

# User Guide

AutoScan\_CTE™



# AutoScan\_CTE™

## Concrete Coefficient of Thermal Expansion Measurement System

Rev 2, Copyright January 2012



Innovators in Instrumentation Technology

# IMPORTANT

## PRECAUTIONS WHEN USING THE AutoScan\_CTE

1. DO NOT attempt any repairs on the unit with the power switch on.
2. DISCONNECT unit from wall power before attempting any repairs.
3. DO NOT operate the device without water in the tank. This will cause serious damage to the unit
4. Wipe off any water from the surface of the unit and from the surfaces surrounding the device to prevent shock.
5. Follow all your other related facility safety instructions while operating this device.
6. DO NOT operate this device without prior training.
7. Maintenance on this device must be done by trained technicians.
8. Call InstroTek if you have any questions.

# IMPORTANT

# *Table of Contents*

Introduction	Page 1
System Location	1
System Component Connections	2
Water System Setup	2
Calibration Procedures	3
Testing Procedures	5
Sample Preparations	5
Sample Setup	5
Using the Software	6
Measure Mode	7
LVDT Adjustment	9
Temperature Starting Point	10
Test Screen	11
Warranty	13

## *Introduction*

InstroTek AutoScan CTE is specifically designed for the measurement of coefficient of thermal expansion of a single concrete sample at a time. The concrete Coefficient of Thermal Expansion (CTE) has a significant influence on performance of pavements. CTE is defined as relative change in length (strain) per degree of temperature change. AutoScan CTE consists of a measurement device that includes a high accuracy LVDT system.

The System is fully automatic with microprocessor control of temperature and measurement acquisition. All the functions of the AutoScan CTE system are automatically controlled and the results are calculated and displayed on user friendly Graphical User Interface (GUI).

## *System Location*

When setting up this unit, remember that CTE measurements involve extremely precise and sensitive measurements of temperature (within  $0.1^{\circ}\text{C}$ ) and core height (within  $0.00125\text{ mm}$  or  $0.00005\text{ in}$ ). It is important that the location selected for this unit meet a set of minimum requirements. Please follow the recommendations below for selection of an appropriate testing location for the AutoScan\_CTE.

1. Set the system in an air-conditioned, well ventilated room. Room Temperature should be set to  $21 \pm 1^{\circ}\text{C}$  ( $70 \pm 2^{\circ}\text{F}$ ).
2. Provide enough room around the unit for air flow.
3. Avoid setting the unit around equipment that generates vibration and heat.
4. Set the unit on a level and stable surface.
5. Use a dedicated AC circuit for powering the unit.
6. Place the unit in a location with minimum amount of foot traffic.
7. When unit is in the testing cycle do not touch, move, or attempt to make adjustments to the unit.

## System Component Connections

The following steps will guide you through the required connection for powering the unit:

1. Plug the USB cable from the back of the CTE unit to a Computer USB port.
2. Turn the PC on
3. The unit is now ready for operations

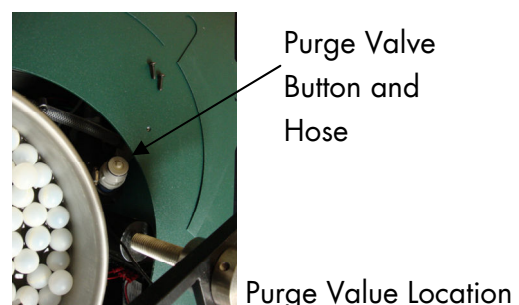
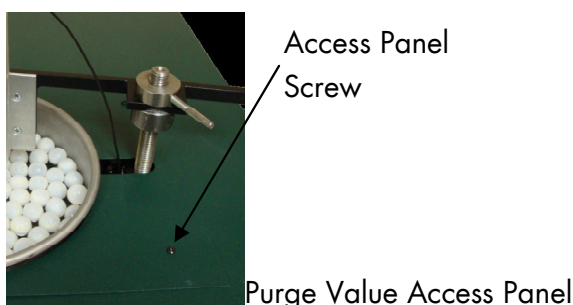
## Water System Setup

The following steps will guide you through the initial use of—or when water is changed in—the unit.

