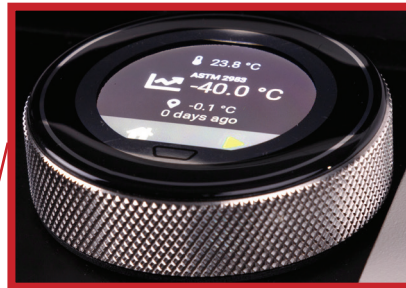




TESC-2983

Thermoelectric Sample Conditioner



Operation Manual

Copyright

Copyright ©2022 Cannon Instrument Company®. All rights reserved.

Trademarks

CANNON®, the CANNON logo, Cannon Instrument Company®, and VISDISK® are registered trademarks of CANNON Instrument Company in the United States and other countries.

Brookfield® is a registered trademark of AMETEK Brookfield in the United States and other countries.

Contact

Address: Cannon Instrument Company
2139 High Tech Road
State College PA 16803, USA

Phone: 814-353-8000 | 800-676-6232

Fax: 814-353-8007

Website: cannoninstrument.com

Email:

Sales: sales@cannoninstrument.com

Service: service@cannoninstrument.com



Contents

Contents	i
Overview	1
Product Specifications	2
Notes/Cautions/Warnings	2
Safety Precautions.....	3
Getting Started	4
Unpack and Inspect	4
Setup the TESC-2983	5
Attach the Head Unit	7
Connect Cables	8
Level Unit	9
Base Unit Touch Encoder	9
Running Quick Verification Test	10
Running an ASTM D2983/D8210 Test	15
Sample Preparation	15
Choose Test Method	25
Running a Sample	26
Calibrating the TESC-2983	28
TESC-2983 Calibration Part One.....	28
TESC-2983 Calibration Part Two.....	32
Alternate Temperature Calibration Procedure	36
Warranty	39
Products Limited Warranty.....	39
Reagent and Chemical Warranty.....	39
Returning a Product to CANNON	39
Required Information	40
Hazardous Materials	40
Shipping Notification	40

List of Figures

Figure 1: Assembled TESC-2983	6
Figure 2: Head Unit Retaining Screws	7
Figure 3: Removing Retaining Ring from Mounting Collar	7
Figure 4: Head Unit on Bracket Frame	7
Figure 5: Collar	7
Figure 6: Head Unit Connections	8
Figure 7: Base Unit Connections	8
Figure 8: Bubble Level and Levelling Legs on TESC-2893	9
Figure 9: Touch Encoder	9
Figure 10: Auto Zero Screen	11
Figure 11: Auto Zero Complete Screen.....	11
Figure 12: Home Screen of Base Unit.....	12
Figure 13: Ready to Select Position	12
Figure 14: Begin Calibration.....	12
Figure 15: Calibration in Progress	13
Figure 16: First Phase of Calibration Complete.....	13
Figure 17: How to Exit out of Calibration	14
Figure 18: Home Screen of the Base Unit.....	14
Figure 19: TESC Base Unit Sample Chamber with Support Ring and Orange O- Ring.....	15
Figure 20: Spindle Placement	16
Figure 21: Home Button	16
Figure 22: Main Menu	16
Figure 23: Load Tests Screen.....	17
Figure 24: Settings Button	18
Figure 25: Settings Screen	18
Figure 26: Device Setup Screen.....	18
Figure 27: Temperature Offset Screen	19
Figure 28: Screen to Change Temperature Offset Name and Value.....	20
Figure 29: Add/Change Temperature Offset Name	20
Figure 30: Main Menu of the Head Unit.....	21
Figure 31: Home Screen of the Head Unit	21
Figure 32: Home screen of the Base Unit	21
Figure 33: Menu Button.....	22
Figure 34: Switch Test Temperatures Button on Main Menu.....	22
Figure 35: Switch Test Temperatures Screen	23
Figure 36: Select Switch Test Temperature	23
Figure 37: Add Test Temperature Button on Main Menu	23
Figure 38: Add Test Temperature Screen with Tens Digit Selected	24
Figure 39: Add Test Temperature Screen with Ones Digit Selected	24

Figure 40: Add Test Temperature Screen with Tenths Digit Selected.....	24
Figure 41: Choose Home Button	25
Figure 42: Test Method/Version Information.....	25
Figure 43: Confirm Test Method	25
Figure 44: Select Run from Home Screens of Head and Base Unit	26
Figure 45: Test in Progress Screens.....	26
Figure 46: Home Screen of the Base Unit.....	28
Figure 47: Ready to Select Position	29
Figure 48: Screens on the Base and Head Units to Begin Calibration	29
Figure 49: First Phase of Calibration Screens.....	29
Figure 50: First Phase of Calibration Complete.....	30
Figure 51: Screen to Edit the Calibration Offset	30
Figure 52: Save Temperature Offset	31
Figure 53: Confirm New Temperature Offset	31
Figure 54: Configure Viscosity Test Screen	32
Figure 55: Select Settings.....	33
Figure 56: Settings Menu.....	33
Figure 57: Device Setup Screen.....	33
Figure 58: Temperature Offset Screen	34
Figure 59: Screen to Change Temperature Offset Name and Value	34
Figure 60: Screen to Change Temperature Offset Value	35
Figure 61: Base Unit Save Icon	35
Figure 62: Inserting Temperature Probe Holder into Collar	36
Figure 63: Temperature Probe inserted into Holder and Test Tube.....	36
Figure 64: Press Home Button on Base Unit.....	37
Figure 65: Main Menu after Scrolling to Calibration.....	37
Figure 66: Calibration Offset Edit Screen.....	38

List of Tables

Table 1: TESC Thermal Conditioning Programs.....	2
Table 2: Product Specifications.....	2
Table 3: Packing List (TESC-2983).....	4
Table 4: Packing List (accessories).....	5
Table 5: Tools and Materials for Setup.....	5
Table 6: Touch Encoder Icon Descriptions.....	10
Table 7: Tools and Materials Required.....	10
Table 8: Tools and Materials Required.....	15
Table 9: ASTM D2983 Viscometer Programs on Head Unit.....	17
Table 10: Commonly Used Temperatures.....	19
Table 11: Tools and Materials Required.....	28



Overview

CANNON's TESC-2983 (Thermoelectric Sample Conditioner) provides controlled sample heating and cooling for ASTM D2983 and D8210. The low cost and small footprint, compared to other sample conditioning options, allows several complete TESC-2983 units to be conveniently operated in the same bench-top area as a single competitor unit. This ensures labs have optimal test versatility and repeatability to maximize productivity and reduce downtime.

TESC-2983 uses ASTM D2983 Procedure D and ASTM D8210. To reduce test variability, the TESC-2983 automates, or removes, many of the steps required to transfer the sample between the conditioning and testing processes. Automation occurs through use of a thermoelectrically controlled sample chamber that manages the sample, without operator intervention, throughout the conditioning and testing processes.

Using a calibrated TESC-2983, an operator runs a D2983/D8210 test as follows:

1. Auto Zero the Head Unit.
2. Measure 20 mL of sample into a 25 mm × 150 mm, rimless test tube.
3. Carefully place the test tube with the sample into the TESC sample chamber.
4. Attach a #4B2 spindle to the Head Unit and lower Head Unit into the run position.
5. Simultaneously press **Start** on the Head and Base Units.

Once the Base Unit program starts, the TESC-2983 heats the sample to the preheat temperature and maintains the sample at that temperature for the required time. The TESC-2983 then cools the sample to room temperature at the same rate used to raise it to the preheat temperature, and then further cools the sample to the desired test temperature according to the equation in D2983 Annex A1. This controlled heating and cooling is critical to reducing variability.

Throughout the thermal conditioning process, the Head Unit program records the temperature of the sample chamber while waiting to measure the viscosity. When thermal conditioning of the sample completes, the Head Unit automatically measures the sample viscosity by stepping through the typical range of spindle speeds for the sample type or expected viscosity; see Table 1 for overview. This eliminates the need to run multiple tubes of a sample. Once the viscosity measurements finish, the TESC-2983 returns the sample to room temperature, nominally 25 °C. Afterwards, the operator can review the data and enhance the digital record with notes and additional information. TESC-2983 comes with a set of thermal conditioning programs for all of the common specification test temperatures as well as certain OEM measurement and report requirements.

Table 1: TESC Thermal Conditioning Programs

Fluid	Preheat Temperature	Test Temperature
Low viscosity (ATF, hydraulic fluid)	50 °C	-10 °C
		-20 °C
		-30 °C
		-40 °C
High viscosity (gear oil)	50 °C	-12 °C
		-26 °C
		-40 °C

Product Specifications

Table 2 provides specifications and compliances for TESC-2983.

Table 2: Product Specifications

Specifications	Details
Model	Thermoelectric Sample Conditioner
Methodology	ASTM D2983 Procedure D, ASTM D8210, DIN 51398
Applications	Gear oils, automatic transmission fluids, industrial and automotive hydraulic oils, tractor fluids, lubricating oils
Dimensions (w × d × h)	16.5 cm × 50.8 cm × 76.2 cm (6.5 in × 20 in × 30 in)
Weight	19.5 kg (43 lb)
Operational temperature range	-40 °C to +90 °C (± 0.1 °C)
Sample capacity	1 x 20 mL sample
Power requirements (max)	100–240 VAC, 50/60 Hz, 300 watts
Operating conditions	15 °C to 30 °C, 10% to 75% relative humidity (non-condensing), Installation Category II, Pollution Degree 2
Compliance	CE Mark: EMC Directive (2004/108/EC); Low Voltage Directive (2006/95/EC); ROHS

Notes/Cautions/Warnings

Notes, caution, and warnings are used in the manual to call an operator's attention to important details prior to performing a procedure or step. Read and follow these important instructions. Failure to

observe these instructions may void warranties, compromise operator safety, and/or result in damage to the TESC-2983.



Note: Provides more information about the content that follows.



Caution: Alerts the operator to conditions that may damage equipment.



Warning: Alerts the operator to conditions that may cause injury.

Safety Precautions

Please observe the following general safety precautions for proper and safe operation of the Thermoelectric Sample Conditioner.

