



TCON 1000

Four Block High Precision Dry Bath System

User's Manual



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DURATECH TCON 1000 SERIES (HEATING ONLY)

HIGH PRECISION DRY BATH SYSTEM

USER'S MANUAL

REVISION 080505MEA

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WARRANTY INFORMATION AND NOTICES

DURATECH warrants all products of its manufacture to be free from defects in material and workmanship. This warranty is effective for one year from the date of delivery to the original Purchaser.

DURATECH warrants all other products not of its manufacture but sold as part of this DURATECH system to be free from defects in material and workmanship. This warranty is effective for ninety days from the date of delivery to the original Purchaser.

Upon prompt notification by the Purchaser, DURATECH will, at its option, repair or replace equipment that proves to be defective during the warranty period. The equipment must be returned to DURATECH at the expense of the Purchaser, if required by DURATECH. Parts, labor and return shipment to the Purchaser shall be at the expense of DURATECH. Parts used and labor performed during on-site warranty service requested by the Purchaser shall be at the expense of DURATECH. Travel costs, meals, and lodging shall be at the expense of the Purchaser.

This warranty shall not apply to defects originating from:

1. Improper maintenance or operation by the Purchaser.
2. Purchaser-supplied accessories or consumables.
3. Modification or misuse by the Purchaser.
4. Operation outside the environmental and electrical specifications for the product.
5. Improper or inadequate site preparation.
6. Purchaser induced contamination or leaks.

DURATECH reserves the right to make changes in design or construction at any time without incurring any obligation to make any changes whatsoever on units previously purchased. DURATECH assumes no obligation of any kind with respect to design or construction of products not of DURATECH manufacture.

This warranty is expressly made by DURATECH and accepted by Purchaser in lieu of all other warranties, including warranties of merchantability and fitness for a particular purpose, whether written, oral, expressed, implied, or statutory. Purchaser agrees that DURATECH shall not be liable for normal wear and tear, nor for any contingent, incidental or consequential damage or expense due to partial or complete inoperability of its products for any reason whatsoever.

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1.0 TECHNICAL SPECIFICATIONS

1.1 Physical

Dimensions:	8" high x 15" deep x 5" wide
Weight:	25 pounds unpacked
Control:	(4) operator pushbuttons; RS-232
Display:	20 character x 4 line backlit LCD

1.2 Power Requirements

115VAC 60 Hz, single phase	3 amps
230VAC 50 Hz, single phase	1.5 amps

1.3 Environmental

Operating Temperature:	30°C maximum
Storage Temperature:	-20°C to 50°C
Humidity:	10% to 60%, non-condensing

1.4 Temperature

Range	Ambient to 100°C guaranteed (can be set from 20°C to 110°C)
Accuracy	Better than $\pm 0.3^\circ\text{C}$
Repeatability	Better than $\pm 0.1^\circ\text{C}$
Stability	Better than $\pm 0.02^\circ\text{C}$ (Measured at the temperature sensor within the blocks. Insertion of tubes to be heated or cooled will momentarily, and slightly, disturb the temperature.)
Uniformity	$\pm 0.1^\circ\text{C}$

1.5 Control

Heating devices are controlled by the firmware on the circuit board. A 24 bit Analog to Digital (A/D) converter monitors temperature sensors. Custom Proportional Integral (PI) algorithms are used for controlling temperature.

1.6 Blocks

The TCON 1036 has a single block which can hold a maximum of 36 18mm tubes. The TCON 1032 has two independently controllable blocks, each holding a maximum of 16 18mm tubes. (Other custom tube diameters are available on request.)

1.7 RS-232 Interface

The TCON uses a standard RS-232 serial interface with the following protocol:

9600, 8, N, 1 (9600 baud, 8 bits, no parity, 1 stop bit)

The format and a detailed list of serial commands are available from Duratech by request.

OVERVIEW

The TCON was designed to replace costly water bath systems. Each deep well block can be programmed to any set point in the temperature range of the instrument.

2.1 Temperature Control

Each block is monitored by a precision RTD temperature sensor, which is read by a 24 bit Analog to Digital (A/D) converter on the circuit board.

The microprocessor constantly calculates and updates the output to the heaters using a custom Proportional Integral (PI) algorithm.

2.2 Temperature Range

The guaranteed temperature range is from ambient + 5°C to 110°C, but the set point may be adjusted from 20°C to 110°C to compensate for possible offsets between the embedded sensor and actual temperatures inside the wells.

3.0 SETUP

3.1 Electrical Connection

Use the supplied power cable to connect the TCON to the power source. Be sure to look at the label for correct voltage operation.

WARNING: Plugging a 115VAC unit into a 220VAC receptacle may destroy the power supply.

4.0 OPERATION

4.1 Basic Operator Interface

The main screen layout looks like this:

BATH		SETPOINT						ACTUAL									
B	2			9	0	.	0	0	°			9	0	.	0	0	°
B	1			4	0	.	0	0	°			4	0	.	0	0	°

B1 to B2 are baths 1 to 2, respectively. Bath 1 is at the front of the unit, bath 2 is at the rear of the unit. The baths are listed this way so they match the actual layout of the blocks. In the case of a single block model the display appears slightly different, since there is no need to identify a block.

The operator interface consists of (4) pushbuttons labeled: MENU, CURSOR, UP, and DOWN. All pertinent data is displayed on the 20 character x 4 line LCD display.

