



TESC-5133

Low Temperature
Viscometer

*Operation
Manual*



TESC-5133 Operation Manual

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Overview

The TESC-5133 Low Temperature Viscometer integrates and automates the ASTM D5133 process of conditioning and testing low temperature viscosities of engine lubricants. CANNON's TESC-5133 provides controlled sample heating and cooling for the ASTM D5133 method. With its low cost and small footprint, it allows several complete TESC (thermoelectric sample conditioner) systems to operate conveniently in the same bench-top area as a comparable single unit. This provides laboratories with optimal test versatility and redundancy, maximizing productivity and reducing downtime.



Figure 1: TESC-5133 Low Temperature Viscometer

ASTM D5133 Forward

Cannon Instrument Company's TESC-5133 is an innovative viscometer with a unique spindle designed specifically to provide test results for ASTM D5133 method.

As an engine oil cools, the rate and duration of cooling can result in a structure that inhibits the flow of oil from the engine sump to the oil pump. In this laboratory test, a sample engine oil is slowly cooled through a temperature range in which wax crystallization is known to occur. Laboratory tests that slowly cool samples through this temperature range have predicted failures of engine oils, known to fail in the field due to lack of oil pumpability. These field failures are believed to be the result of the oil forming a flow-inhibiting structure, an excessive viscosity, or both. The presence of a significant Gelation Index, as

calculated by this test method, is indicative that there is a high probability of the lubricant forming such a flow inhibiting structure.

The TESC-5133 System uses a method equivalent to ASTM D5133. To reduce test variability, the instrument 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 requiring operator intervention, throughout the conditioning and testing processes.

Using the calibrated TESC-5133 instrument, a D5133-equivalent test is run with the following simple steps:

1. Auto-zero the Brookfield DV2T viscometer 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 the 5133 spindle to the DV2T Head Unit and lower the viscometer into the run position.
5. Start both the temperature control program and the viscometer software program.

Once the temperature control program starts, the TESC-5133 heats the sample to the designated preheat temperature and maintains that temperature for the required time. The TESC-5133 then cools the sample to -5 °C in preparation to start the test. The sample is then further cooled to -42 °C at a rate of 1 °C per hour. This controlled heating and cooling is critical to obtaining accurate and reliable results.

Throughout the thermal conditioning process, the DV2T Head Unit program records the temperature of the sample chamber while waiting to measure the viscosity. When thermal conditioning of the sample completes, the TESC software automatically measures the sample viscosity as it cools in order to calculate results. Once the viscosity measurements finish, the TESC-5133 returns the sample to room temperature, ostensibly 20 °C. The operator can now review the data and enhance the digital record with notes and additional information if desired.

The instructions in this manual are written in the order in which they are to be performed. The instrument is factory-calibrated and, once installed, ready to run samples. Instructions on calibrating temperature and torque are included in this manual but are not necessary to start testing samples immediately.

Specifications and Compliances

Table 1: Specifications and Compliances

Specifications		Details
Model		TESC-5133 Low Temperature Viscometer
Methodology		ASTM D5133
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)
Temperature Range		−42 °C to +90 °C (± 0.1 °C)
Sample Capacity & Volume		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, cautions, and warnings are used in this 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-5133 instrument.



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

Observe the following general safety precautions for proper and safe operation of the TESC-5133 Low Temperature Viscometer.

- Only qualified personnel should operate the TESC-5133.
- Make sure to read and understand all operating instructions and safety precautions listed in this Operation Manual before installing or operating the unit. Direct questions regarding instrument operation or documentation to Cannon Instrument Company.
- Do not deviate from the installation, operation, or maintenance procedures described in this manual. Improper use of the TESC-5133 may result in a hazardous situation and/or 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, and prior to moving the unit.
- Refer all service and repairs to qualified personnel.



Getting Started

Unpack and Inspect

Upon receipt of the instrument, unpack and inspect the complete CANNON TESC-5133 Low Temperature Viscometer and all accessories. Refer to the packing list in Table 2.