**BEFORE USING THE AutoScan\_CTE ENSURE THE TANK HAS SUFFICIENT WATER TO COVER BOTH WATER PORTS IN THE TANK WALLS.**

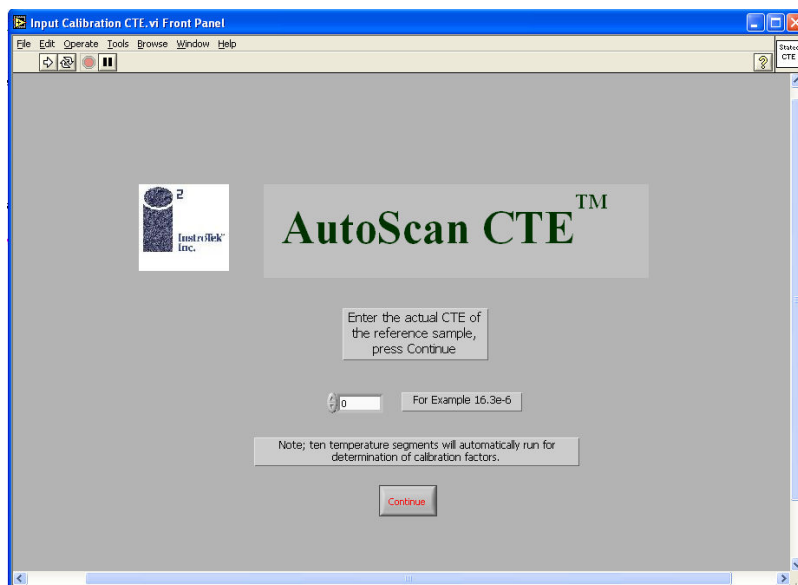
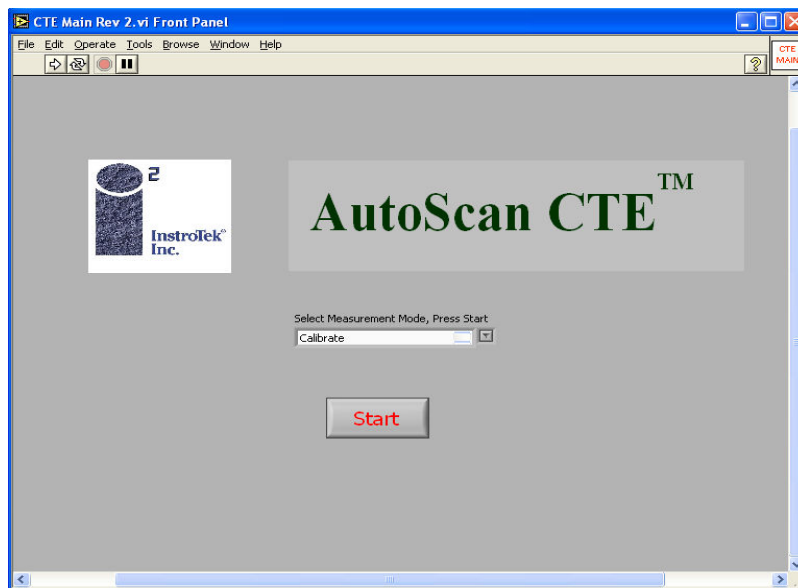
1. Remove the two screws located on the top of the AutoScan\_CTE closest to the LVDT support arm.
2. Slide cover off device, taking care to not bend the cover.
3. Fill the tank to 3/4 full; this will submerge both water ports inside the tank.
4. Press and hold the purge button. You may see water rise in the purge valve hose.
5. Release the purge button.
6. Start the Temperature Set Point Program on the PC; turn the unit power switch to on, the pump will start. Allow to run for a few seconds. Turn the unit off, leave the PC program running.
7. Repeat steps 4 through 6 until no air can be seen coming from the intake water port.
8. The device is now ready to begin testing.

**PURGE SYSTEM OF ANY EXCESS AIR BEFORE INITIAL USE OR WHEN WATER IS CHANGED.**



# Calibration

1. From MS Windows desktop, double click on the AutoScan\_CTE Main icon. Main screen will appear.
2. Click on the drop down arrow on the Operation Menu to select the following mode: Calibrate and press Start.



Enter the CTE of your calibration reference standard. For example, for a CTE of  $10.0 \times 10^{-6}$ , enter 10.0e-6.

## *Calibration (cont.)*

At this point the program follows the screen input steps as explained in the Measure Mode; however, it will run 10 segments and accumulate an average for calculation of the calibration correction. This correction factor from this calibration is automatically used in all future measurements.

