

CANNON® TESC

Thermoelectric Sample Conditioner System
For low temperature viscosity of lubricants
ASTM D2983



TESC
Operator's Manual

Thermoelectric Sample Conditioner System Operator's Manual

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Overview

CANNON's Thermoelectric Sample Conditioner (TESC) System provides controlled sample heating and cooling for ASTM D2983. Low cost and a small footprint, compared to other sample conditioning options, allow several complete TESC Systems to be conveniently operated in the same bench-top area as a single competitor unit. This gives labs optimal test versatility and redundancy to maximize productivity and reduce downtime.

Theory of Operation

The TESC System uses a method equivalent to Procedure B of ASTM D2983. To reduce test variability, the TESC System automates or removes many of the steps required to transfer the sample between 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 System, an operator runs a D2983 test as follows:

1. Auto-zero the Brookfield DV2T viscometer.
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 DV2T and lower the viscometer into the run position.
5. Start both the temperature control program and the viscometer program.

Once the temperature control program starts, the TESC System heats the sample to the preheat temperature and maintains it at that temperature for the required time. The TESC System 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 DV2T program records the temperature of the sample chamber while waiting to measure the viscosity. When thermal conditioning of the sample completes, the DV2T automatically measures the sample viscosity by stepping through the typical range of spindle speeds for the sample type or expected viscosity. This eliminates the need to run multiple tubes of a sample. Once the viscosity measurements finish, the TESC System 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. The TESC System 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
	D2983-09	D2983-15	
Low viscosity (ATF, hydraulic fluid)	50 °C	50 °C	-10 °C
			-20 °C
			-30 °C
			-40 °C
High viscosity (gear oil)	90 °C	50 °C	-12 °C
			-26 °C
			-40 °C

Related Documents

Table 2 — Related documents

Title	Reference Number
Standard Test Method for Low-Temperature Viscosity of Lubricants Measured by Brookfield® Viscometer	ASTM D2983
Automotive Gear Lubricant Viscosity Classification	SAE J306

Specifications / Compliances

Table 3 — Specifications and compliances

Specifications		Details
Model		Thermoelectric Sample Conditioner
Methodology		ASTM D2983-equivalent
Applications		Gear oils, automatic transmission fluids, industrial and automotive hydraulic oils, tractor fluids, lubricating oils
Dimensions (w × d × h)	(TESC only)	16.5 cm × 50.8 cm × 63.5 cm (6.5 in × 20 in × 25 in)
	(with DV2T)	16.5 cm × 50.8 cm × 76.2 cm (6.5 in × 20 in × 30 in)
Weight	(TESC only)	16.8 kg (37 lb)
	(with DV2T)	19.5 kg (43 lb)
Operational temperature range		−40 °C to +90 °C (± 0.1 °C)
Sample capacity		1 sample, 20 mL sample required
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 System.



Notes provide more information about the content that follows.



Cautions alert the operator to conditions that may damage equipment.



Warnings alert 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 System.
- 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 System 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.

- 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.
- Refer all service and repairs to qualified personnel.

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 Thermoelectric Sample Conditioner System and all accessories as soon as they are received.



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

1. Carefully unpack the entire contents of the shipment.
2. Referring to the packaging list, verify that all materials were received.
3. Inspect materials for defects and shipping damage. Contact your CANNON representative to resolve any issues.

Table 4 — Packing List (TESC System)

Description	Part Number
TESC base unit	17.5075
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
RS-485 to USB cable	17.5122
Brookfield® DV2T viscometer	17.5126
Brookfield® #4B2 insulated spindle	17.5128
Brookfield® EZ-Lock spindle coupling	17.5129

Table 5 — Packing list (accessories)

Description	Part Number
Test cells (pkg of 12); 25 mm OD × 150 mm, rimless	9725-F84
Certificate of Calibration	N/A
TESC Operator's Manual	17.5125
USB flash drive with program files	17.5121

Setup the TESC System

The TESC System ships partially disassembled for ease of packaging. Basic assembly is simple, quick, and requires only a few common tools.

Table 6 — Tools and materials required

Description
TESC base unit
Brookfield DV2T viscometer
Retaining ring
MAINS AC power cable

Description
$\frac{3}{16}$ " Allen wrench
Mounting collar
Retaining screws (4)
MAINS AC pass-through power cable

Assemble the TESC System

Assemble the TESC System on a secure, level surface. Refer to Figure 1 as necessary.



