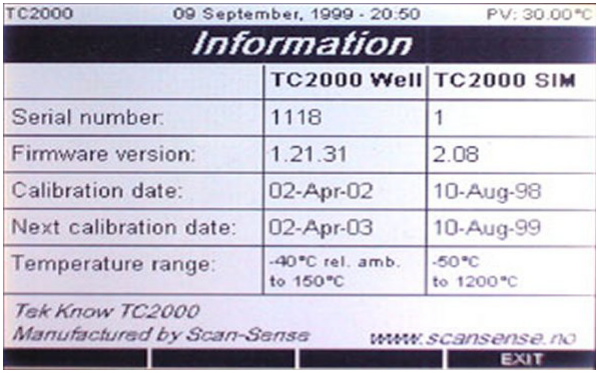
The following data is defined during manufacturing and cannot be cannot be changed during its operation.

Serial number TC2000 Well Firmw.version TC2000 Well
Serial number TC2000 SIM Firmw.version TC2000 SIM

.

On completion of a calibration, the TCCal software will add the following data:

Calibration date TC2000 Well Next calibration date TC2000 Well
Calibration date TC2000 SIM Next calibration date TC2000 SIM



3.7 Pre-calibration cleaning of well and insert

If necessary, clean the temperature well (interior) and insert (interior and exterior) before use. A dirty or oxidized surface can affect the transfer of heat between the well and the insert and may also cause the insert to stick in the well and be difficult to remove.



WARNING:
Use eye protection if you are using compressed air to blow debris out of the temperature well or insert openings to avoid eye injury.

3.7.1 Procedure for cleaning the interior of the temperature well and insert

1. Insert dry, white paper and turn it so as to remove all dust, dirt or smudges from the interior of the temperature well to ensure optimal heat trensfer to the temperature sensor.

2. If necessary, use compressed air to blow debris from the interior of the temperature well and insert. (A small vacuum hose can be used to extract debris).

3. If necessary, use a cloth with mild soap and water to remove exessive contamination. Alcohol may also be used for this purpose.

4. Use a rod with a small piece of cloth attached to it (e.g. gun-cleaning kit).

5. When using liquid cleaners, ensure that the well, insert and probe is completely dry before placing the insert to the well.

3.7.2 Procedure for cleaning the exterior of the insert

1. Insert dry, white paper and rub so as to remowe all dust, dirt or smudges from the exterior surface of the insert to ensure optimal heat or cold transfer from the temperature well.

2. Wipe clean with a clean, dry, lint-free cloth.

3.7.3 Instructions for handling Liquid-filled Insert

Only use clean oil, water or other liquids that have been authorized for use in the Liquid-filled Insert.

CAUTION:
Care should be taken to avoid spillover into the temperature well when using Liqued-filled Inserts. Use only recommended oil/liquids to fill the insert. Do not use glass wool when using Liquid-filled Inserts.

WARNING:
Handle carefully when extracting a Liqued-filled Insert because the liquid in the insert will be hot and cause burns to any skin surfaces in contact with it.



4 Operational menus, controls and indicators

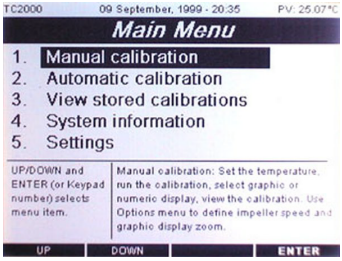
4.1 Introduction

The TC2000 is highly automated and requires minimal operator interaction during a calibration. Normally, you are only required to set the temperature necessary for the calibration and to configure the sensor to be tested.

4.2 Main Menu

The Main Menu contains sub-menus to main available functions. Menu entries are listed with a unique number. To select Main Menu functions:

Press the UP or DOWN softkey, and then press the ENTER softkey, or
Select the function-number on the numeric keypad (Do not press ENTER when using a number from the numeric keypad).



The selected menu line is **inverted**

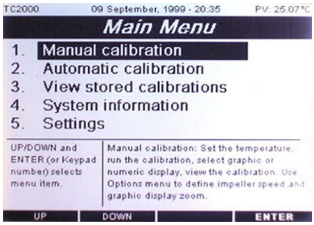
The ¼ VGA LCD display will show Information regarding interaction, controls and the available menus.