- Only qualified personnel should operate the TESC-2983.
- Make sure that you read and understand all operating instructions and safety precautions listed in this manual before installing or operating your unit. If you have questions regarding instrument operation or documentation, contact Cannon Instrument Company.
- Do not deviate from the installation, operation, or maintenance procedures described in this manual. Improper use of the TESC-2983 may result in a hazardous situation and may void the manufacturer's warranty.
- Handle and transport the unit with care. Sudden jolts or impacts may cause damage to components.
- Observe all warning labels. Never remove warning labels.
- Never operate damaged or leaking equipment.
- Refer all service and repairs to qualified personnel.
- Unless procedures specify otherwise, always turn off the unit and disconnect the MAINS AC power cable from the power source before performing service or maintenance procedures, or before moving the unit.

The **~MAINS** symbol indicates the connections for the AC power supply.
The AC power input must match the electrical specifications of the instrument.

~MAINS Never operate the equipment with a damaged MAINS AC power cable.

Use only the manufacturer-supplied MAINS AC power cable. This cable must be inserted into a receptacle with a protective earth ground.

(O) The **(O)** symbol indicates the OFF position for the electrical switches for your unit.



Getting Started

Unpack and Inspect

Unpack and inspect the complete CANNON TESC-2983 (Thermoelectric Sample Conditioner) and all accessories as soon as they are received.



Caution: *Many components are fragile. Use caution when moving and handling the TESC-2983 and accessories.*

1. Carefully unpack the entire contents of the shipment. Refer to the Packaging Lists to verify all materials were received. See Table 3 and Table 4.

Table 3: Packing List (TESC-2983)

Description	Part Number
TESC-2983 Base Unit (Base Unit)	17.5075
Brookfield® DV2T viscometer (Head Unit)	17.5126
Mounting collar	17.5113
Retaining ring	17.5114
Retaining screws (4)	01.4022
MAINS AC power cable	74.2110 (US standard)
MAINS AC pass-through power cable	17.5135
#4B2 insulated spindle	17.5128
Magnetic coupler	17.5150
Allen wrench, $\frac{3}{32}$ "	17.5147
Fitting elbow	52.5070
USB A-to-B cable	67.1032

Table 4: Packing List (accessories)

Description	Part Number
Certificate of Calibration	N/A
Plastic syringe, 20 mL (5 each)	17.5133
Test cells (pkg of 12); 25 mm OD × 150 mm, rimless	9725-F84
USB drive (containing software & Operation Manual)	N/A
Viscosity reference standard CL 160, 500 mL	9727-N12.016

2. Inspect materials for defects and shipping damage. Contact your CANNON representative to resolve any issues.

Setup the TESC-2983

The TESC 2983 ships partially disassembled. Assembly is simple and quick; all components required are shipped with the unit. See Table 5 for tools and materials needed and Figure 1 for an overview of assembled unit.

Table 5: Tools and Materials for Setup

Description
$\frac{3}{32}$ " Allen wrench
Base Unit
Head Unit
MAINS AC pass-through power cable
MAINS AC power cable
Mounting collar
Retaining ring
Retaining screws (4)



Figure 1: Assembled TESC-2983

Attach the Head Unit

Assemble the TESC-2983 on a secure, level surface. The Head Unit sits on top of the TESC Base Unit and is braced on a bracket frame. Simple installation consists of installing the Head Unit onto the bracket frame and then inserting the cables.

1. Remove and save all four screws holding the retaining ring to the mounting collar using a $\frac{3}{32}$ " Allen wrench. See Figure 2.

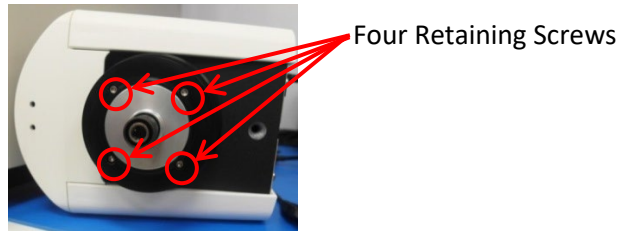


Figure 2: Head Unit Retaining Screws

2. Remove the retaining ring, keeping the mounting collar on the Head Unit. See Figure 3.



Figure 3: Removing Retaining Ring from Mounting Collar

3. Place Head Unit and mounting collar on the bracket frame in the installation hole. See Figure 4.



Figure 4: Head Unit on Bracket Frame

4. Attach the retaining ring to the mounting collar with the previously removed screws, with the bevel of the retaining ring facing outwards. See Figure 5.

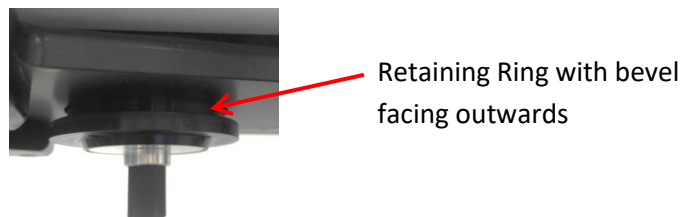


Figure 5: Collar

Connect Cables

All primary cables are shipped with the TESC-2983.

1. Verify that the Head Unit power switch is off. See Figure 6 for switch location.



Caution: *The MAINS AC pass-through connector on the Base Unit is not controlled by the TESC-2983 ON/OFF switch. Whenever the Base Unit is plugged in, power will be passed to the Head Unit.*

2. Verify that the Base Unit power switch is off. See Figure 7 for power switch placement.
3. Connect the MAINS AC pass-through power cable from the Head Unit to the Base Unit. See Figure 6 and Figure 7.
4. Connect the RTD probe from the Base Unit to the socket on the back of the Head Unit. See Figure 6.
5. Connect the MAINS AC power cable to the Base Unit and a MAINS AC outlet. See Figure 6.

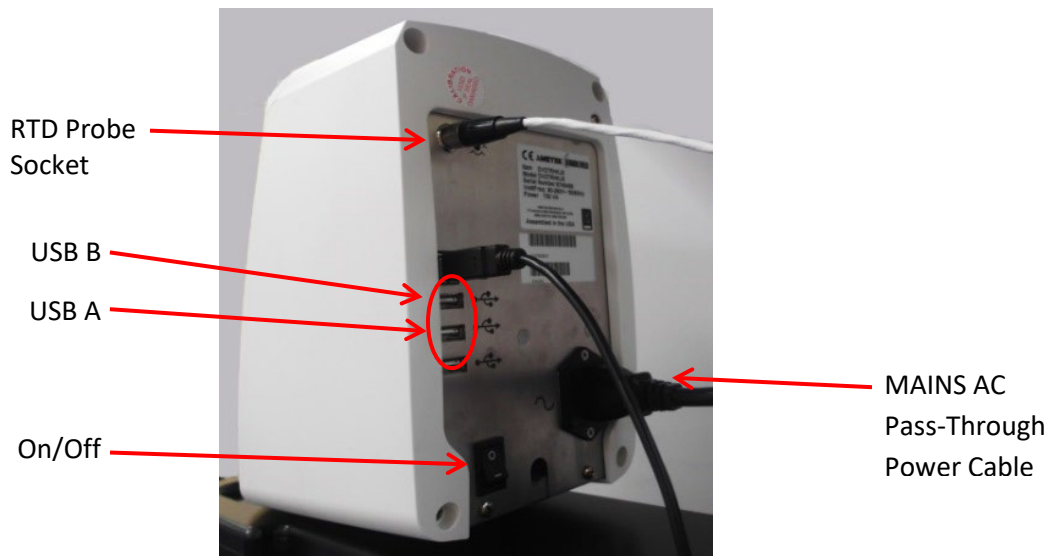


Figure 6: Head Unit Connections



Figure 7: Base Unit Connections

Level Unit

Ensure the TESC-2983 is level by verifying that the bubble level, located on the front, is in the center of the circle. If not, adjust the screw legs to level instrument as necessary. See Figure 8.



Figure 8: Bubble Level and Levelling Legs on TESC-2983




















Base Unit Touch Encoder

The base unit is controlled by an intuitive, easy-to-use touch encoder. Simply tap the touchscreen or turn the dial to easily navigate through menus and options. See Figure 9 for touch encoder overview and refer to Table 6 for descriptions of the icons you will encounter.



Figure 9: Touch Encoder

Table 6: Touch Encoder Icon Descriptions

Icon	Description	Icon	Description
	Add		Run
	Back to Last Screen		Save
	Calibration		Stop
	Calibration Offset		Switch Test Temperatures
	Cancel		Temperature Current
	Confirm		Temperature Set Point
	Edit		Temperature Target
	Menu		Temperature Test
	Remove		Test Method/ Version Information
	Rotate Screen for More Options		

Running Quick Verification Test

This test verifies calibration and provides a technician with basic training in operating the TESC-2983. See Table 7 for tools and materials required.

Table 7: Tools and Materials Required

Description	Description
Assembled TESC-2983	20 mL reference sample
25 mm × 150 mm rimless test tube	#4B2 insulated spindle
Sample preparation materials	USB flash drive with program files

1. Turn on Head Unit and Base Unit.
2. Auto Zero Head Unit
 - a. Remove spindle (if present).
 - b. Lower viscometer to measurement position.
 - c. Ensure TESC-2983 is level.
 - d. On Head Unit, from the **Auto Zero** Screen, press **Next**. See Figure 10.

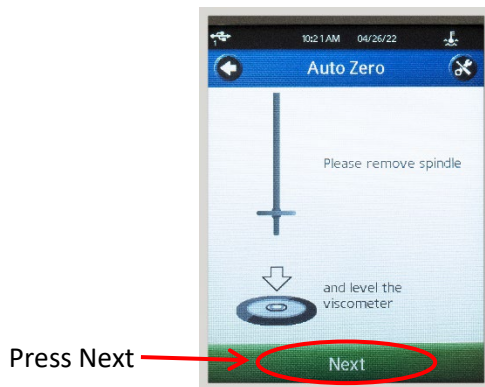


Figure 10: Auto Zero Screen

3. When **Auto Zero** is complete, select **Next** and raise head unit. See Figure 11.

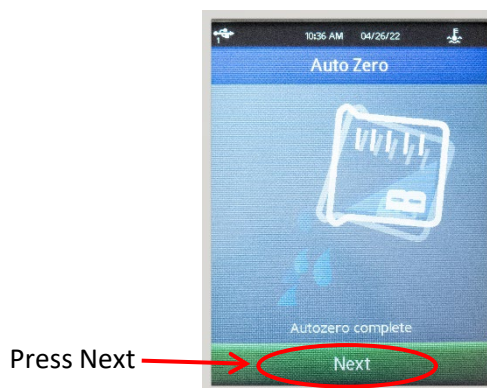


Figure 11: Auto Zero Complete Screen

4. Prepare a 20 mL sample according to your laboratory practices. See Sample Preparation for information.
 - a. Insert a 25 mm x 150 mm test tube containing 20 mL (± 0.2 mL) of the reference sample in the test chamber and gently hand-tighten the cone ring.
 - b. Attach a clean #4B2 spindle to the viscometer.
 - c. Carefully lower head unit into measurement position.