Note: If the TESC System is moved after assembly, you must level the unit again.

1. With a $\frac{3}{16}$ " Allen wrench, securely mount the Brookfield DV2T onto the viscometer tray.
2. Level assembled unit by adjusting the screws in the feet of the TESC base unit.

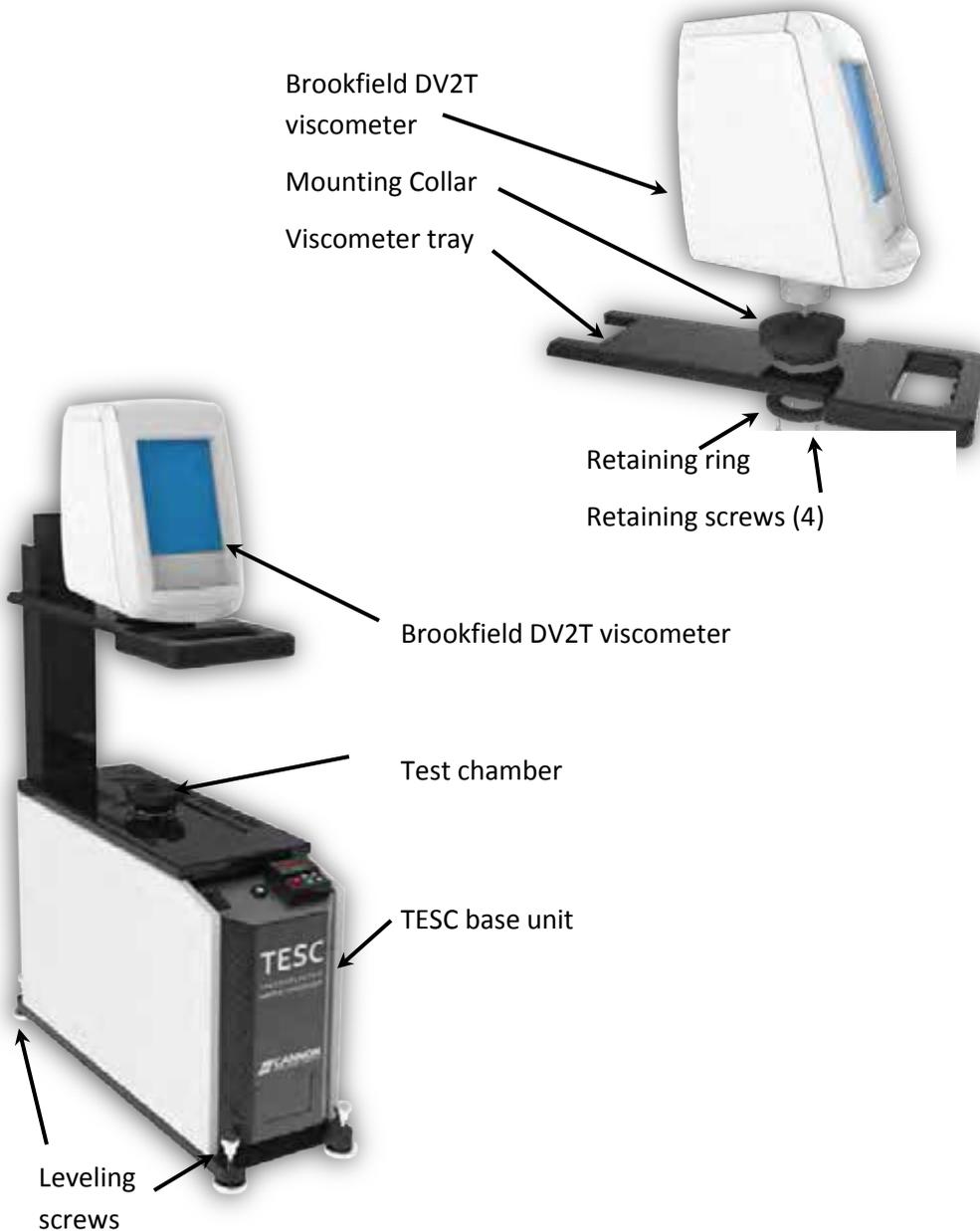


Figure 1 — Assembled TESC System

Connect Cables

All primary cables are shipped with the TESC System. Refer to Figures 2, 3, and 4 as necessary.