The Calibration Mode is performed every time the unit is relocated or every 12 months, whichever comes first.

The calibration constant is found from the following equation below.

$$correction = \frac{(\alpha_{meas} - \alpha_{actual}) \times L}{\Delta T}$$

Where:

$\alpha_{meas}$  = *CTE measured with a zero correction*

$\alpha_{actual}$  = *The calibration reference standard CTE value*

L = *Height of the sample at room temperature*

$\Delta T$  = *Test temperature range*

The equation above gives the correction in terms of length per degree C and is stored in a calibration file.



# *Testing Procedures*

The AutoScan CTE Main software has a dialogue box where either Measure or Calibrate may be chosen. In calibration mode the CTE is assumed known and the measurement is made without any correction. Comparison of the known and the measurement allows for an assignment of a correction factor. Please make certain a calibration is performed prior to taking measurements on samples.

## **Step 1 – Sample Preparations**

AutoScan CTE is a contact measurement system. However, the measurement sensor is in the room environment not subject to the harsh environment of the sample.

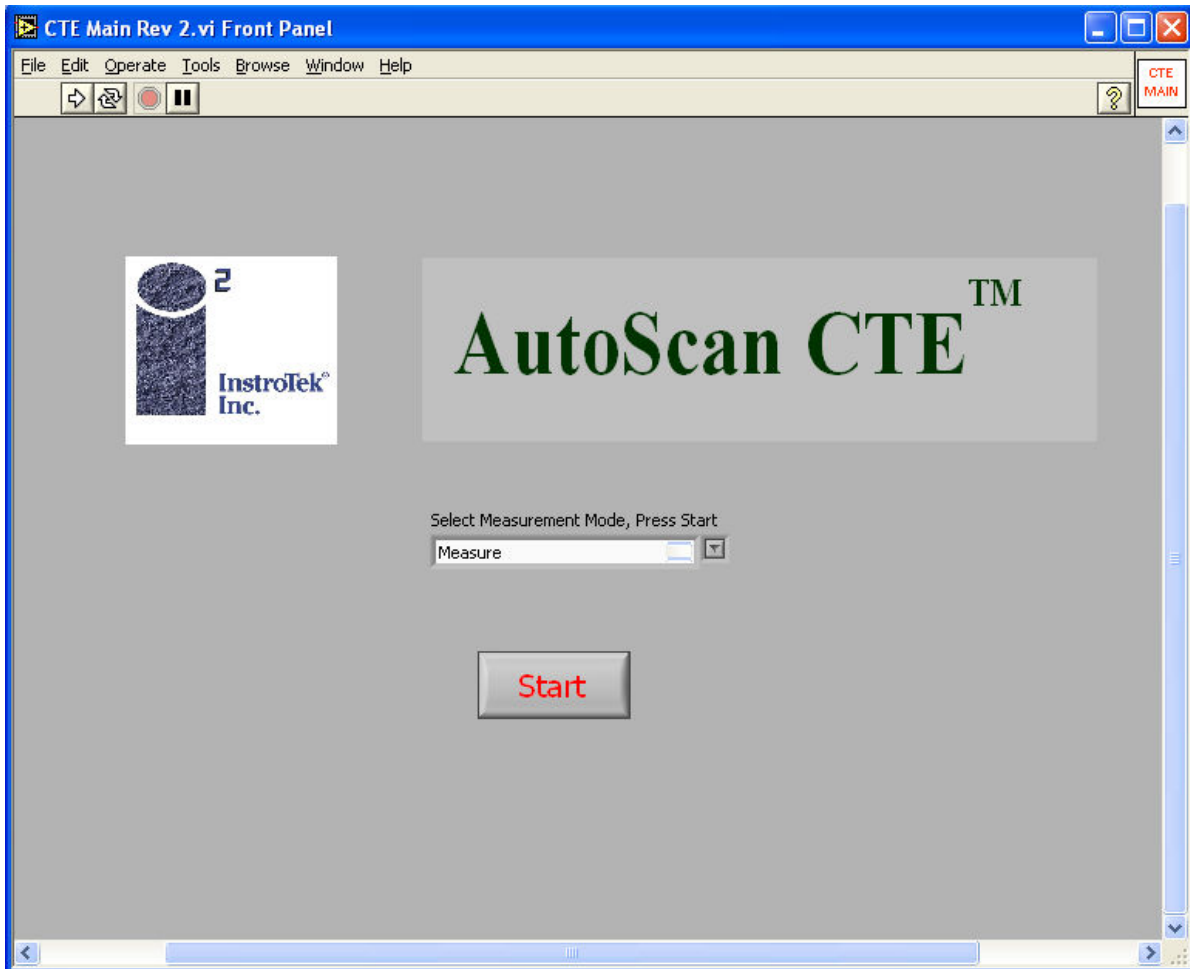
The AutoScan CTE is capable of testing 100 and 150 mm diameter samples. The minimum and maximum height requirements for the samples are 170 mm and 210 mm (6.7 to 8.3 inches), respectively.