NOTE:

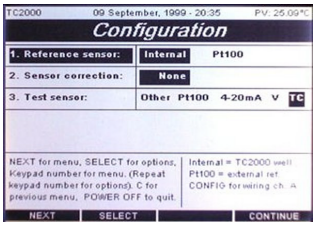
The TC2000 uses the defined configuration values until they are changed. Therefor, it is important to ensure that the values are correctly defined before starting a calibration.

When power is swiched on, default opening screens will show until the calibrator has booted and the main menu screen in visible.

4.3 Manual Calibration



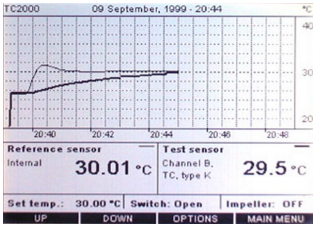
Select choice **1. Manual calibration**, to enter the manual calibration mode, the ***Configuration*** menu will then be displayed. This will enable you to configure your reference sensor and the type of sensor to be tested.



See chapter on Configuration for more details on how to configure and select a sensor.
Press Continue to enter into the manual calibration mode.

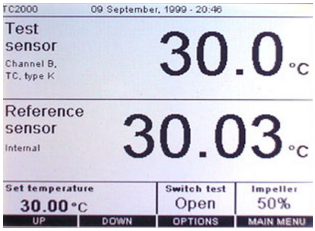
The set point temperature can either be set using the numerical keypad + enter or using the softkeys. The softkeys will give setpoint increments of 10°C

Pressing the **MAIN MENU** softkey will take you back to the main menu.



Selecting the **OPTIONS** softkey in the manual calibration mode will allow you to:

* Set the temperature resolution in the graphical display using the **ZOOM IN** and **ZOOM OUT** softkeys
* Toggle between the graphic and the numeric displays.
* Define the speed of the liquid insert impeller in % of full speed (0 to 100 % in steps of 1).

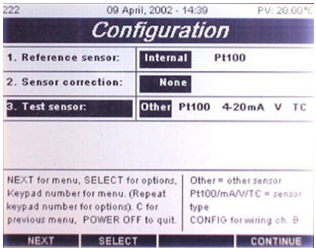


Default values are:

* Set temperature = 25 ºC
* Swich test = OPEN
* Impeller speed = OFF (0%)
* Graphical resolution = 2 °C / horizontal line

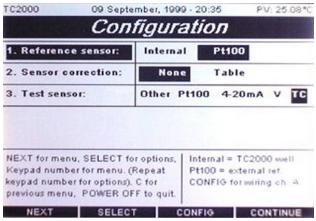
4.4 Configuration

Important input connection information to remember:
Channel A is the connector for the external "**Reference sensor**".
Channel B is the connector for the sensor to be tested "**Test sensor**".



4.4.1 Reference sensor selection

The **NEXT** softkey will allow you to navigate and change each setting by stepping up or down in the menu.
Use the **SELECT** softkey to select the available settings.

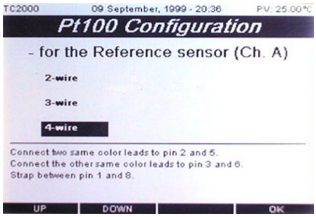


Select 1. **Internal**, to use the calibrators internal reference sensor. In the manual calibration mode window the reference sensor will be labeled with *Internal.*

Select 1. **Pt100**, to use an external reference sensor.
Then press **CONFIG** to setup the external reference sensor.

4.4.2 Reference sensor configuration

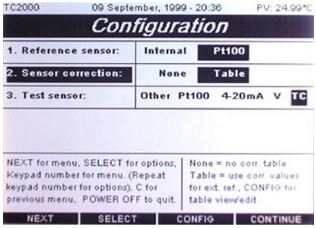
The external reference sensor can be configured as either a 2, 3 or 4 wire sensor. Use the **UP** and **Down** softkeys to select the appropriate configuration.



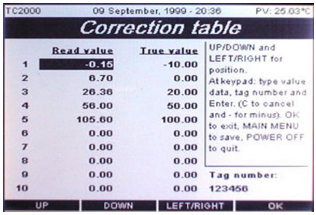
Please note that in each configuration the sensor will be terminated differently to the 8-pin connector.
See advisory text giving pin connections.

4.4.3 Reference correction

If you have selected an external sensor as the reference sensor, its correction values can be placed into the sensor correction table. Sensor correction will show the value as **None** (internal sensor or no correction data), and **Table** (sensor correction data). The default selection is **None**.