Caution: The MAINS AC pass-through connector on the TESC base is not controlled by the TESC System ON/OFF switch. Whenever the TESC base is plugged in, power will be passed to the Brookfield viscometer.

1. Verify that the DV2T power switch is off.
2. Verify that the TESC power switch is off.
3. Connect the MAINS AC pass-through power cable from the TESC base to the DV2T.
4. Connect the RTD probe from the TESC base to the socket on the back of the DV2T.
5. Connect the MAINS AC power cable to the TESC and a MAINS AC outlet.



Figure 2 — TESC with Watlow controller

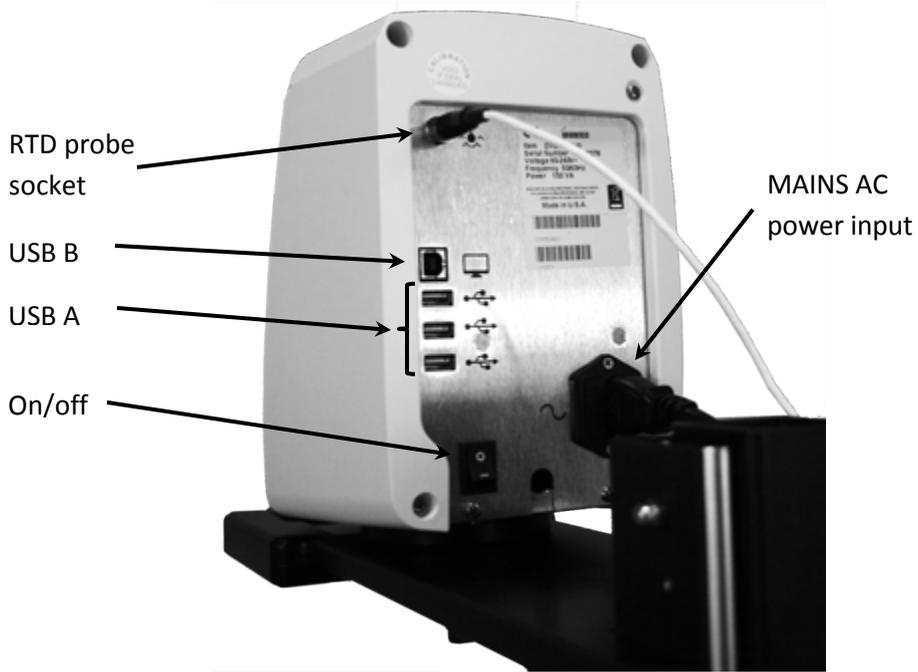


Figure 3 — Brookfield DV2T connections



Figure 4 — TESC connections

Run Quick Verification Test

This test verifies system calibration and provides a technician with basic training in operating the CANNON Thermoelectric Sample Conditioner System.

Table 7 — Tools and materials required

Description	Description
Assembled TESC System with mounted Brookfield viscometer	20 mL of an appropriate reference sample
25 mm × 150 mm rimless, disposable test tube	Brookfield #4B2 insulated spindle
Sample preparation materials	USB flash drive with program files

1. Turn on DV2T and TESC. If the Watlow controller starts to run a program, press the red **EZ** button to halt the test. (Steps symbol  indicates a running program.)
2. Autozero DV2T:
 - a. Remove spindle if present.
 - b. Lower viscometer to measurement position.
 - c. Level TESC System if necessary.
 - d. Select **Next** on the DV2T **AutoZero** screen.
 - e. When the DV2T indicates that the AutoZero is complete, raise viscometer.
3. Prepare a 20 mL sample according to your laboratory practices:
 - a. Insert a 25 mm × 150 mm test tube containing 20 mL (± 0.2 mL) of the reference sample into the test chamber and gently hand-tighten the cone ring.
 - b. Attach a clean #4B2 spindle to the viscometer.
 - c. Carefully lower viscometer into measurement position.
4. Set the TESC System temperature:
 - a. Using the control buttons on the Watlow controller, set the target temperature, which depends on the characteristics of the reference sample you are testing.
 - b. The TESC System immediately begins cooling or heating to achieve the target temperature.



Note: The 2 hour DV2T calibration program waits 2 hours for the temperature of the sample to stabilize, and then it runs a viscometry test.

All TESC programs are preloaded by CANNON onto the DV2T. Backup copies are available on the USB flash drive.