## **Sample Setup**

1. Loosen the screw clamp on the post and swing the LVDT out of the way.
2. Place the sample in the tank on the three posts in the bottom. Be sure the sample is not to one side or the other and that it is stable.
3. Place the quartz on top of the sample, there is no need to glue it or fasten it in any way, the spring on the LVDT will hold it to the sample securely.
4. Swing the LVDT back and center over the quartz and tighten the post nuts so that the LVDT arm is secure.
5. Using the screw slide turn the knob until the LVDT is centered and just rests on the quartz; once the program is started further adjustment can be made until the LVDT is in the appropriate position.

## Step 2 – Using the Software

1. From MS Windows desktop, double click on the AutoScan CTE Main icon. Main screen will appear.
2. Click on the drop down arrow on the Operation Menu to select the following modes: Measurement or Calibrate.



**Measurement Mode**- This mode starts the measurement process, incorporating any correction factor previously determined by the calibrate mode. It will then call the data screen.

**Calibrate Mode**- In this mode the measurement process is started and the correction factor is assumed to be zero, it will then call the data screen.

## Step 3 – Measure Mode

### Date Input

The next user interface is the Data Entry screen, which is the same for both the Measure Mode and the Calibrate Mode.

**AutoScan CTE™**

**\*Sample ID**

**\*Sample Height (mm)**  
  
150 - 200 mm

**\*Sample Diameter (mm)**  
  
90 - 160 mm

**Sample Mass (kg)**

**\* = Required**

**Data Storage Period**  
Default 60 seconds

**Error Limit**

**\*Low Test Temp**

**\*High Test Temp**

Temp must be between 10 and 60

**Continue**

**All Parameters Assigned**

There are three columns, the right column is sample information, the middle column is the quantity of data storage, and the left column is the test temperatures.

The sample information column has the following entries:

- Sample ID
- Sample Height in mm
- Sample Diameter in mm
- Sample Mass in Kg  
(\* indicates a required field)

## Data Storage

The quantity of data storage has only one input, it is the period at which data will be stored and the default is 60 seconds. Every 60 seconds the computer will store the displacement and the temperature in a file.

Error Limit allows the program to continue or stop depending on the difference in CTE between two segments. For example, low to high and high to low temperature CTE value are checked against each other and if the difference is smaller than the Error Limit, the unit will stop. If the difference is larger than the Error Limit, the unit will continue another temperature segment.