Reference sensors that have calibration data values which have been determined during a calibration, can be placed in a table to allow correction of the reference sensor so that the result will be that the reference sensor works in true temperature.



1. Use **NEXT** softkey to move to **2. Sensor correction**. The selected "cell" **2. Sensor correction** will be inverted.

2. Press SELECT softkey to change your options.

3. Press the CONFIG softkey and use the UP or DOWN and LEFT/RIGHT softkeys to define the correction information and tag number for the Pt100. Press EXIT when finished. The correction values that are placed in the correction table are normally produced during calibration of the sensor. For example, when a sensor reads 21.0 temperature (Read value), the display shows the correct value as 20.0 (True value). Read value is what the sensor is reading, True value is what it should be reading.

4. Press EXIT to return to the 3. Sensor correction menu.

5. Move to another item in the menu by pressing NEXT, or press MAIN MENU to save your changes.

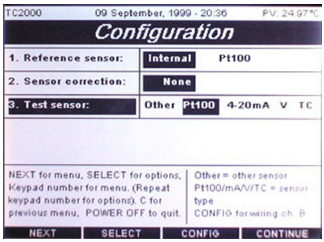
When the Sensor correction table for the Pt100 is selected, it will

always be used whenever the Pt100 is defined as the reference sensor for this configuration , until you change the configuration.

NOTE: *It is very important to remember which reference sensor is being used, and whether or not you need to use the sensor correction table. If you are using the internal temperature reference, return to* **2. Reference sensor,** *select* **INTERNA***L and* **OK***.*

4.4.4 Test sensor

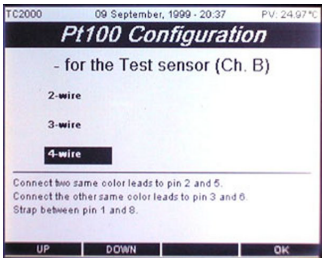
You can use **3. Test sensor:** to select the type of sensor to be tested and to obtain information for connecting it to Channel B. The default selection is Pt100.



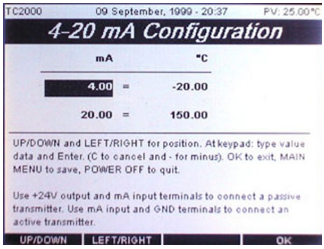
To make a selection:

Use the NEXT softkey to move to **3. Test sensor:** The selected "cell" **3. Test sensor** is inverted.
Press **SELECT** softkey to change your options.

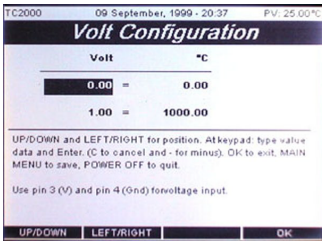
1. Pt100 selection : Select **Pt100** using **SELECT** softkey and press **CONFIG** softkey to obtain Channel B connection information.
   In **CONFIG**, use the **UP** or **DOWN** softkeys to select the wiring for obtaining the connection information for the Pt100. Press the **OK** softkey when finished. Then press **CONTINUE** softkey in ***Configuration*** to start manual calibration.



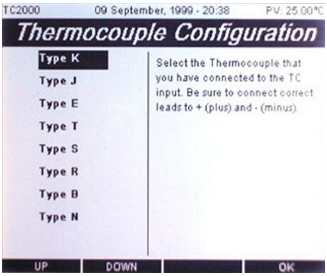
2. 4-20 mA selection : Select **4-20mA** using **SELECT** softkey and press **CONFIG** softkey to obtain Channel B connection information.
   In **CONFIG**, use the UP or **DOWN** softkeys to define the miliamphere to temperature information from the 4-20 mA sensor, and the wiring connection information for the 4-20 mA.
   Press **OK** when finished. Then press **CONTINUE** softkey in ***Configuration*** to start manual calibration.



3. Volt selection : Select **V** using **SELECT** softkey and press **CONFIG** softkey to obtain Channel B connection information connection information. In **CONFIG**, use the **UP** or **DOWN** softkeys to define the voltage to temperature information from the Volt sensor, and the wiring connection information for the Voltage snesor. Press **OK** when finished.