5. Load and run the 2 hour DV2T temperature calibration program:
 - a. From the DV2T Main Menu, select **Load Test > Viscosity Tests > Internal Memory > Temp Cal 2 Hour DV2T.dvt**.
 - b. Click **Run**.
6. When the DV2T test completes, review the results by scrolling through the step results. Compare the measured viscosity at the highest torque reading to the certified viscosity of the sample. If the measured viscosity is outside of the tolerable range of the sample, the TESC System will need to be calibrated prior to running an ASTM D2983 test. Refer to *Calibrating the TESC System*, beginning on page 18 for calibration instructions.
7. To save the test data from the DV2T:
 - 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**.

Testing using the DV2T is complete. Click the **Main Menu** icon in the upper-left corner of the screen and click **No** when a dialog box prompts you to save the data.

Warning: Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Refer to your lab safety standards for more information.



Sample temperature will lag behind the temperature displayed by the Watlow controller (TE cooler block temperature). Wait until approximately 30 minutes after the controller reaches the target temperature before handling the sample.

8. Set the Watlow controller target temperature to +25.0 °C. When the sample reaches +25.0 °C, raise the viscometer; remove and clean spindle and test tube.



Running an ASTM D2983 Test

This procedure runs sample conditioning programs and viscosity tests designed to meet ASTM method D2983.

Table 8 — Tools and Materials Required

Description
Assembled TESC System with mounted Brookfield DV2T viscometer
25 mm × 150 mm rimless, disposable test tube
Sample preparation materials
USB flash drive with program files

Description
20 mL sample to be tested
Brookfield #4B2 insulated spindle
RS-485 to USB cable

1. Turn on DV2T and TESC. If the Watlow controller starts to run a program, press the red **EZ** button to halt the test. (Steps symbol indicates a running program.)



Note: For instructions on installing the Watlow EZ-Zone Configurator program, refer to page 19.

2. If necessary, load the appropriate thermal conditioning program into Watlow controller:
 - a. Connect PC to Watlow controller using RS-485 to USB cable.
 - b. Launch Watlow configurator program: **Start Menu > EZ-ZONE Configurator > EZ-ZONE Configurator**.
 - c. Select **Download a configuration file to a device**. Click **Next**.
 - d. Select the COM port to which the Watlow controller is connected. Click **Next**.
 - e. Select **Load Program from File**.
 - f. Select program according to Table 9:

Table 9 — ASTM D2983-15 Thermal Conditioning Programs

Program Name	Test Temperature	Test Time	Description
D2983-15-Minus10.wcf	-10 °C	17.2 hours	
D2983-15-Minus10-Abbrev.wcf	-10 °C	6.9 hours	Short soak time
D2983-15-Minus12.wcf	-12 °C	17.2 hours	
D2983-15-Minus12-Abbrev.wcf	-12 °C	6.9 hours	Short soak time
D2983-15-Minus18.wcf	-18 °C	17.2 hours	
D2983-15-Minus18-Abbrev.wcf	-18 °C	6.9 hours	Short soak time
D2983-15-Minus20.wcf	-20 °C	17.2 hours	
D2983-15-Minus20-Abbrev.wcf	-20 °C	6.9 hours	Short soak time
D2983-15-Minus23pt3.wcf	-23.3 °C	17.2 hours	
D2983-15-Minus23pt3-Abbrev.wcf	-23.3 °C	6.9 hours	Short soak time
D2983-15-Minus26.wcf	-26 °C	17.2 hours	
D2983-15-Minus26-Abbrev.wcf	-26 °C	6.9 hours	Short soak time
D2983-15-Minus30.wcf	-30 °C	17.2 hours	
D2983-15-Minus30-Abbrev.wcf	-30 °C	6.9 hours	Short soak time
D2983-15-Minus35.wcf	-35 °C	17.2 hours	
D2983-15-Minus35-Abbrev.wcf	-35 °C	6.9 hours	Short soak time
D2983-15-Minus40.wcf	-40 °C	17.2 hours	
D2983-15-Minus40-Abbrev.wcf	-40 °C	6.9 hours	Short soak time

g. Click [Exit](#).



Note: The Watlow calibration offset is unique at each test temperature; the offset for -40 °C may not be the same offset for -26 °C.