5. On the Base Unit, press the **Home** button to go to the main menu screen. See Figure 12.

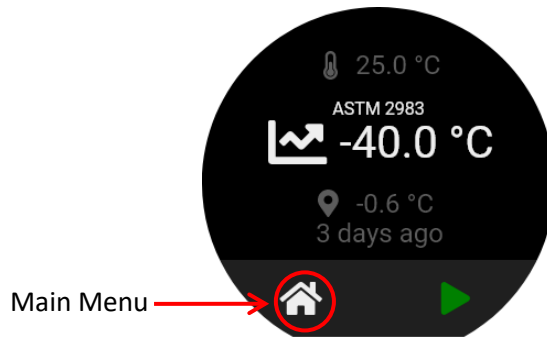


Figure 12: Home Screen of Base Unit

6. Rotate Base Unit controller so the **Calibration** button is in the ready to selection position. See Figure 13.

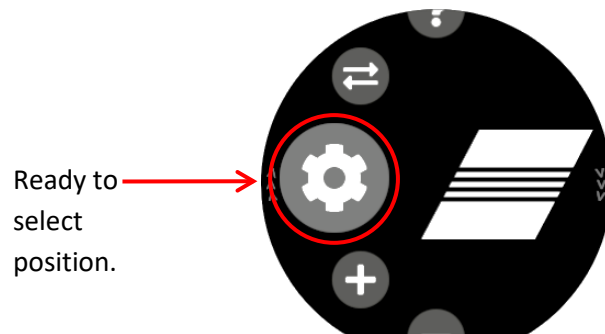


Figure 13: Ready to Select Position

7. At the same time, press **Run** on the Head Unit and the **Calibration** button on the Base Unit. See Figure 14.

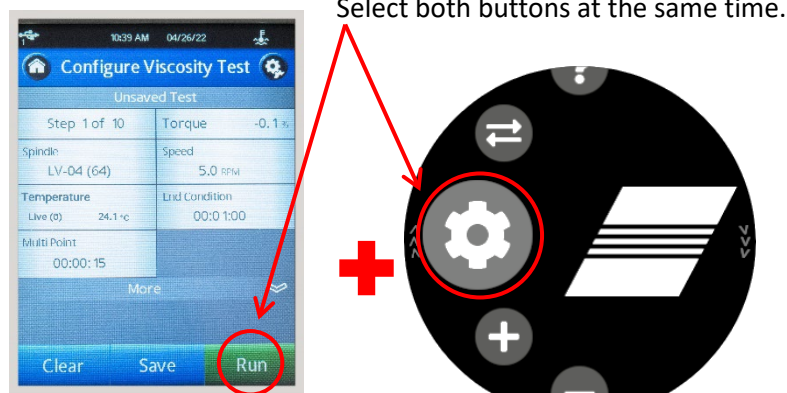


Figure 14: Begin Calibration

- Screens will indicate the calibration is in progress on both the Head Unit and Base Unit. See Figure 15.

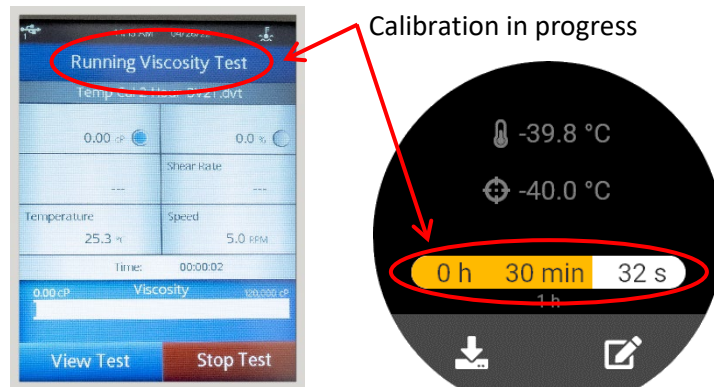


Figure 15: Calibration in Progress

- After the progress bar on the Base Unit completes, the Head Unit will continue running the calibration for less than half an hour. You will know when both are complete when you see the **Run** button on the Head Unit and **Ready** button on the Base Unit. See Figure 16.



Figure 16: First Phase of Calibration Complete



Note: The two hour Head Unit calibration program waits about two hours for the temperature of the sample to stabilize, then it runs a viscometric test. After the two hour soak and initial test, only one hour is required between tests for small temperature adjustments to stabilize.



Note: The temperature displayed on the Head Unit may differ from the Base Unit. Refer to the Base Unit display for the calibrated temperature.

- When the Head Unit test completes, review the results by scrolling through the step results. Take note of the measured viscosity at the highest torque reading and the calibrated viscosity of the sample at this temperature.

11. Press the back button on the TESC Base Unit to return to the home screen. See Figure 17.

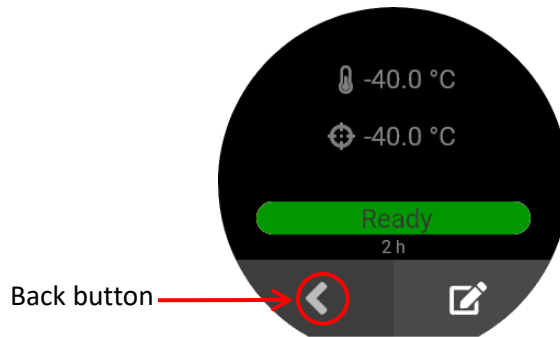


Figure 17: How to Exit out of Calibration

12. On the home screen, the current temperature is displayed. See Figure 18.

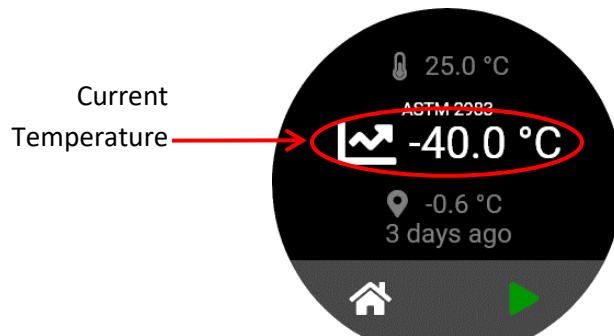


Figure 18: Home Screen of the Base Unit

13. The TESC Base Unit is set to return the TESC-2983 to 25 °C after verification is finished.



Warning: Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Sample temperature will lag behind the temperature displayed on the Base Unit (TE cooler block temperature). Wait approximately 30 minutes after the controller reaches the target temperature before handling the sample. See your lab safety standards for more information.

14. When the sample is at a safe handling temperature, raise the Head Unit, remove and clean the spindle and test tube.



Running an ASTM D2983/D8210 Test

This procedure runs sample conditioning programs and viscosity tests designed to meet ASTM methods D2983 and D8210. See Table 8 for tools and materials required.

Table 8: Tools and Materials Required

Description
Assembled TESC-2983
25 mm × 150 mm rimless test tube
Sample preparation materials
20 mL sample to be tested
#4B2 insulated spindle

Sample Preparation

1. Fill the rimless test tube with 20 mL of sample oil and carefully place it in the TESC sample chamber, ensuring the orange O-ring is not displaced during sample insertion. See Figure 19.

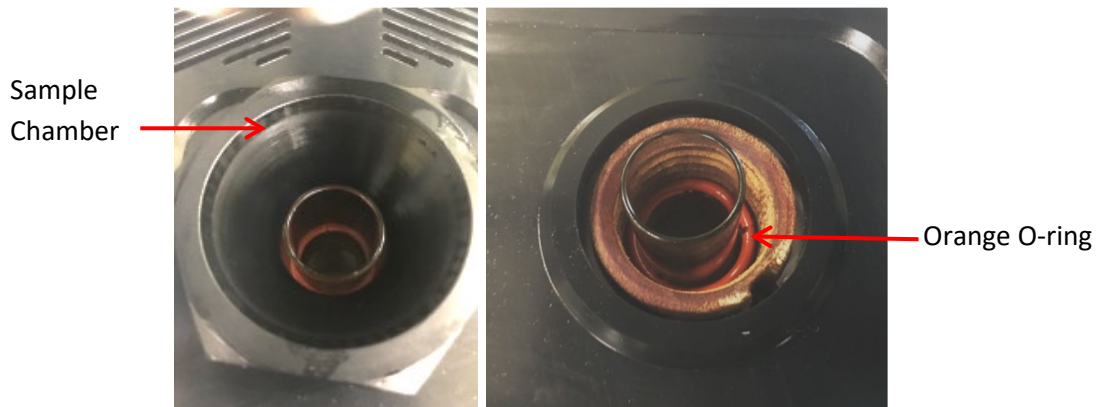


Figure 19: TESC Base Unit Sample Chamber with Support Ring and Orange O- Ring

2. Screw down the support ring into the sample chamber as follows:



Caution: Do not overtighten the support ring. Hand-tighten only. Tighten the support ring until the test tube can no longer move in the chamber, and then gently hand-tighten another quarter-turn.

- a. Hold the test tube down while turning the retaining ring clockwise until resistance is felt.
 - b. Hand-tighten an additional ¼ turn. Do not overtighten.
3. Turn on Head Unit and Base Unit. At this point, the spindle is not attached to the head or in the unit at all.

4. Verify the TESC-2983 is level. See **Level Unit** for more information.
5. Press **Next** on the **Auto Zero** screen to start the auto-zero process. See Figure 10.
6. When the Auto Zero process is complete, press the green **Next** button. See Figure 11.
7. Attach #4B2 spindle to the Head Unit. See Figure 20.



Figure 20: Spindle Placement

8. Next, the **Configure Viscosity Test** screen appears. Press the **Home** button on the top left corner to access the Main Menu. See Figure 21.