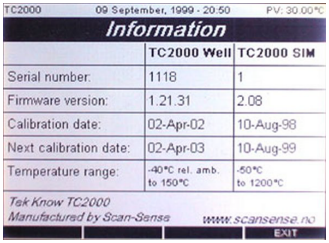


4. Thermocouple selection : Select **TC** using **SELECT** softkey and press **CONFIG** softkey to obtain Channel B Thermocouple Configuration In ***Thermocouple Configuration*** select the type of thermocouple using the **UP** or **DOWN** softkeys.Press **OK** softkey when finished .



5. Other sensor selection : Select **OTHER** using **SELECT** softkey then press **CONTINUE** softkey to start the maual calibration mode without using any of the inputs on channel B. Other selection is used when the test sensor is connected to external instrumentation.

4.5 System information



The TC2000 contains the following data that you cannot alter during operation of the unit:

* Serial number	TC2000 Well	TC2000 SIM
* Firmware version	TC2000 Well	TC2000 SIM
* Calibration date	TC2000 Well	TC2000 SIM
* Temperature range	TC2000 Well	TC2000 SIM

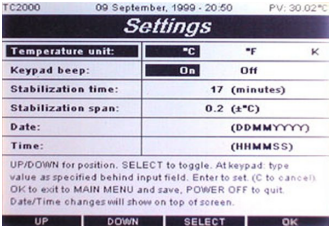
On completion of a re-calibration of TC2000, the TCCal software will add the following data:

* Next calibration	TC2000 Well	TC2000 SIM

4.6 Settings

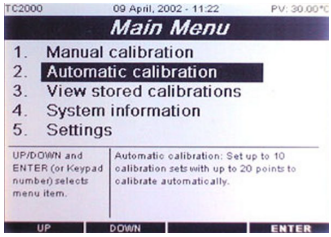
By highlighting either of the sections can be set :

Temperature unit	°C	°F	°K
Keypad beep	ON	OFF	
Stabilization time	0	to	1hour
Stabilization span	0	to	20°C
Date and time can be set			

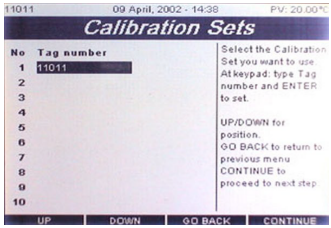


4.7 Automatic calibration

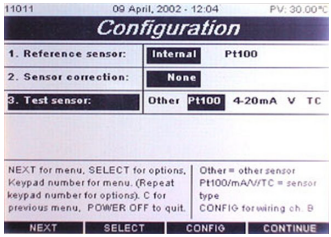
Select choice **2. Automatic calibration**, to enter the automatic calibration mode, the ***Calibration Sets*** menu will then be displayed. This will enable you to set up your calibrator to perform an automatic calibration task.



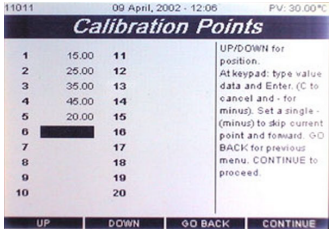
Each calibration set may consist of up to 20 calibration temperatures.
Up to 10 calibration sets may be programmed. Each set is identified with a tag number.
Press continue to enter the configuration menu for your calibration set.



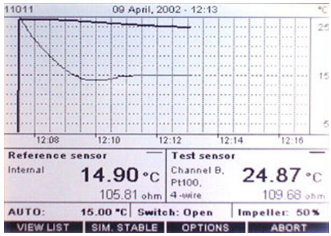
Select the configuration you want for your calibration set.
See chapter 4.4 on sensor configuration.
Note the calibration set tag no. is displayed in the top left corner of the screen.
Press continue to enter ***Calibration Points*** menu.



Up to 20 different calibration point temperatures can be set using the numeric keypad.
The temperature range is from -20°C to + 150°C
Press continue to start the automatic calibration mode.

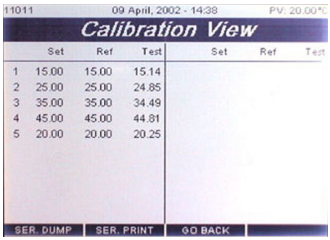


When the automatic calibration has started the sensor temperatures will be displayed in a graphical screen. the calibration will continue automatically through every set point temperature that was set in the Calibration Set.

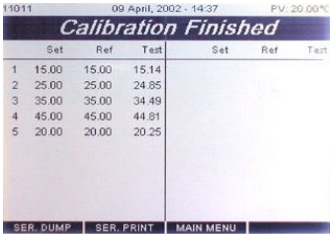


At any stage in the calibration process one can define to simulate at stable state in order to force the TC2000 to make a measurement and proceed to the next set point temperature.