Caution: Many components are fragile. Use caution when moving and handling the TESC-5133 and accessories.

1. Carefully unpack the entire contents of the shipment.
2. Refer to the packing list in Table 2 and verify that all materials are present.
3. Inspect materials for defects and shipping damage. Contact your local CANNON representative to resolve any issues.

Table 2: TESC-5133 Packing List

Description	Part Number
TESC Base Unit	17.5075
Brookfield Head Unit:	17.5142
• Mounting collar	17.5113
• Retaining ring	17.5114
• Retaining ring screws (4)	01.4022
• Brookfield Magnetic spindle coupling	17.5150
MAINS AC power cable	74.2110 (US standard)
MAINS AC pass-through power cable	17.5135
USB to RS-485 cable	17.5122
USB A-to-B cable	67.1032
CANNON D5133 Spindle	17.5118
Test cells (pkg of 12); 25 mm OD × 150 mm, rimless	9725-F82
Certificate of Calibration	N/A
USB drive containing software & documentation	N/A
• TESC Operator's Manual (on USB drive)	N/A

Set Up the TESC-5133

The TESC-5133 ships partially assembled. Final assembly is simple, quick, and requires only a few common tools, as outlined in Table 3. Compile the components listed below in preparation for assembly.

Table 3: Tools and Materials Required

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

Attach the Brookfield Head Unit

The Brookfield Head Unit is installed on top of the TESC Base Unit and fixed on a bracket frame. Simple connection consists of installing the Head Unit onto the bracket frame and then inserting the cables. Upon receipt, the Brookfield Head Unit appears as shown below in Figure 2.

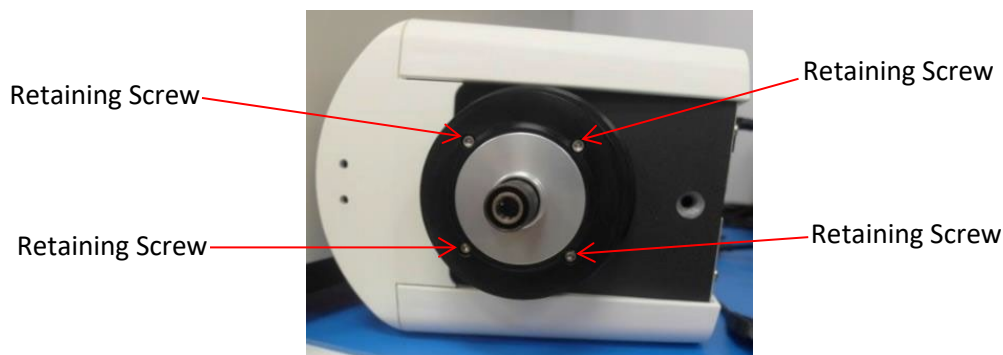


Figure 2: Brookfield Head Unit (on its side)

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

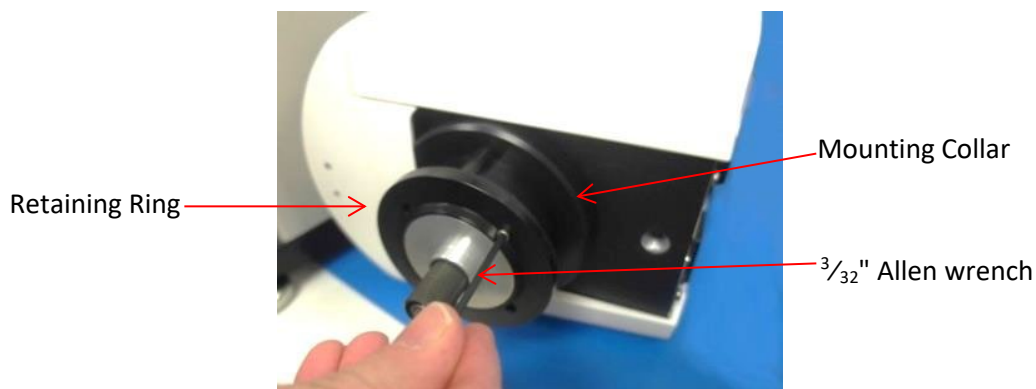


Figure 3: Retaining Ring Removed from Mounting Collar

2. Remove the retaining ring, keeping the mounting collar on the Head Unit as shown in Figure 3.
3. Place the Head Unit and mounting collar on the bracket frame in the installation hole. Refer to Figure 4.