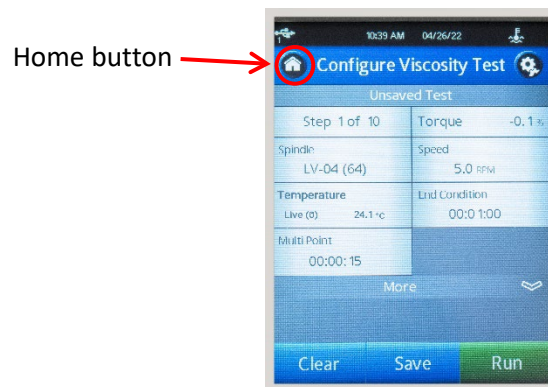


Figure 21: Home Button

9. From the Main Menu, press the **Load Test** button. See Figure 22.

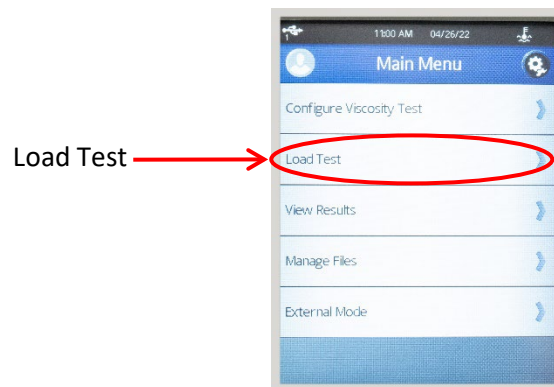


Figure 22: Main Menu

10. Press the **Viscosity Tests** button. See Figure 23.

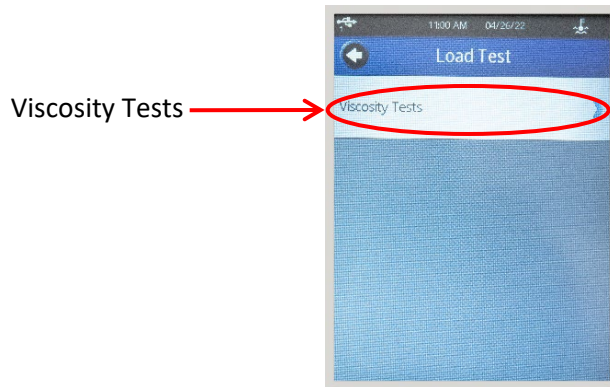


Figure 23: Load Tests Screen

11. Press the appropriate viscosity measurement program based on how you will use this sample. All TESC programs are preloaded by CANNON onto the Head Unit during the manufacturing process. Backup copies are available on the USB flash drive. See Table 9 for the Internal Memory programs and descriptions.

Table 9: ASTM D2983 Viscometer Programs on Head Unit

Program Name	Test Time	Description
D2983-Visc-17hr.dvt	16 hours 39 minutes	Running a sample
D8210-Visc-6hr.dvt	6 hours 33 minutes	Special circumstances
Temp Cal 2 Hour DV2T.dvt	2 hours 13 minutes	Calibration or verification
Temp Cal 1 Hour DV2T.dvt	1 hour 25 minutes	The calibration procedure will instruct you to load this program at the proper time.



Note: *The temperature program of the Base Unit does not last the same amount of time as the Head Unit.*



Note: *If your lab is in Germany, your unit will come with potentially multiple programs to test DIN 51398, named with the test temperature in the program name. These programs take a variable amount of time based on the test temperature.*

12. From the Configure Viscosity Test screen, press the **Settings** button on the top right corner. See Figure 24.

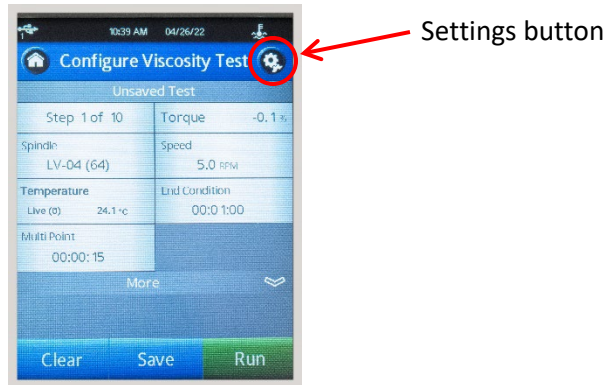


Figure 24: Settings Button

13. Press the **Device Setup** button. See Figure 25.

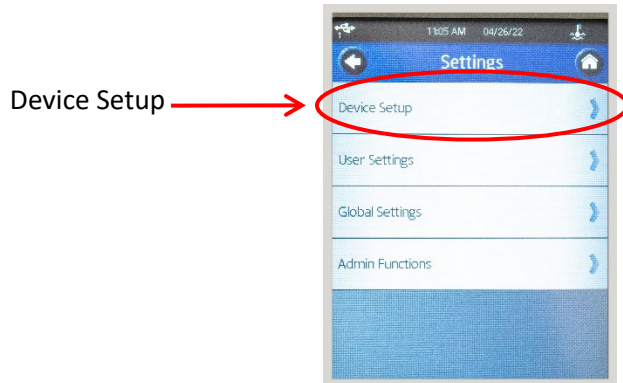


Figure 25: Settings Screen

14. Press the **Temperature** button. See Figure 26.

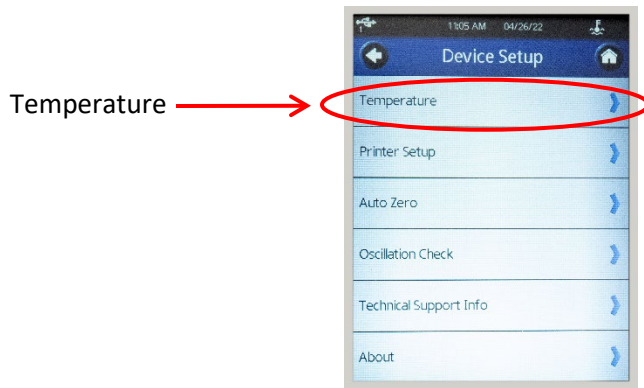


Figure 26: Device Setup Screen

15. Determine your target test temperature. The test temperature should be chosen according to the characteristics of the sample you are using to test or calibrate. See Table 10.

Table 10: Commonly Used Temperatures

Test Temp	Description
0 °C	
-5 °C	
-10 °C	ATF, hydraulic, etc.
-12 °C	Gear oils
-15 °C	
-17.8 °C	
-18 °C	
-20 °C	ATF, hydraulic, etc.
-23.3 °C	
-25 °C	
-26 °C	Gear oils
-30 °C	ATF, hydraulic, etc.
-35 °C	
-40 °C	Gear oil, ATF, hydraulic, etc.



Note: *The temperature offset is unique at each test temperature; the offset for -40 °C may not be the same offset for -26 °C. This applies to both the Base and Head Units. Each temperature must be calibrated before use during a test.*

16. Select the appropriate temperature offset by pressing the middle or left side of the label with the test temperature in its name. A blue dot will appear on the left side of the label to show it is selected. See Figure 27.

Blue dot indicates row is selected.

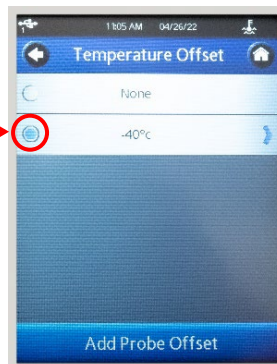


Figure 27: Temperature Offset Screen

17. If you were able to choose the correct offset temperature, continue to Step 0.

If there is no offset for the temperature displayed, then the unit has not been calibrated to this temperature

a. Press **Add Probe Offset**. See Figure 28.

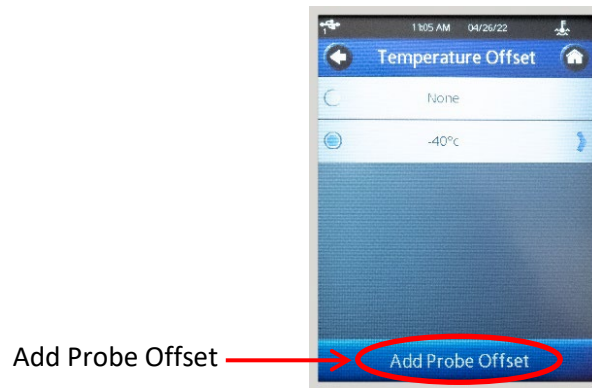


Figure 28: Screen to Change Temperature Offset Name and Value

b. This opens a screen where you can change the temperature offset name or value. First, press **Name**. Then enter the name which includes the associated test temperature, such as **-30 °C Offset**. Next, press **Ok**. See Figure 29.

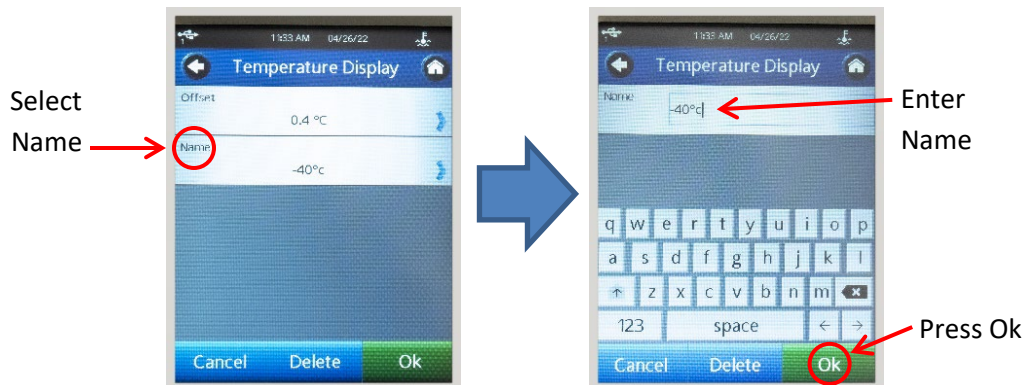



Figure 29: Add/Change Temperature Offset Name

c. Press **Ok** again to return to the Temperature Offset Screen.

d. You may now select the newly created temperature offset by pressing the middle or left side of the label. A blue dot will appear on the left side of the label to show it is selected. See Figure 27.

18. Now that the appropriate offset is selected, press the **Back** button , three times to return to the Main Menu and select **Configure Viscosity Test**. See Figure 30.