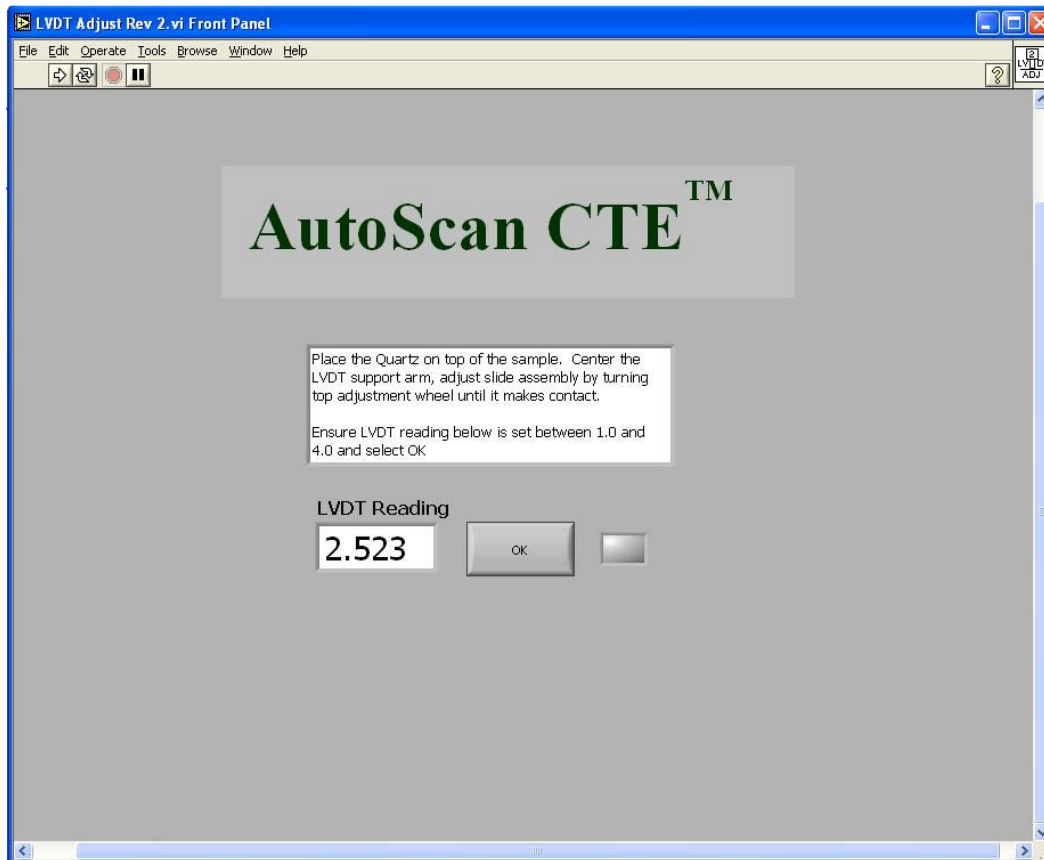
## Test Temperatures

The AutoScan\_CTE is run using two test temperatures to calculate the CTE value for the sample. The CTE is found using a 40°C temperature span. Test temperature 1 is the low temperature setting and test temperature 2 is the high temperature setting. The default Low Temperature is 10°C and High Temperature is 50°C.

Once all parameters are entered press Continue. If all required data has been entered the indicator at the bottom of the left most panel will turn green; if the indicator does not turn green, check for missing data.

## Step 4 – LVDT Adjustment

On pressing Continue the software will display the LVDT adjustment screen as shown below.