3. Using the Watlow configurator program, verify that the proper calibration offset has been entered into the program.
4. Autozero DV2T:
 - a. Remove spindle if present.
 - b. Lower viscometer to measurement position.
 - c. Level TESC System if necessary.
 - d. Press **Next** on the DV2T **AutoZero** screen.
 - e. When the DV2T indicates AutoZero complete, raise viscometer.
5. Prepare a 20 mL sample according to your laboratory practices:
 - a. Insert a 25 mm × 150 mm test tube containing 20 mL ± 0.2 mL of the reference sample into the test chamber and gently hand-tighten the cone ring.
 - b. Attach a clean #4B2 spindle to the viscometer.
 - c. Carefully lower viscometer into measurement position.
6. Load and run the appropriate DV2T viscosity measurement program:
 - a. From the DV2T Main Menu, select **Load Test > Viscosity Tests > Internal Memory > see Table 10**.
 - b. Click **Run**.

Table 10 — ASTM D2983-15 DV2T Viscometer Programs

Program Name	Test Time	Description
D2983-Visc.dvt	17.2 hours	For any viscosity.
D2983-Visc -Abbrev.dvt	6.9 hours	For any viscosity / short soak time
D2983-LowVisc.dvt	17.2 hours	For visc < 45 Pa(s)
D2983-LowVisc-Abbrev.dvt	6.9 hours	For visc < 45 Pa(s) / short soak time
D2983-HighVisc.wcf	17.2 hours	For visc > 40 Pa(s)
D2983-HighVisc-Abbrev.wcf	6.9 hours	For visc > 40 Pa(s) / short soak time



Warning: The thermal conditioning program will return the TESC to 25 °C after test measurements are complete. Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Refer to your lab safety standards for more information.

7. Press red **EZ** button on the Watlow controller.



Note: Full sample conditioning and viscosity test for ASTM method D2983 requires approximately 19.5 hours to complete.

8. When the DV2T test completes, review the results by scrolling through the step results.
9. To save the test data from the DV2T:
 - 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**.

Testing using the DV2T is complete. Click the **Main Menu** icon in the upper-left corner of the screen and click **No** when a dialog box prompts you to save the data.



Warning: Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Refer to your lab safety standards for more information.

Sample temperature will lag behind the temperature displayed by the Watlow controller (TE cooler block temperature). Wait until approximately 30 minutes after the controller reaches the target temperature before handling the sample.

10. If necessary, set the Watlow controller target temperature to +25.0 °C. When the sample reaches +25.0 °C, raise the viscometer; remove and clean spindle and test tube.



Calibrating the TESC System

Cannon Instrument Company calibrates all TESC Systems as part of the manufacturing process. However, differing ambient conditions during usage may necessitate adjusting the offset values applied to the Watlow controller and Brookfield viscometer to ensure accurate results.

Two resistance thermometers installed in the thermal core monitor the temperature of the unit. The temperatures measured by these thermometers must be adjusted with an offset value to match the actual temperature of the sample being tested. For example, a temperature at the thermal core of $-40\text{ }^{\circ}\text{C}$ may result in the sample being at $-39\text{ }^{\circ}\text{C}$ due to the ambient air temperature of the lab warming the sample slightly.

The Watlow controller manages the temperature of the TESC base unit via an RTD probe located in the thermal core in front of the test chamber. The Watlow controller displays the adjusted temperature. In the example, the Watlow controller displays a temperature of $-40.0\text{ }^{\circ}\text{C}$, but it is known that the sample is actually at $-39.0\text{ }^{\circ}\text{C}$ (see Table 11, row 1). To correct for this deviation, slightly more than $+1\text{ }^{\circ}\text{C}$ is added to the Calibration Offset value of the Watlow controller, such as $+1.1\text{ }^{\circ}\text{C}$ (see Table 11, row 2). Because the Watlow controls the temperature of the TESC core, this adjustment results in the sample gradually cooling to $-40.0\text{ }^{\circ}\text{C}$ when the Watlow controller is programmed to $-40.0\text{ }^{\circ}\text{C}$ (see Table 11, row 3).