Pressing View List in the soft key menu displays the calibration set points that have alredy been performed.

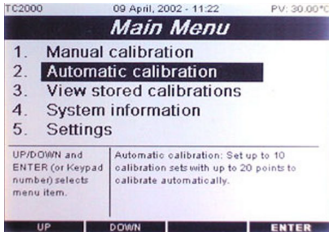


After the last calibration set point temperature has been completed the Calibration finished menu will show. In this menu there are options for dumping the calibration data to a computer or printing a calibration report to a serial printer.
See section for serial port setup.

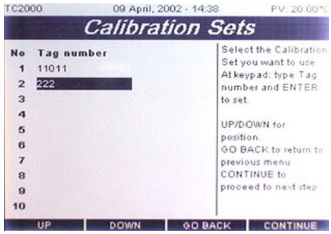


4.8 Semi Automatic calibration

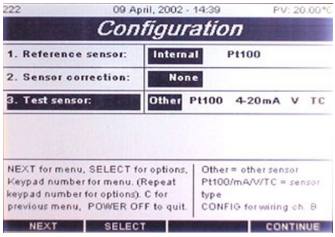
Select choice **2. Automatic calibration**, to enter the automatic calibration mode, the ***Calibration Sets*** menu will then be displayed. This will enable you to set up your calibrator to perform an automatic calibration task.



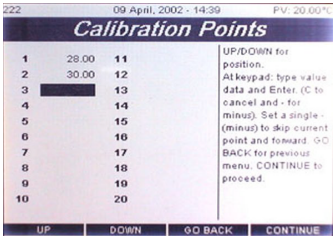
Each calibration set may consist of up to 20 calibration temperatures.
Up to 10 calibration sets may be programmed. Each set is identified with a tag number.
Press continue to enter the configuration menu for your calibration set.



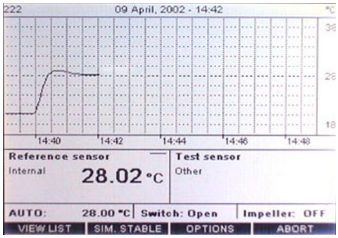
Select the configuration you want for your reference sensor. See chapter 4.4 on sensor configuration.
For test sensor select **Other** to enter the S***emi Automatic Mode***.
Press continue to enter ***Calibration Points*** menu.



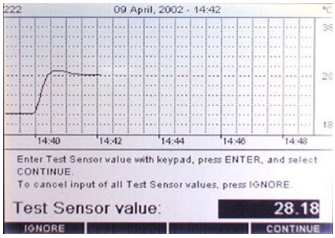
Up to 20 different calibration point temperatures can be set using the numeric keypad.
The temperature range is from -20°C to + 150°C



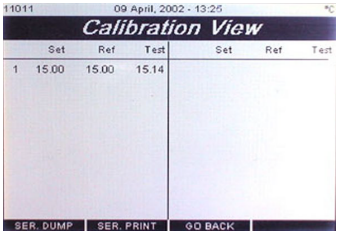
Press **CONTINUE** start the semi-automatic calibration. The temperature of the well will be shown on the LCD screen. At any time you may choose to similate a stable condition of your test sensor by selecting the **SIM.STABLE** softkey option.



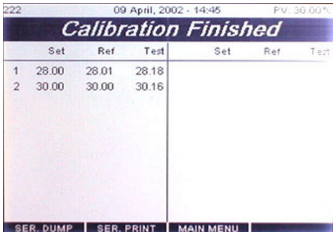
When the temperature and sensor is at a stable state the calibrator will promt you for a temperature entry of your test sensor. Enter this using the numerical keypad on the TC2000. The calibrator will then continue to the next set point temperature.



At any time during the semi-automatic calibration the ***Calibration View*** menu can be activated to show the progress in the calibration.



After the last set point temperature is stable and a entry has been made the ***Calibration Finished*** menu will be displaed.
from here you have the choise to dump the calibration data to an other computer via RS232 or send a calibration report to a serial printer.