Configure
Viscosity Test

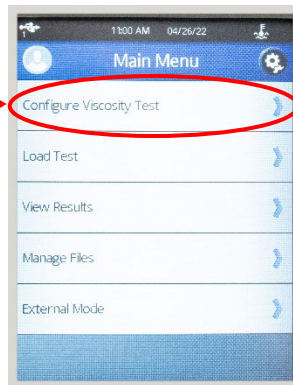


Figure 30: Main Menu of the Head Unit

19. This returns you to the home screen of the Head Unit. See Figure 31.

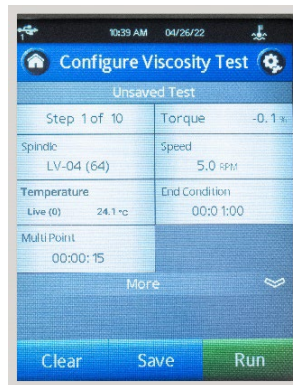


Figure 31: Home Screen of the Head Unit

20. Next, turn your attention to the Base Unit display. See Figure 32.

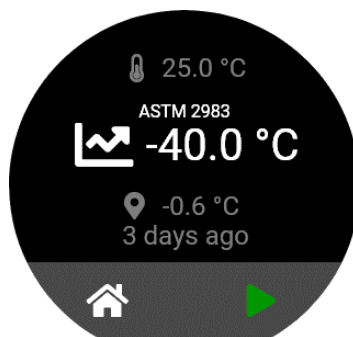


Figure 32: Home screen of the Base Unit

21. Ensure the test temperature is the one you intend to run. If it is, check that the last calibration did not occur later than your laboratory's calibration policy. If the calibration is too old, please recalibrate following the procedure in **Calibrating the TESC-2983**.

22. If you kept records of the latest Base Unit temperature offset for this test temperature, ensure that your records match the display. If not, it is recommended to recalibrate by following the procedure in section **Calibrating the TESC-2983**.
23. If the temperature is correct, the calibration is not old, and the offset matches your records, then you have finished sample preparation. Depending on how you arrived at this procedure, return to one of the following:
 - a. Step 0 of **Running a Sample**.
 - b. Step 1 of **TESC-2983 Calibration Part One**.

If the test temperature is not the one you want, you must change it to the proper test temperature. Continue to the next step of this procedure.

24. First, press the menu button. See Figure 33.

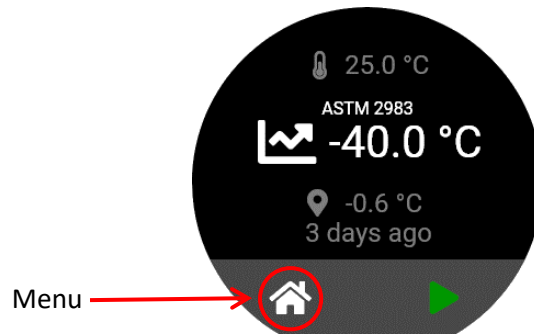


Figure 33: Menu Button

25. Rotate the Base Unit controller and scroll to the **Switch Test Temperatures** button. Press to select. See Figure 34.

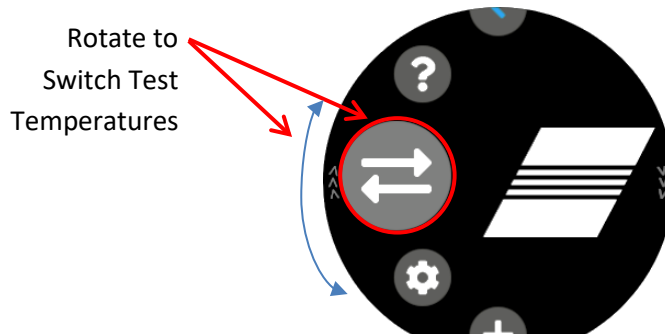


Figure 34: Switch Test Temperatures Button on Main Menu

26. Rotate the Base Unit controller to scroll to the test temperature you want. See Figure 35.

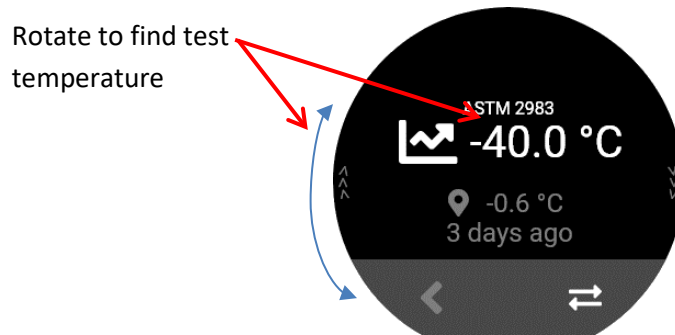


Figure 35: Switch Test Temperatures Screen

27. If you find the temperature you want, press the **Switch Test Temperatures** button. See Figure 36. This will bring you back to the home screen. You have now finished sample preparation.

- a. Return to **Running a Sample**.
- b. Or, step 2 of **Running Quick Verification Test**.
- c. Or, **TESC-2983 Calibration Part One**.

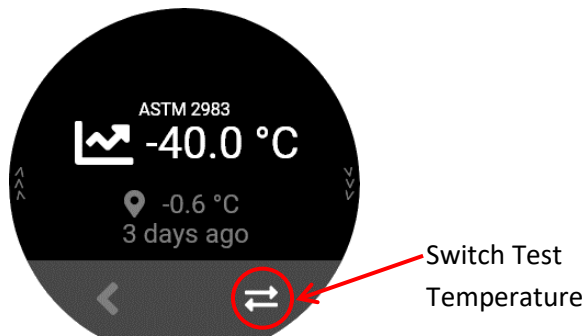


Figure 36: Select Switch Test Temperature

28. If the temperature you want is not in the list, then this unit has never used that temperature. Press the back button to return to the menu. Rotate the Base Unit controller and scroll to **Add Test Temperature** button. Press to select. See Figure 37.

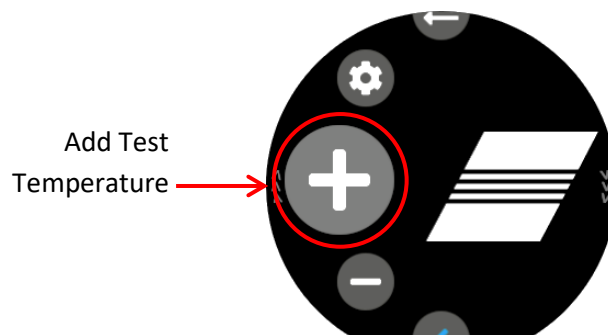


Figure 37: Add Test Temperature Button on Main Menu

29. Select tens digit by tapping **x10**. Then, rotate dial to your desired test temperature. Rotate clockwise for positive temperatures and counter-clockwise for negative temperatures. See Figure 38.

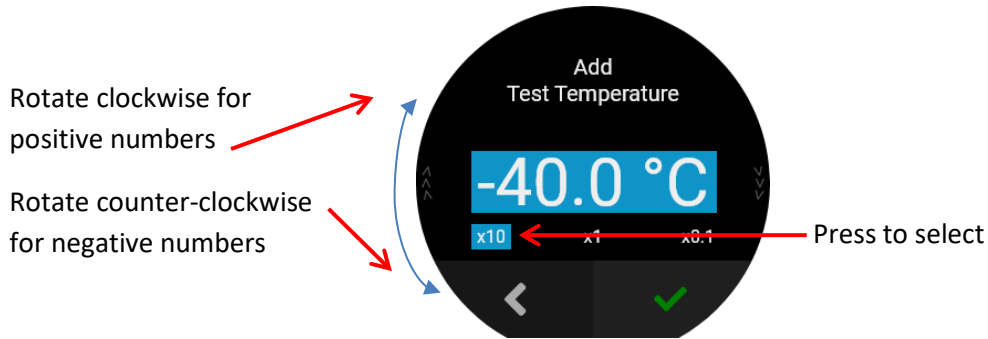


Figure 38: Add Test Temperature Screen with Tens Digit Selected

30. Continue by selecting the ones digit icon **x1** and rotating to desired temperature. See Figure 39.

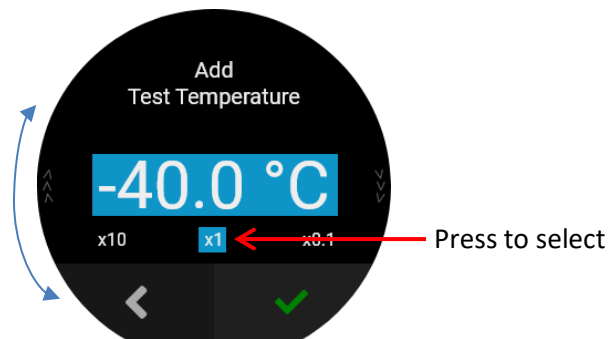


Figure 39: Add Test Temperature Screen with Ones Digit Selected

31. Repeat again for tenths digit using **x0.1**. When finished, press the green check mark to confirm test temperature. See Figure 40.

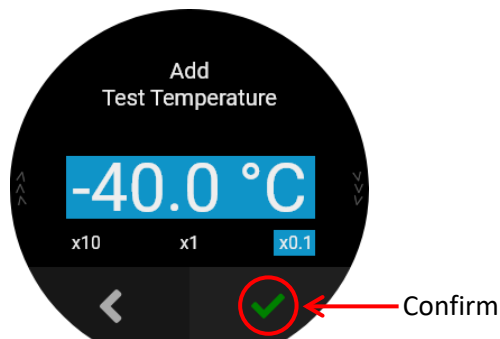


Figure 40: Add Test Temperature Screen with Tenths Digit Selected

32. This new temperature will need to be calibrated. Follow the procedure as outlined in **Calibrating the TESC-2983**.

Choose Test Method

The default test method is set to ASTM 2983. To change your test method to ASTM D8210 or DIN 51398, follow the directions below.