Table 11 — Watlow Offset Example

	Watlow Display		Calibration Offset		Thermal Core	Sample Temperature
1	$-40.0\text{ }^{\circ}\text{C}$	=	0	+	$-40.0\text{ }^{\circ}\text{C}$	$-39.0\text{ }^{\circ}\text{C}$
2	$-38.9\text{ }^{\circ}\text{C}$	=	$+1.1\text{ }^{\circ}\text{C}$	+	$-40.0\text{ }^{\circ}\text{C}$	$-39.0\text{ }^{\circ}\text{C}$
3	$-40.0\text{ }^{\circ}\text{C}$	=	$+1.1\text{ }^{\circ}\text{C}$	+	$-41.1\text{ }^{\circ}\text{C}$	$-40.0\text{ }^{\circ}\text{C}$

During testing, the Brookfield viscometer measures and records the temperature of the TESC base unit via an RTD probe located in the thermal core behind the test chamber. Adjusting the offset of the Brookfield viscometer only enables the recording of an accurate sample temperature. It does not affect the operation of the TESC System.

Table 12 — Brookfield Offset Example

Brookfield Display	Offset	Watlow Display	Sample Temperature
-41 °C	0	-40 °C	-40 °C
-40 °C	+1 °C	-40 °C	-40 °C

Watlow Controller Calibration

The Watlow controller must be calibrated before adjusting the temperature probe offset of the Brookfield viscometer.

Table 13 — Tools and Materials Required

Description	Description
Assembled TESC System with mounted Brookfield DV2T viscometer	20 mL of an appropriate reference sample
25 mm × 150 mm rimless, disposable test tube	Brookfield #4B2 insulated spindle
Sample preparation materials	RS-485 to USB cable
USB flash drive with program files	

Install Watlow Configurator Program

A copy of the Watlow EZ-ZONE Configurator 6.0 program is provided with the TESC software package. This program must be loaded onto a computer running a Windows® operating system prior to calibrating or operating the TESC System.

1. To load the Watlow EZ-ZONE Configurator 6.0 program, run **USB flash drive > Watlow Configurator Installer > EZCv6.exe**.
2. Follow the instructions provided by the installation wizard. For support and additional information, visit www.watlow.com.

Install RS-485 to USB Cable Drivers

The first time that the RS-485 to USB cable is connected to a computer, the Windows OS will attempt to automatically install the proper device drivers. If this does not work, drivers may be manually installed.

1. To manually load the drivers, run **USB flash drive> Watlow Configurator Installer > CDM v2.12.10 WHQL Certified.exe**.
2. Follow the instructions provided by the installation wizard.

Calibration Procedure

Use the following procedure to calibrate the Watlow controller.

1. Turn on DV2T and TESC. If the Watlow controller starts to run a program, press the red **EZ** button to halt the test. (Steps symbol indicates a running program.)
2. Autozero DV2T:
 - a. Remove spindle if present.
 - b. Lower viscometer to measurement position.
 - c. Level entire unit if necessary.
 - d. Select **Next** on the DV2T **AutoZero** screen.
 - e. When the DV2T indicates AutoZero complete, raise viscometer.
3. Prepare a 20 mL sample according to your laboratory practices:
 - a. Insert a 25 mm × 150 mm test tube containing 20 mL (± 0.2 mL) of the reference sample into the test chamber and gently hand-tighten the cone ring.
 - b. Attach a clean #4B2 spindle to the viscometer.
 - c. Carefully lower viscometer into measurement position.
4. Using the control buttons on the Watlow controller, set the target temperature, such as at -40 °C.



Note: The 2 hour DV2T calibration program waits 2 hours for the temperature of the sample to stabilize, and then it runs a viscometry test. After the 2 hour soak and initial test, only 1 hour is required between tests for small temperature adjustments to stabilize.

Ignore the temperature recorded by the DV2T. It may not be accurate, but this will not affect the calibration of the Watlow controller.

5. Load and run the 2 hour DV2T temperature calibration program:
 - a. From the DV2T Main Menu, select **Load Test > Viscosity Tests > Internal Memory > Temp Cal 2 Hour DV2T.dvt**.
 - b. Click **Run**.
6. Wait for the DV2T test to complete.



Note: The computer only needs to be connected to the TESC System and the Watlow configuration program only needs to be running when you are actively changing the Watlow controller. During test runs, the computer may be disconnected from the TESC System.

7. If it is not already running, start Watlow configurator program:
 - a. Connect PC to Watlow controller using RS-485 to USB cable.
 - b. Launch Watlow configurator program: **Start Menu > EZ-ZONE Configurator > EZ-ZONE Configurator**.
 - c. Select **Configure a device while communicating with it**. Click **Next**.
 - d. Select the COM port to which the Watlow controller is connected. Click **Next**.
 - e. Select the TESC System from the list of available EZ-ZONE Devices. Click **Next**.
 - f. In the Parameter Menus, open **EZ-ZONE PM > Setup > Analog Input**. The Calibration Offset is shown in the display window.
8. When the DV2T test completes, review the results by scrolling through the step results.