4.9 Calibration report

T E M P E R A T U R E
C A L I B R A T I O N R E P O R T

Printing date: 23-Jan-02 14:51 Page 1 of 1

INSTRUMENT (SENSOR) CALIBRATED

Type of instrument	: Temp node1
Model	: Proto
Manufacturer	: ScanSense AS
Serial number	: 01
Tag/Id Number	: 4
Temperature range	: 0 -150 C
Output signal	: 0-10 V
Accuracy	: 0.5%

CALIBRATION POINTS

No	Set point	Ref value	Test value	Deviation	Date/time
1	28.00 C	28.00 C	29.24 C	1.24 C	9-Apr-02 14:02
2	30.00 C	30.00 C	31.06 C	1.06 C	9-Apr-02 14:19

INTERMEDIATE INSTRUMENT

Type of instrument	: Temperature Calibrator
Model	: Tek Know TC2000 Sensor Interface Module : Input Ch.B OTHER
Manufacturer	: Scan-Sense AS
Serial number	: (SIM serial no.)
Temperature range	: (i henhold til input valg)
Accuracy	: (i henhold til input valg)
Calibration cert.no.	:

REFERENCE INSTRUMENT

Sensor	: TC2000 Internal Reference
Manufacturer	: Scan-Sense AS
Serial number	: 1072
Temperature range	: +/- 0.18% F.S.
Calibration cert.no.	:

CALIBRATION ENVIRONMENT

Air temperature	: 22 C
Air humidity	: 70 %

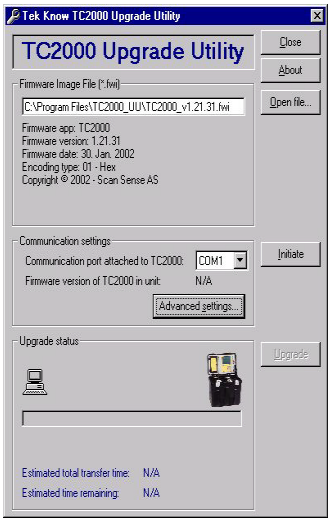
CALIBRATION STATUS

Date calibrated	: 9-Jan-02 14:02
Company	: ScanSense AS

Calibrated by : Certified by :

4.10 Software upgrade utillity

In order to be able to upgrade the application a program called TC2000 Upgrade Utillity must be run on a PC and the TC20000 must be connected to the PC through the serial port.



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In the start up proceedure of the calibrator select Firmware upgrade when the Task manger appears on the screen. This will set up the calibrator so that it can receive a new application software from the PC.

The transfere time and staus will be displayed on the PC TC2000 Upgrade Utillity program.
Use a standard TC serial cable for transfere.



After the transfere is complete the calibrator will automatically install the software internal and go to the Main Menu.

5 Technical tips

We define "calibration" as being able to compare the ability of the equipment to perform to a known standard. Temperature calibration provides a means of quantifying uncertainties in temperature measurement in order to optimize sensor and/or system accuracy.

This chapter provides general, informative information about dry-block calibration and tips/hints to help you obtain accurate calibrations with the TC2000 dry-block calibrator. Dry-block calibration is recommended for calibrating industrial sensors such as RTD (Resistive Temperature Device), thermocouples, thermistors, bi-metal thermostats or liquid-in-glass thermometers, etc., because the dry-block provides the reliable heat (or cold) source needed to verify the accuracy of these devicec.

The dry-block calibrator offers a combination of accuracy, portability and price for industrial calibration applications. Most dry-well calibrators will produce a calibration accuracy of better than +/- 0.5ºC. For comparison of sensors in a dry-well's temperature block, hole-to-hole uniformity is typically +/- 0.05ºC. These uncertainties are well matched to the typical uncertainties of industrial temperature sensors.

5.1 General information regarding accurate dry-block calibrations

The dry -block in the calibrator is often used as heat/cooling source and a reference thermometer - i.e., the thermometer (or sensor to be tested) is placed in the block and its reading is compared to the reading of the temperature in the dry-block calibrator's display. The calibrator's display shows both the defined temperature, as set by the operator, and the actual temperature that is measured by the block's internal sensor. To ensure an accurat calibration, always observe the following when using this type of calibration:

* Ensure the internal reference sensor and the sensor being tested or calbrated is positioned close togehter in the insert. To do otherwise will mean you can only guess the accuracy of the temperature shown at the display.

* Ensure that display-accuracy includes traceable calibration report with the dry-block calibrator.

* Use accurate reference thermometer during your calibrations.