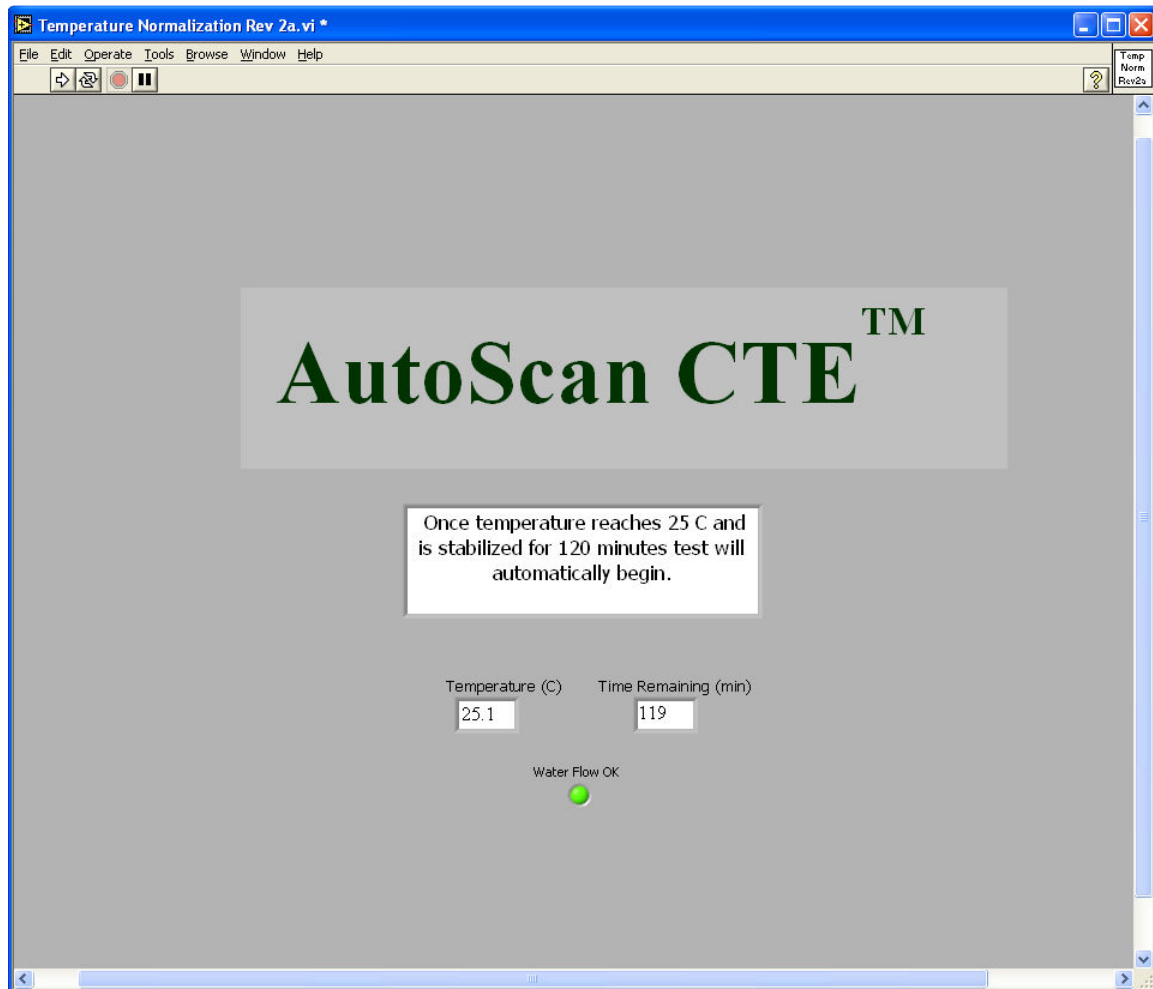


There are two ways to adjust the LVDT, using the coarse adjustment allows the user to adjust the LVDT platform so that the LVDT slide is in range of the sample. Once the coarse adjustment is completed the slide assembly allows for the fine adjustment of the LVDT to meet the criteria shown in the screen above.

Once the LVDT has been set between 1 and 4, select the OK button. The green box will eliminate and the program will continue to the next step.

## Step 5 – Temperature Starting Point

The next screen brings the water bath to 25 °C and acquires a displacement reading to start the run.