1. On the Base Unit, press the **Home** button to open main menu screen. See Figure 41.

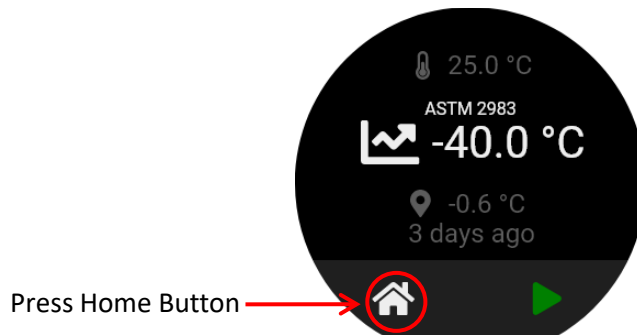


Figure 41: Choose Home Button

2. Rotate the Base Unit controller to **Test Method/Version Information** and press to select. See Figure 42.

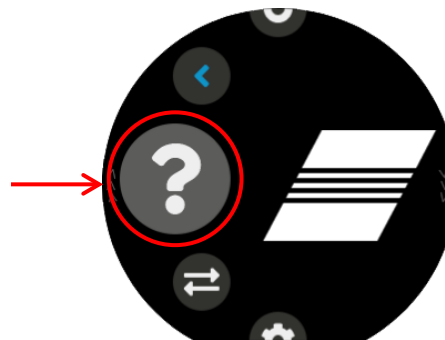


Figure 42: Test Method/Version Information

3. Tap screen 3 times and **Test Method Option** screen will open.
4. Choose appropriate test method and press green checkmark to confirm choice. The new method chosen will remain as the default method on your unit until this process is repeated and a new method is chosen. See Figure 43.

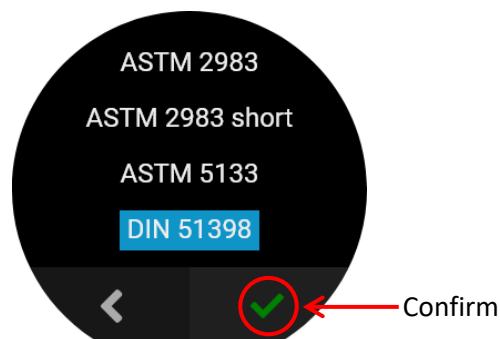


Figure 43: Confirm Test Method

Running a Sample

1. Follow the procedure in section **Sample Preparation** to load **D2983-Visc-17hr.dvt** and the temperature offset associated with the test temperature onto the Head Unit.

After the Sample Preparation is complete, you will be on the home screen of both the Head Unit and Base Unit. Pressing both buttons at the same time, select **Run** on the Head Unit and the Base Unit. See Figure 44.

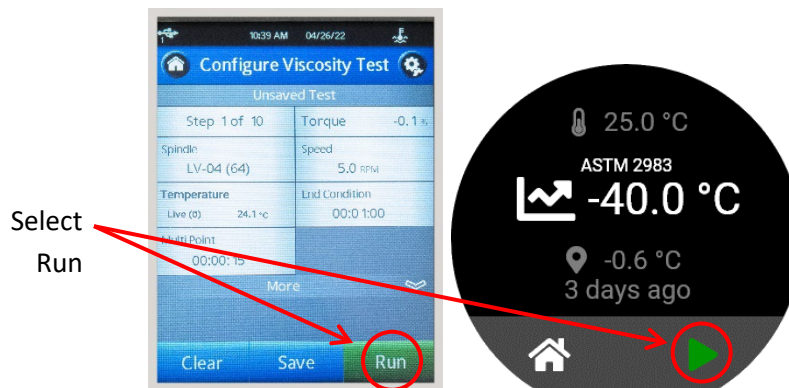


Figure 44: Select Run from Home Screens of Head and Base Unit

2. You will see screens indicating that the test is in progress on both the Base and Head Units. See Figure 45.



Figure 45: Test in Progress Screens

3. When the Head Unit completes, although the Base Unit will still be running, you can review the results by scrolling through the step results on the Head Unit.
4. To save the test data from the Head Unit:
 - a. Click **Save**.
 - b. If necessary, click **Path** and adjust the path to which the data saves.
 - c. If necessary, click **File Type** and change the file type.
 - d. Click **Save**.

5. Testing using the Head Unit is complete. Click the **Main Menu** icon in the upper-left corner of the screen of the Head Unit and click **No** when a dialog box prompts you to save the data.
6. The Base Unit will still be running; the thermal conditioning program is set to return the TESC-2983 to 25 °C after viscometer measurements are complete.



Warning: *Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Sample temperature will lag behind the temperature displayed by the Base Unit (TE cooler block temperature). Wait approximately 30 minutes after the controller reaches the target temperature before handling the sample. See your lab safety standards for more information.*

7. When the sample is at a safe handling temperature, raise the Head Unit, remove and clean the spindle and test tube.



Calibrating the TESC-2983

Cannon Instrument Company calibrates all TESC instruments as part of the manufacturing process. However, due to factors such as ambient lab temperature, small adjustments of ±0.1 °C may be necessary to fine tune the temperature setting. In the case that you need to calibrate, follow the steps in this section to ensure proper operation and results. See Table 11 for tools and materials required.

Note: *If desired, the actual temperature of the sample may be determined using a viscosity calculation tool, such as VISDISK® (supplied by CANNON). Then, the following formula can be applied to find the new temperature offset of the Base Unit.*



$$\text{new offset} = \text{current offset} + \left(\frac{\text{actual viscosity} - \text{tested viscosity}}{\text{Rate} \times 10} \right)$$

Where:

Rate of viscosity response to temperature change:

125 mPa(s) per 0.1 °C for CL160 at -40 °C

120 mPa(s) per 0.1 °C for CL280 at -26 °C

Table 11: Tools and Materials Required

Description	Description
Assembled TESC-2983	20 mL of an appropriate reference sample
25 mm × 150 mm rimless test tube	#4B2 insulated spindle
Sample preparation materials	USB flash drive with program files

TESC-2983 Calibration Part One

The TESC Base Unit must be calibrated before adjusting the temperature probe offset of the Head Unit.

1. First, follow the procedure in section **Sample Preparation** to load **Temp Cal 2 Hour DV2T.dvt** onto the Head Unit.
2. On the Base Unit, press the **Home** button to go to the main menu screen. See Figure 46.

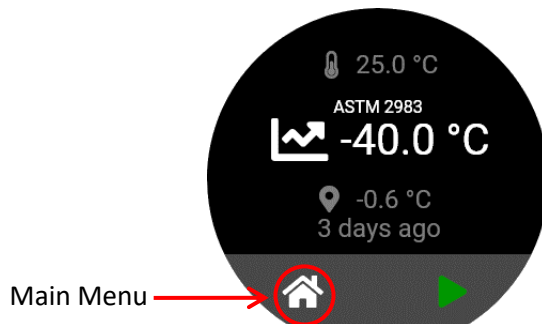


Figure 46: Home Screen of the Base Unit

3. Rotate the Base Unit controller and scroll so the **Calibration** button is in the ready to selection position. See Figure 47.

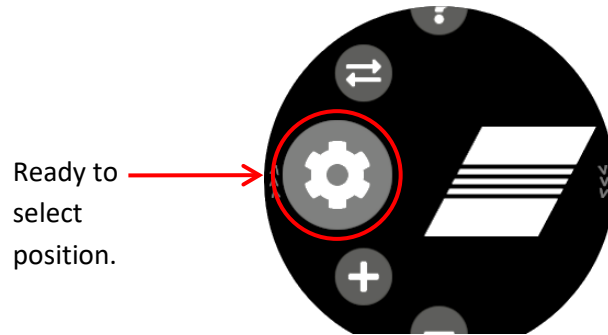


Figure 47: Ready to Select Position

4. At same time, press **Run** on the Head Unit and the calibration button on the Base Unit. See Figure 48.

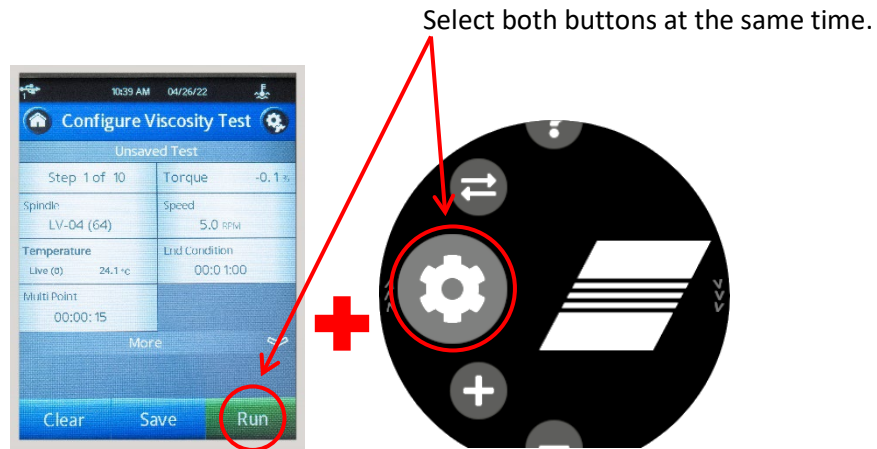


Figure 48: Screens on the Base and Head Units to Begin Calibration

5. You will see screens indicating that the calibration is in progress on both the Head Unit and Base Unit. See Figure 49.

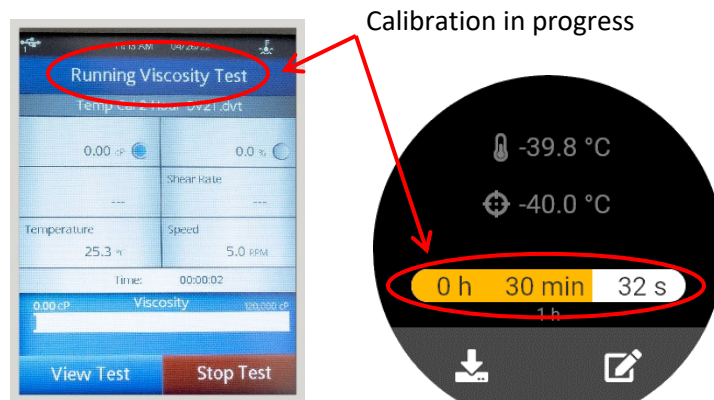


Figure 49: First Phase of Calibration Screens

- After the progress bar on the Base Unit completes, the Head Unit will continue running the calibration for less than half an hour. You will know when both are complete when you see the **Run** button on the Head Unit and **Ready** button on the Base Unit. See Figure 50.