5.2 The importance of testing instrument validation

Validation of measuring instrument (as well as material measurement) comprises testing and stamping by responsible calibration authorities (in accordance with calibration directives). This validation testing ensures that the measuring instrument meets the demands made on its characteristic data and its maesuring technology properties, more especially it determines whether the measurement deviation contributions re within the error limit(s). Stamping (or marking) the instrument documents that it has fulfilled these requirements at the time of testing, and declares that the condition of the measuring instrument is expected to remain within the tolerance range until the date for revalidation (provided it is handled in accordance with the rules of technology). Laws regulate which measuring instruments are subject to mandatory validation and which instruments are not.

5.3 The importance of a traceable standard

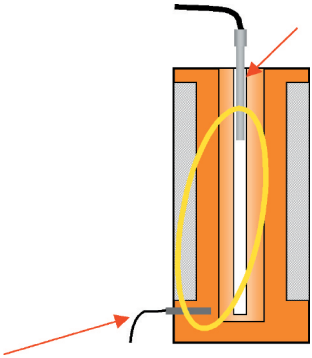
A treceable standard is a procedure by which the "measurand", indicated by a measuring instrument (or a material measurement), is compared with a national standard. In each level of standard, the deviation in measurement has been determined beforehand by calibration to a higher evel standard. This gives a calibration hieratchy as shown in Figure 2 Calibration hierarchy.

5.4 Correct positioning of the probe in the temperature block

The block in the TC2000 Temperature Calibrator can be used as either a source of heat or cold, or as a thermometer reference. In other words, the sensor can be placed into the temperature block and its reading compared to the reading on the TC2000 display or it can be compared with the reading from an external thermometer.

How the sensor is placed in the insert is of crucial importance to obtaining accurate calibration measurements. Regardless of what type of reference is used (i. e. internal or external) it is crucial that the sensor and the reference be at an equal distance when placed into the calibrator's insert. For example, immersing a 2-inch sensor assembly into a 6-inch well could yield an error up to 10ºC. This error is inherent in all dry-well calibrators.

NOTE: INCORRECT WAY DOING CALIBRATION



5.5 Calibrating a short-stem probe

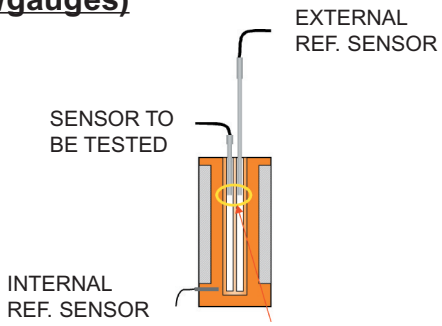
We recommend the use of a comparison technique when calibrating a short-stem probe. Do not compare the test reading to the dry-block display; it will not give you the best results. It is more accurate to use a reference probe of similar size and diameter. Size and diameter greatly affect the amount of heat lost to ambient through the probe stem. Therefore, the closer the sizes match, the more accurate the comparison.

Your objective should be to achieve identical heat properties inside the block to ensure that both sensors are sensing the same temperatures in the same way. Any deviation will cause further error. Therefore, for a satisfactory result, we recommend that you immerse the reference probe and the test probe, both of which should be identical in size, into their bore holes in the insert to exact same depth.

Our new "Liquid-filled Insert" eliminates this problem and can be used to calibrate short probes of any length using the probe's internal sensor as the reference.

5.6 Using the calibrator as a reference when adjusting measuring devices (meter/gauges)

The temperature calibrator can also be used as a calibrated reference when adjusting measuring devices such as meters or gaughes. Using a multi-hole insert allows multiple meters/gauges to be adjusted at the same temperature.



NOTE: RECOMMENDED CALIBRATION OF SHORT-STEM PROBES

5.7 The Time Constant influence on temperature-well mass

The sensor being tested has a large time constant due to larger mass and longer distance to the cooling/heating elements. Consequently, the temperature curve for the internal reference sensor and the sensor being tested (center of insert) will be different (see Figure 3 Temperature reference).
All Scan-Sense temperature calibrators have an internal reference sensor mounted in the temperature block to react quickly to temperature changes and thus reduce the resulting time constant.