All numeric data is entered the same way: MENU selects the next menu item, the CURSOR key moves the cursor, and the UP & DOWN arrows adjust the digit above the cursor. A typical screen could show:

BATH		SETPOINT						ACTUAL									
B	2			9	0	.	0	0	°								
B	1			<u>4</u>	0	.	0	0	°	←	e	n	t	e	r		

Note there is a cursor under the “4” for block 1. Pressing CURSOR advances the cursor to the right. (The cursor will wrap around to the first digit.) Using the UP and DOWN buttons changes the value above the cursor. You can press MENU at any time to bypass the current screen.

NOTE: Be sure that the main screen (with set points and actual temperatures) is showing when you are done setting temperatures.

4.2 Notes

When changing set points, the temperature of the adjacent block may be affected. The adjacent block temperature may increase or decrease about 0.05°C while the other block is moving towards its set point.

5.0 CALIBRATION

5.1 Calibrating with a Precision Thermometer

Use a precision thermometer and a test tube to calibrate. Your thermometer should be calibrated to be correct when it is inserted in the sample to the depth that you are using. Put the test tube, with the thermometer in it, near the middle of the block that you are first going to calibrate. The test tube should be filled with anti-freeze (ethylene glycol) to a level so that WHEN THE PRECISION THERMOMETER IS INSERTED, THE LEVEL WILL BE AT THE NORMAL SAMPLE LEVEL. Calibration is done at 40°C and 90°C. First, you must do the calibration at 40°C. Proceed as follows:

1. Set all the temperatures to 40°C and let the temperatures stabilize for about 1 hour.
2. Press the MENU button once. This takes you to the screen to enter the set point for block 1. Press it again to select the next block (if applicable). Then press and hold the MENU button. The display will then go to the calibration screen for that block.
3. Now enter the temperature read from the thermometer. Then press the MENU button to return to the operating screen. Repeat the above for the remaining block (if applicable).
4. Proceed in a similar manner with calibration at 90°C.
5. Record the results. A pocket on the back panel of the TCON is provided as a convenient place to store a 4x6 card with the calibration values. The current values can be viewed by holding down the $\uparrow\downarrow$ buttons when turning power on. Should calibration be lost for any reason it can be restored without repeating the calibration steps above by re-entering these values. See "RESTORING A LOST CALIBRATION" (section 5.1).

You may re-calibrate at any time. The TCON automatically takes into account all previous calibrations and calculates the required offset and slope from your inputs. The sum of all calibrations is stored, and can be read out. To do this, turn off power, then turn it on while holding down both the up and down buttons. The 40°C calibrations are listed under the set point column, and the 90°C calibrations are listed under the actual column. Press and hold the MENU button to save the new calibration(s) and return to normal operation, or turn off power to cancel the changes.

The TCON has been calibrated at the factory. However, there are many factors that affect the temperature of the sample. The temperature that is actually controlled is a point within the aluminum block. The sample is slightly separated from this. It can be influenced by the temperature of the neighboring block (if applicable), by the thermal characteristics of the test tube, and by the thermal conductivity of the precision thermometer itself.

5.1 Restoring a Lost Calibration

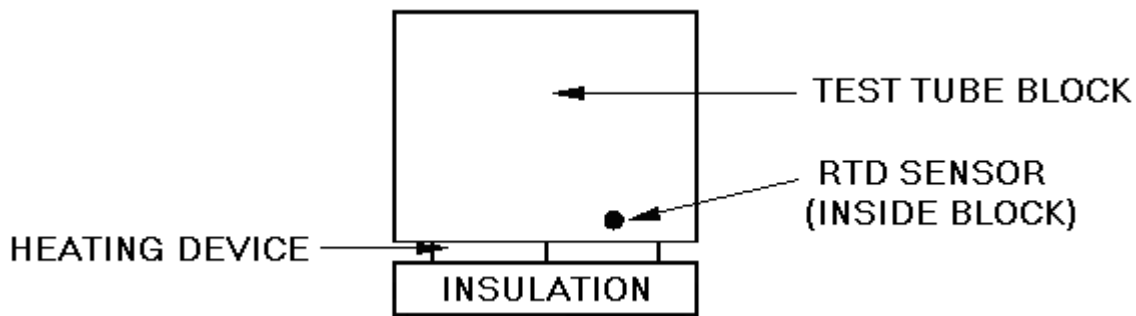
The last set point and calibration values for each block are stored in non-volatile memory (memory that is maintained when power to the unit is off). Should the calibration be lost for any reason, such as a fault, or operator error, it can be restored without repeating the calibration steps above, providing that the calibration values have been recorded. The values entered at the factory are recorded and placed on a card that is inserted into a pocket on the back panel of the unit. The card also contains instructions for using the values to restore

calibration and space to enter a later calibration performed by the customer. The recorded values may be re-entered as follows:

- 1) View current calibration by turning power on while pressing the $\uparrow\downarrow$ keys.
- 2) If in error, select a calibration value to change using the MENU key.
- 3) Correct a calibration value with the CURSOR and $\uparrow\downarrow$ keys.
- 4) Save corrected calibration values by pressing and holding the MENU key.
- 5) Repeat step 1 to confirm corrections.
- 6) Exit without re-saving changes by turning power off.

6.0 OPERATIONAL THEORY

The basic construction of one dry bath is shown below:



The heating device is in contact with the test tube block at the top and rests on an insulating pad at the bottom. It can be switched on and off many times per second. This fast switching provides the superior temperature stability of the TCON.

The test tube block temperature is measured using a Resistance Temperature Detector (RTD) that is placed close to the heating device. This allows the unit to rapidly detect changes in temperature. The temperature displayed on the front panel is from this sensor. We state a temperature stability of better than $\pm 0.02^{\circ}\text{C}$. This is the temperature read at the RTD's location in the aluminum mass.