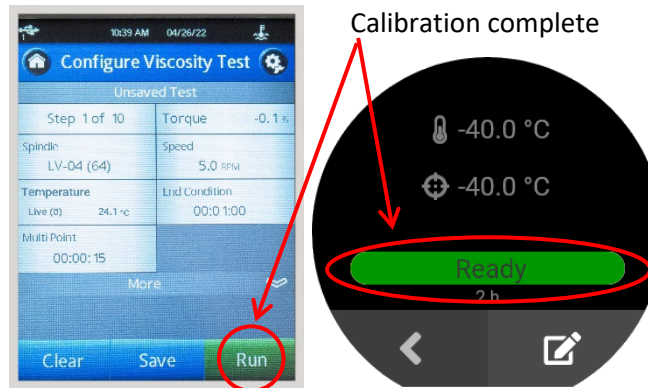


Figure 50: First Phase of Calibration Complete



Note: The two hour Head Unit calibration program waits about two hours for the temperature of the sample to stabilize, then it runs a viscometric test. After the two hour soak and initial test, only one hour is required between tests for small temperature adjustments to stabilize.



Note: The temperature displayed on the Head Unit may differ from the Base Unit. Refer to the Base Unit display for the calibrated temperature.

- When the Head Unit test completes, review the results by scrolling through the step results. Take note of the measured viscosity at the highest torque reading and the calibrated viscosity of the sample at this temperature.
- Press the **Edit** button on the Base Unit to edit the temperature offset. When you enter this screen, the current calibration offset will be shown on top, and that same number will be initially shown highlighted as the new offset. Press **Confirm**. See Figure 51.

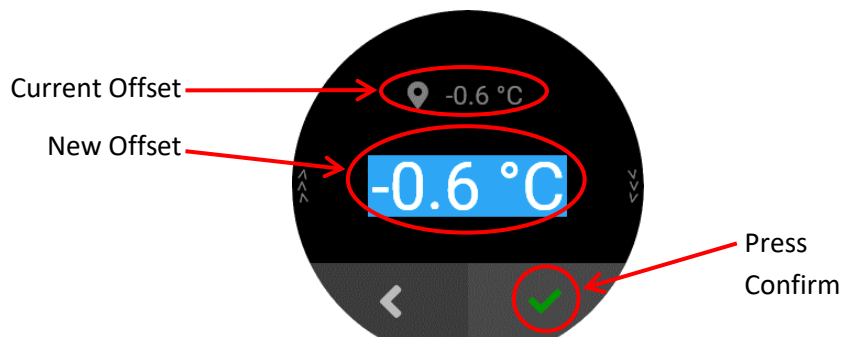


Figure 51: Screen to Edit the Calibration Offset

9. Compare the measured viscosity to the certified viscosity of the sample.
 - a. If the measured viscosity is within the tolerance range of the calibrated viscosity of the sample, the temperature of the sample is correct. Skip to step 12 of this section.
 - b. If the measured viscosity is higher than the calibrated viscosity, then the temperature of the sample is lower than the target temperature. Rotate the TESC controller counter-clockwise to subtract 0.1 °C from the highlighted new offset.
 - c. If the measured viscosity is lower than the calibrated viscosity, then the temperature of the sample is higher than the target temperature. Rotate the TESC controller counter-clockwise to add 0.1 °C to the highlighted new offset.
10. Press **Save** on the base unit to save the new offset. See Figure 52.

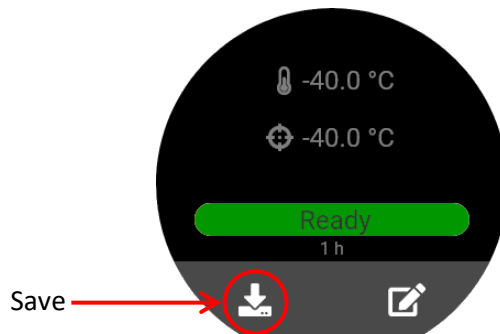


Figure 52: Save Temperature Offset

11. Load the **Temp Cal 1 Hour DV2T.dvt** program and repeat steps 4–10 of this procedure.
12. Verify the new offset entered matches the current offset. Press the **Confirm**. See Figure 53.

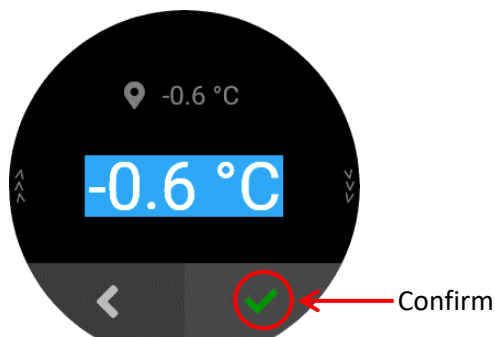


Figure 53: Confirm New Temperature Offset

13. Continue to **TESC-2983 Calibration Part Two**.

TESC-2983 Calibration Part Two

Use the following procedure to adjust temperature offset of the Head Unit and complete the TESC-2983 calibration. The temperature probe offset is the difference between the temperature displayed by the Head Unit and the Base Unit.



Note: Generated reports saved or printed from the Head Unit do not indicate the offset.



Note: Because the TESC-2983 is calibrated during manufacturing, only small adjustments of ± 0.1 °C are necessary to fine tune the temperature setting. If desired, the following formula can be applied to find the new temperature offset of the Head Unit.

$$\text{new offset} = \text{current offset} + \text{test temperature}$$

1. For your own record keeping, we recommended to record the Base Unit Serial Number, Head Unit Serial Number, Head Unit Probe Offset Label, and Head Unit Offset Value, Base Unit Offset Value, and associated Test Temperature.
 - a. The Head Unit and Base Unit serial numbers can be found on a sticker the back of the respective units.
 - b. The Head Unit offset label and offset value can be found by following steps 3-8. To get back to the home screen, follow step 10.
 - c. The Base Unit offset value can be found on the Base Unit home screen.
2. On the Head Unit, take note of the temperature reading; it will be used in later steps. See Figure 54.

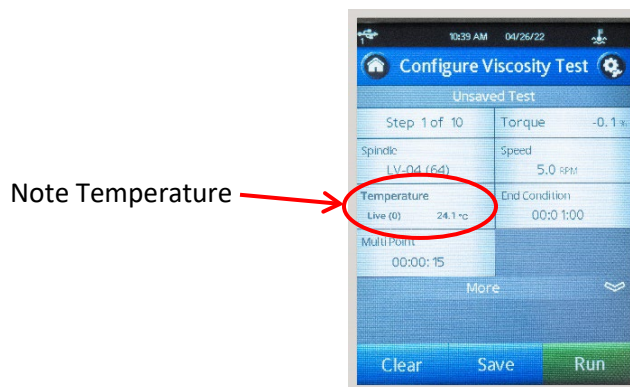


Figure 54: Configure Viscosity Test Screen

3. If this temperature is exactly equal to the test temperature, then skip to step 12.

4. Press the **Settings** button on the top right corner. See Figure 55.

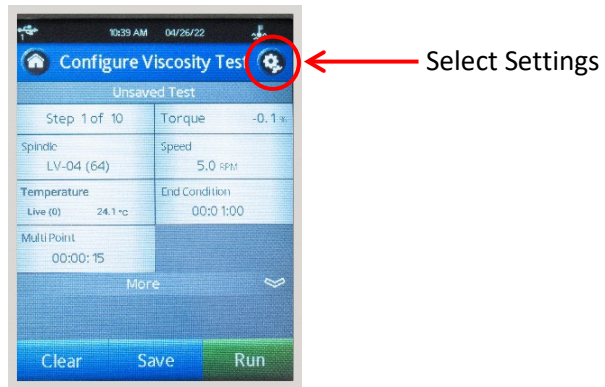


Figure 55: Select Settings

5. Press the **Device Setup** button. See Figure 56.

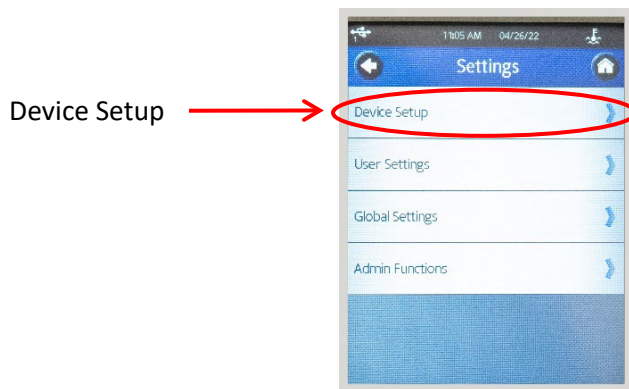


Figure 56: Settings Menu

6. Press the **Temperature** button. See Figure 57.

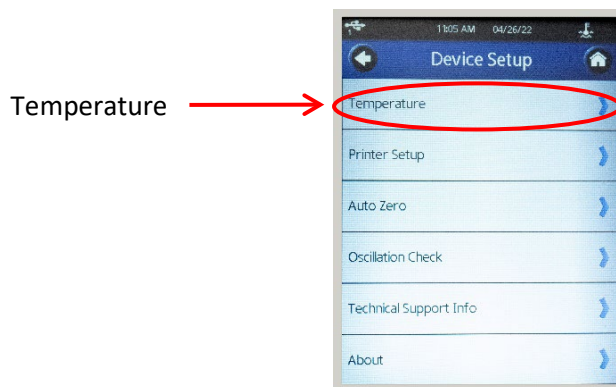


Figure 57: Device Setup Screen

7. A blue dot will be displayed to the left of the offset for this test temperature because you selected this offset during **Sample Preparation**. Press the right side of the offset label for this test temperature. See Figure 58.

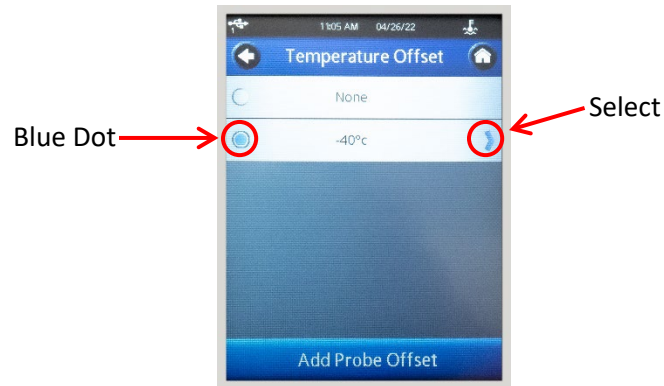


Figure 58: Temperature Offset Screen

8. This opens the screen where you can change the temperature offset name or value. See Figure 59.

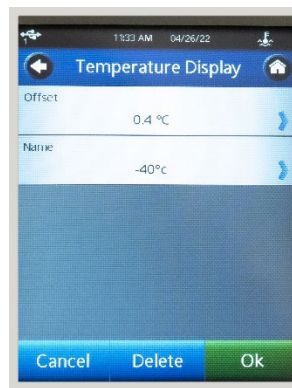


Figure 59: Screen to Change Temperature Offset Name and Value

9. After selecting **Offset**, you will see the current offset and a keypad to enter a new value. The new value will overwrite the previous value, so there is no need to press backspace to clear what was there. See Figure 60.
 - a. If the temperature you found in step 1 is colder than the test temperature, subtract 0.1 from the offset, and type in that new value.
 - b. If the temperature you found in step 1 is hotter than the test temperature, add 0.1 to the current offset, and type in that new value.
 - c. Press **Okay**.