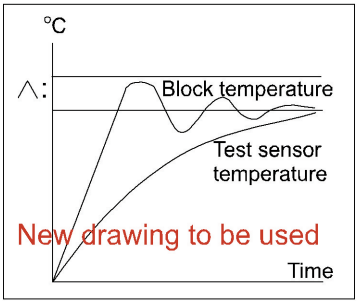


Figure 3. Temperature reference

5.8 When to take the calibration reading

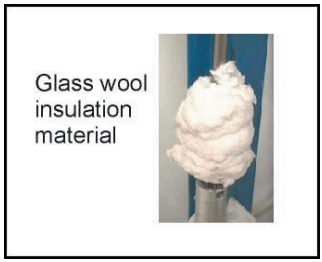
With the TC2000, when the REF temperature, that is the temperature at the center of the well, has been stable +/- 0.2ºC for at east 10 minutes (default value), the display will show the message "Temperature stable, take reading". Some temperature overshoot will occur when approaching the SET temperature. However, this only applies to the internal reference sensor. The sensor being tested has

a larger mass bacause of the insert, so it reacts more slowly to temperature changes; see Figure 3 Temperature reference.

5.9 The importance of cleanliness to attain high accuracy results

The ability of any dry-block calibrator to provide accurate calibrations and performance depends on factors such as; sensor length, sensor diameter, thermal-conductivity, the sensor position in the insert, etc. cleanliness of the sensor, temperature well and insert is crucial to the resulting accuracy of each calibration, you must ensure that all surfacec are clean and free of dust, dirt, smudges and oxidaization.

5.10 Insulating with glass wool to minimize cold/heat loss to surrounding air



Loss of cold or heat to the surrounding air will occur when calibrating or testing a long sensor thet is partly exposed when it is placed into the calibrator. When the sensor has a large exposed mass, this cold or heat loss can affect the accuracy of the calibration by as much as 0.5ºC to 1ºC. As a general rule, the effect of cold or heat loss is minimal if the length of the part of the sensor that is exposed is less than (<) 1/4 of its length. We recommend that the exposed part of the sensore be insulated. Further, we recommend the use of glass wool for insulation because, although there are different types of insulating materials available, the material of choice must have good insulating characteristics and be able to withstand extreme operating temperatures. It must also be flexible enough to be tucked around the sensor, hence the choice of glass wool. Also bear in mind that drafts can affect the stability of the calibrator. Please contact ScanSense for further information.

6 Specifications

TEMPERATURE RANGE

Temperature range	-40ºC* to +150ºC * Rel. ambient
Accuracy	±0.3ºC
Resolution	0.01ºC
Gradients at 95ºC w/water	0.06ºC
Stability (30 min. after normal stabilisation):	
* As a dry block	±0.02ºC
* As a stirred liquid bath	±0.005ºC
* As a stirred ice bath	±0.001ºC
Uncertainty (best)	<0.03ºC (depending on ext. ref.)
Well depth	155mm
Well diameter	50mm
Bath volume	261cm³
Thermostat test	yes
Serial interface	RS232
Power supply	110V(90-130V), 50/60Hz 230V(180-250V), 50/60HZ
Operating temp.	0 to +40°C
Dimensions	406x254x356 mm
Weight	15.5 kg without inserts

7 Electrical specifications

INPUTS PORT A:	RANGE	RES.	ACCURACY	(% of reading)
Pt100 2, 3 and 4-wire*	-50 to 800ºC	0.01ºC	±0.05ºC	±0.009%
Inputs Port B:				
Pt100 2, 3 and 4-wire*	-50 to 800ºC	0.01ºC	±0.05ºC	±0.009%
Type K	-100 to 1370ºC	0.1ºC	±0,25ºC	±0,03%
Typr J	-200 to 1200ºC	0.1ºC	±0.25ºC	±0.03%
Type E	-200 to 1000ºC	0.1ºC	±0.25ºC	±0.04%
Type T	-200 to 400ºC	0.1ºC	±0.25ºC	±0.03%
Type S	0 to 1760ºC	0.1ºC	±0.25ºC	±0.03%
Type R	0 to 1760ºC	0.1ºC	±0.25ºC	±0.03%
Type B	+400to 1820ºC	0.1ºC	±0.25ºC	±0.03%
Type N	-200 to 1300ºC	0.1ºC	±0.25ºC	±0.05%
Type L				
Voltage**	0 to 10V	1µV	±0.25ºC	±0.02%
Current**	0 to 22mA	1µA	±2µV	±0.02%
Cold junction***	0 to 40ºC	0.1ºC	±2µA	±0.25%

* Pt100 conforms to IEC751 and temperature scalev of ITS-90
** All thermocouple inputs are cold junction compensated
*** Will in addition indicate negative inputs but these are not calibrated
Published specifications may change without notice!

TC input temperature drift 90ppm
V and mA input temperature drift 27ppm