Note: Because the TESC System is calibrated during manufacturing, only small adjustments of $\pm .1$ °C should be necessary to fine tune the temperature setting.

If desired, the actual temperature of the sample may be determined using a viscosity calculation tool, such as VISDISK.



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

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

9. Compare the measured viscosity at the highest torque reading to the calibrated viscosity of the sample.

- If the measured viscosity is higher than the calibrated viscosity, then the temperature of the sample is lower than the target temperature. Subtract 0.1 °C from the value shown for the Calibration Offset and enter this new value into the Watlow configurator program. Continue to step 10.
- If the measured viscosity is lower than the calibrated viscosity, then the temperature of the sample is higher than the target temperature. Add 0.1 °C to the value shown for the Calibration Offset and enter this new value into the Calibration configurator program. Continue to step 10.
- If the measured viscosity is within the tolerance range of the calibrated viscosity of the sample, the temperature of the sample is correct. Calibration is complete, go to step 13.

10. Load and run the 1 hour DV2T temperature calibration program:

- a. From the DV2T Main Menu, select **Load Test > Viscosity Tests > Internal Memory > Temp Cal 1 Hour DV2T.dvt**.
- b. Click **Run**.

11. Wait for the DV2T test to complete.

12. Repeat steps 8 through 11 as needed. Step 10.a only needs to be performed one time.

- Record the offset value. You will need to enter it into each TESC temperature control program prior to running it.



Warning: Do not attempt to remove a sample from the test chamber until it has reached a safe handling temperature. Refer to your lab safety standards for more information.

Sample temperature will lag behind the temperature displayed by the Watlow controller (TE cooler block temperature). Wait until approximately 30 minutes after the controller reaches the target temperature before handling the sample.

- Press the red **EZ** button on the Watlow controller to halt the test. Set the Watlow controller target temperature to +25.0 °C. When the sample reaches +25.0 °C, raise the viscometer; remove and clean spindle and test tube.

Brookfield DV2T Temperature Probe Offset Adjustment

Use the following procedure to adjust the probe offset.



Note: Generated reports saved or printed from the DV2T do not indicate the offset.

- Calibrate the Watlow controller.
- The temperature probe offset is the difference between the temperature displayed by the DV2T and the temperature displayed by the Watlow controller.
- Enter the offset value in the appropriate screen on DV2T and assign an appropriate label, such as “-40 C.”
- Record instrument Id, DV2T serial number, probe offset label, and offset value.



Specifications

Table 14 — Specifications

Specifications		Details
Model		Thermoelectric Sample Conditioner System
Methodology		ASTM D2983-equivalent
Applications		Gear oils, automatic transmission fluids, industrial and automotive hydraulic oils, tractor fluids, lubricating oils
Dimensions (w × d × h)	(TESC only) (with DV2T)	16.5 cm × 50.8 cm × 63.5 cm (6.5 in × 20 in × 25 in) 16.5 cm × 50.8 cm × 76.2 cm (6.5 in × 20 in × 30 in)
Weight	(TESC only) (with DV2T)	16.8 kg (37 lb) 19.5 kg (43 lb)
Operational temperature range		−40 °C to +90 °C (± 0.1 °C)
Sample capacity		1 sample, 20 mL sample required
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



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 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

CANNON Fax Number 814-353-8007

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.

Replacement Parts List

Table 15 — TESC System Replacement Parts

Description	Part Number
TESC base unit	17.5075
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
RS-485 to USB cable	17.5122
Brookfield® DV2T	17.5126
Brookfield® #4B2 insulated spindle	17.5128
Brookfield® EZ-Lock spindle coupling	17.5129
Test cells (pkg of 12); 25 mm OD × 150 mm, rimless	9725-F84
TESC Operator's Manual	17.5125
USB flash drive with program files	17.5121

Table 16 — Standards

Description	Part Number
Viscosity reference standard CL160, 500 mL	9727-N12.016
Viscosity reference standard CL280, 500 mL	9727-N26.016



Cannon Instrument Company®
2139 High Tech Road
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