Figure 60: Screen to Change Temperature Offset Value

10. Press back button three times, and then Configure Viscosity Test, to return to the home screen.
11. Verify that the temperature reading now matches the test temperature. If it does not, repeat steps 1–10.
12. On the Base Unit, press the **Save** button. See Figure 61.

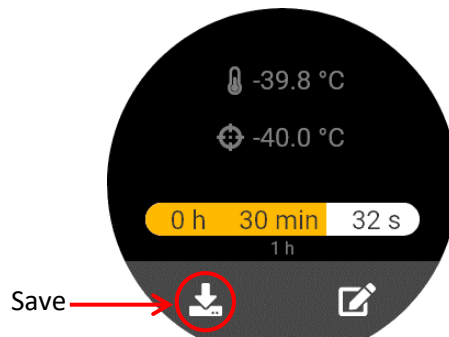


Figure 61: Base Unit Save Icon

13. The temperature offset of the Base Unit is now saved.
14. The TESC Base Unit is set to return the TESC-2983 to 25 °C after calibration is finished.



Warning: *Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Sample temperature will lag behind the temperature displayed by the Base Unit (TE cooler block temperature). Wait approximately 30 minutes after the controller reaches the target temperature before handling the sample. See your lab safety standards for more information.*

15. When the sample is at a safe handling temperature, raise the Head Unit, remove and clean the spindle and test tube.

Alternate Temperature Calibration Procedure

1. Follow the procedure in **Sample Preparation** to load [Temp Cal 2 Hour DV2T.dvt](#) onto the Head Unit.
2. Insert the temperature probe holder into the collar. See Figure 62.



Figure 62: Inserting Temperature Probe Holder into Collar

3. Insert the temperature probe into the probe holder. See Figure 63.



Figure 63: Temperature Probe inserted into Holder and Test Tube

4. Connect the temperature probe to the handheld meter.

5. Press the home button on the Base Unit to go to the main menu. See Figure 64.

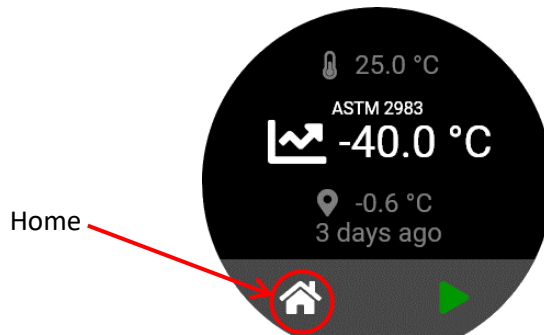


Figure 64: Press Home Button on Base Unit

6. Rotate the Base Unit controller and scroll to the **Calibration** button. Press to select. See Figure 65.

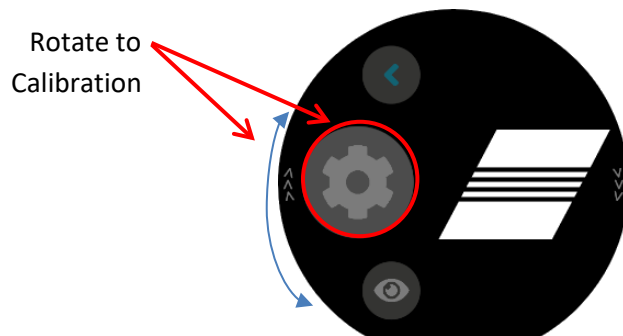


Figure 65: Main Menu after Scrolling to Calibration

7. You will see screens indicating that the calibration is in progress on both the Head Unit and Base Unit.
8. Wait 3 hours for the sample to reach test temperature and stabilize. The progress bar on the Base Unit may indicate a different time frame but wait the full 3 hours for the temperature to stabilize for this calibration.
9. Turn on the thermometer and read the displayed temperature.

10. Press the edit button on the Base Unit to edit the temperature offset. When you enter this screen, the current calibration offset will be shown on top, and that same number will be initially shown highlighted as the new offset. See Figure 66.

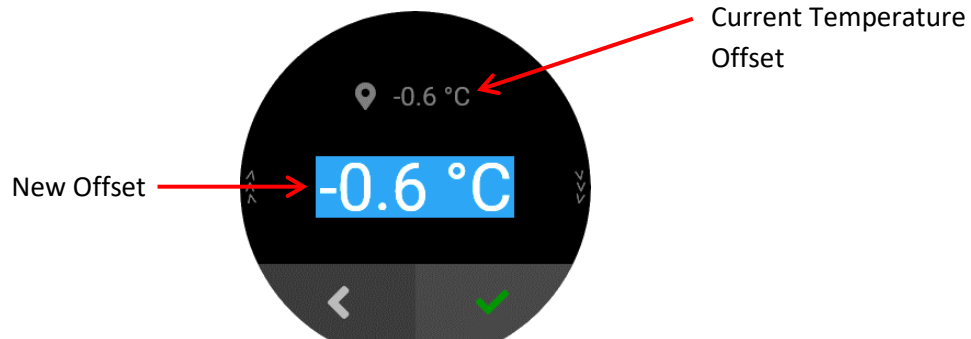


Figure 66: Calibration Offset Edit Screen

Note: Because the TESC-2983 is calibrated during manufacturing, only small adjustments of ± 0.1 °C are necessary to fine-tune the temperature setting.

If desired, the actual temperature of the sample may be determined using the following equation:

$$\text{new offset} = \text{current offset} + \text{thermometer reading} - \text{test temperature}$$



Example:

$$\text{current offset} = -0.6 \text{ °C}$$

$$\text{thermometer reading} = -30.4 \text{ °C}$$

$$\text{test temperature} = -30.0 \text{ °C}$$

$$\text{new offset} = (\text{current offset}) + (\text{test temperature}) - (\text{thermometer reading})$$

$$\text{new offset} = (-0.6 \text{ °C}) + (-30.4 \text{ °C}) - (-30.0 \text{ °C})$$

$$\text{new offset} = -1.0 \text{ °C}$$

11. Compare the thermometer reading to the test temperature.
 - a. If the thermometer temperature shows the sample is the test temperature, the temperature of the sample is correct. Calibration is complete, go to step 13.
 - b. If the thermometer temperature shows the sample is warmer than the test temperature, then rotate the TESC controller counter-clockwise to subtract 0.1 °C from the highlighted new offset.
 - c. If the thermometer temperature shows the sample is colder than the test temperature, then rotate the TESC controller clockwise to add 0.1 °C to the highlighted new offset.
12. Verify the new offset entered matches the current offset. Press the **Confirm**. See Figure 53.
13. Complete calibration under **TESC-2983 Calibration Part Two**.



Warranty

Products Limited Warranty

In addition to other manufacturers' warranties, Cannon Instrument Company ("the Company") warrants all products (other than reagents and chemicals) delivered to and retained by their original purchasers to be free from defect in material and workmanship for one year from the date of the Company's invoice to the purchaser. For a period of one year from the date of such invoice, the Company will correct, either by repair or replacement at the Company's sole discretion, any defect in material or workmanship (not including defects due to misuse, abuse, abnormal conditions or operation, accident or acts of God, or to service or modification of the product without prior authorization of the Company) without charge for parts and labor. The determination of whether any product has been subject to misuse or abuse will be made solely by the Company. For repairs and service of the Brookfield DV2T Head Unit and associated accessories, contact Brookfield Engineering.

The Company shall not be liable for any special, incidental, or consequential damages, or any damage to plant, personnel, equipment or products, directly or indirectly resulting from the use or misuse of any product. Representations and warranties made by any person, including dealers and representatives of the Company, which are inconsistent, in conflict with, or in excess of the terms of this warranty shall not be binding upon the Company unless placed in writing and approved by an officer of the Company.

Reagent and Chemical Warranty

Cannon Instrument Company ("the Company") warrants all reagents and chemicals sold by the Company and delivered to and retained by their original purchasers to conform to the weight, specifications and standards stated on the package. The Company will, at its sole discretion, either replace or refund the price (net of freight, handling charges and taxes), of any reagent or chemical sold by the Company which does not conform to such weight, specifications and standards upon the prompt return of the unused portion. Except for replacement or refund of the net price, the Company shall not be liable for any damages occurring as a consequence of the failure of any reagent or chemical sold by the Company to conform to the weight, specifications and standards stated on the package.

Returning a Product to CANNON

Before returning a CANNON product for repair or service, make every attempt to identify the problem. If, after careful checking, the problem remains unidentified or unsolved, telephone Cannon Instrument Company (or the local service agent) to consult with a product specialist. If the specialist cannot recommend a simple solution or repair, CANNON will authorize the return of the product through the issuance of a Return Authorization number (RA).

CANNON Telephone Number: 814-353-8000

Products returned to CANNON must be carefully packed. Ship prepaid to the following address:

CANNON Instrument Company
ATTN: Return Authorization # _____
2139 High Tech Road
State College, PA 16803 USA

Please include the following:

Required Information

- The Return Authorization number (RA).
- The name and telephone number of the person at your company to contact regarding the product.
- Shipping and billing instructions for the return of the product to your location.
- A detailed explanation of the reason for the return. If the product is not covered by warranty, the customer will be provided with an estimate of the repair costs and asked for approval before any repairs are made. The customer will be required to issue a purchase order for the cost of the repairs.

Hazardous Materials

Please contact CANNON before returning a product that could possibly contain hazardous material.

Shipping Notification

Products returned without CANNON's prior authorization, will not be accepted. The customer may be billed a testing fee if a product is returned to CANNON and found to be working properly.



CANNON INSTRUMENT COMPANY®

2139 High Tech Road | State College, PA 16803 | USA
800-676-6232 | 814-343-8000 | Fax: 814-353-8007
sales@cannoninstrument.com | www.cannoninstrument.com