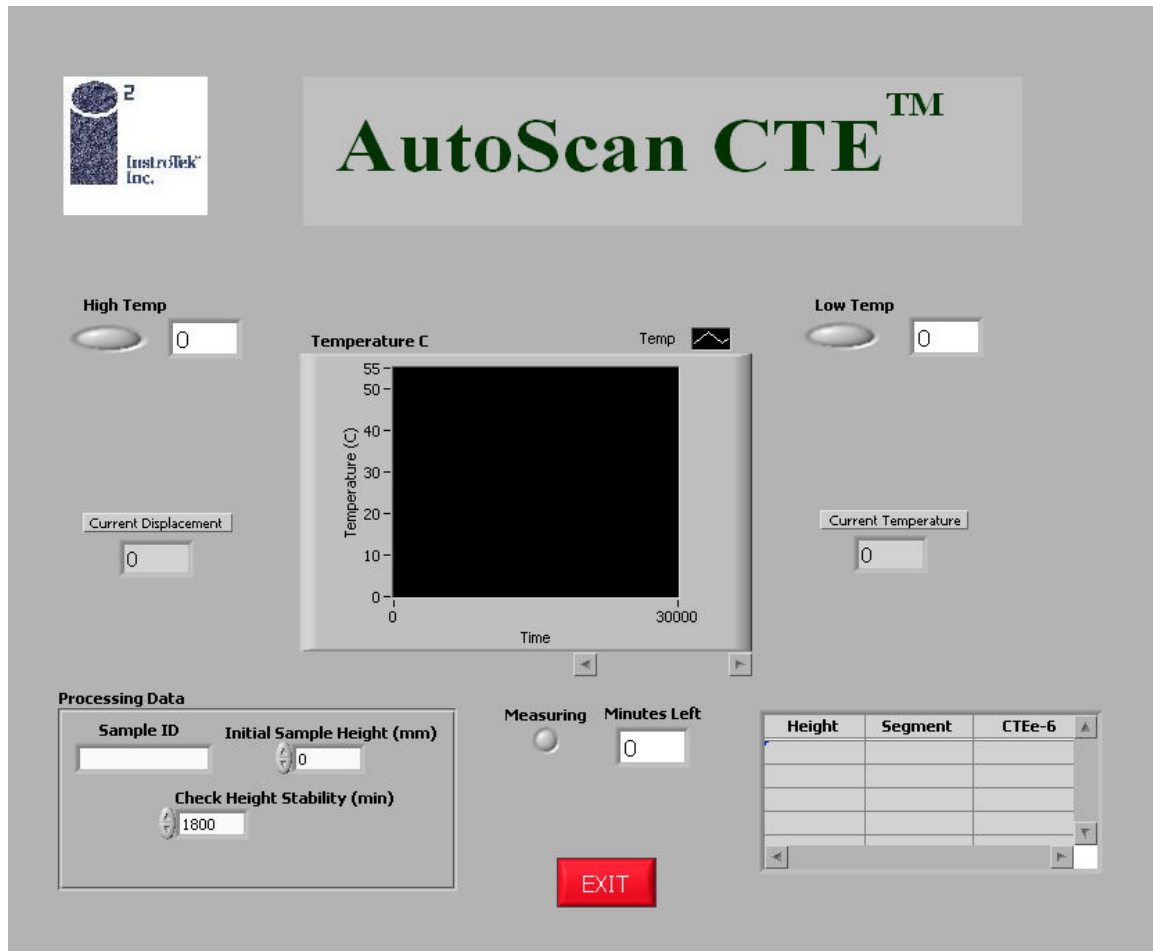


Before acquiring a reading the unit will stabilize at 25° C for 120 minutes and the Time Remaining is shown in minutes along with the current temperature of the water bath.

When the temperature has stabilized the program will continue to the next screen, the test screen.

## Step 6 – Test Screen

The Test Screen conveys a significant amount of information, starting from the top and working from left to right each indicator or set of indicators will be explained.



- High Temp, this will turn green when the temperature controller set point has been set to high temperature, otherwise it will be gray.
- Low Temp, this will turn green when the temperature controller set point has been set to low temperature, otherwise it will be gray.
- Displacement, this is a numerical indicator which displays the actual position of the LVDT, not the height of the sample.
- Temperature graph, this gets the temperature data every second and plots it versus time in seconds.

## Step 6 – Test Screen (cont.)

- Current Temperature, this is a numerical indicator of the temperature.
- Sample ID, this is the sample ID you indicated during the data entry phase.
- Initial Sample Height (mm), is the measured height of the sample at room temperature.
- Check Height Stability (min), once set point temperature is reached, a height reading is taken by the LVDT. The unit will then rest at the same temperature for 30 minutes. A second height reading is taken at this time. If the difference between the first and the second height reading is below 0.00125 mm, the unit will continue to the next temperature setting. Otherwise, the unit will rest 30 more minutes until the height difference between two consecutive readings is less than 0.00125 mm.
- Measuring, this will turn green once the unit is measuring the height of the sample.
- Minutes Left, this is the time remaining (countdown) prior to the next height comparison. Note, for height comparison routine, please see Check Height Stability above.
- Exit, will Exit the program completely and will store the data already collected.
- Table, tracks the height in mm, the segment number, and the CTEe-6 corresponding to that segment number.



After the LVDT has been adjusted, place the cover on top of the device to protect sample from room ventilation.



# Warranty

*InstroTek extends a 1-year warranty on the AutoScan\_CTE to the original purchaser of this equipment. This warranty covers defects in material, workmanship, and operation under the conditions of normal use and proper maintenance.*

*This WARRANTY DOES NOT cover the replacement of the pump due to improper setup or running the unit without sufficient water.*

*InstroTek will replace, free of charge, any part found to be defective within the warranty period.*

*This warranty is void if inspection shows evidence of abuse, misuse or unauthorized repair.*

*This warranty covers replacement of defective materials and workmanship only. It does not cover shipping charges, duties or taxes in the transport to and from the factory or authorized service center.*

*InstroTek's liability is in all cases limited to the replacement price of its products. InstroTek shall not be liable for any other damages, whether consequential, indirect, or incidental arising from use of its product.*

*If return of the product is necessary, please include return shipping directions, contact name, phone & fax number and a description of the action needed.*

*Call InstroTek, Inc. for shipping details at (919) 875-8371*