Figure 4: Brookfield Head Unit on Bracket Frame in Installation Hole

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



Retaining Ring with bevel
facing outwards

Figure 5: Collar with Bevel Facing Outwards

5. Attach MAINS power cable and the USB A-to-B cable to the Head Unit, as shown in Figure 6.

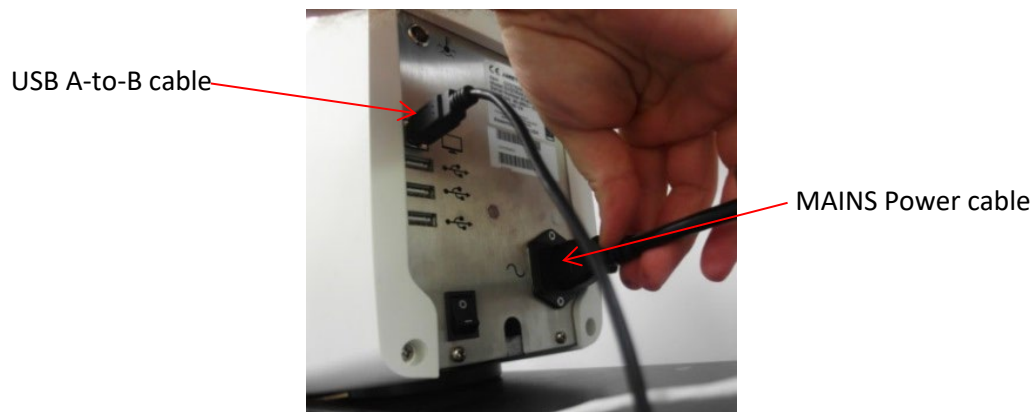


Figure 6: Attach MAINS Power and USB Cable

6. Attach the white Temperature Probe cable from the Base Unit to Head Unit, as shown in Figure 7.

Temperature Probe Cable



Figure 7: Temperature Probe Cable

Connect Cables

The TESC-5133 system is shipped with all primary cables included. Refer to Figure 10 as needed.



Caution: The MAINS AC pass-through connector on the TESC base is not controlled by the TESC-5133 ON/OFF switch. When the TESC base is plugged in, power is passed to the Brookfield head.

1. Verify that the Head Unit power switch is OFF. Refer to Figure 8.

Brookfield Head
Unit On/Off
button

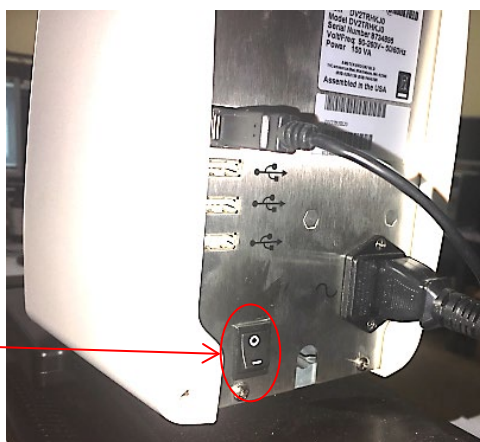


Figure 8: Head Unit ON/OFF Button (in rear)

2. Verify that the TESC Base Unit power switch on the front of the unit is OFF. Refer to Figure 9 (pictured ON).

On/Off button



Figure 9: TESC Base Unit ON/OFF Button

3. Connect the MAINS AC pass-through power cable from the Base Unit to the Head Unit.
4. Connect the MAINS AC power cable to the Base Unit and a wall outlet. Refer to Figure 10.

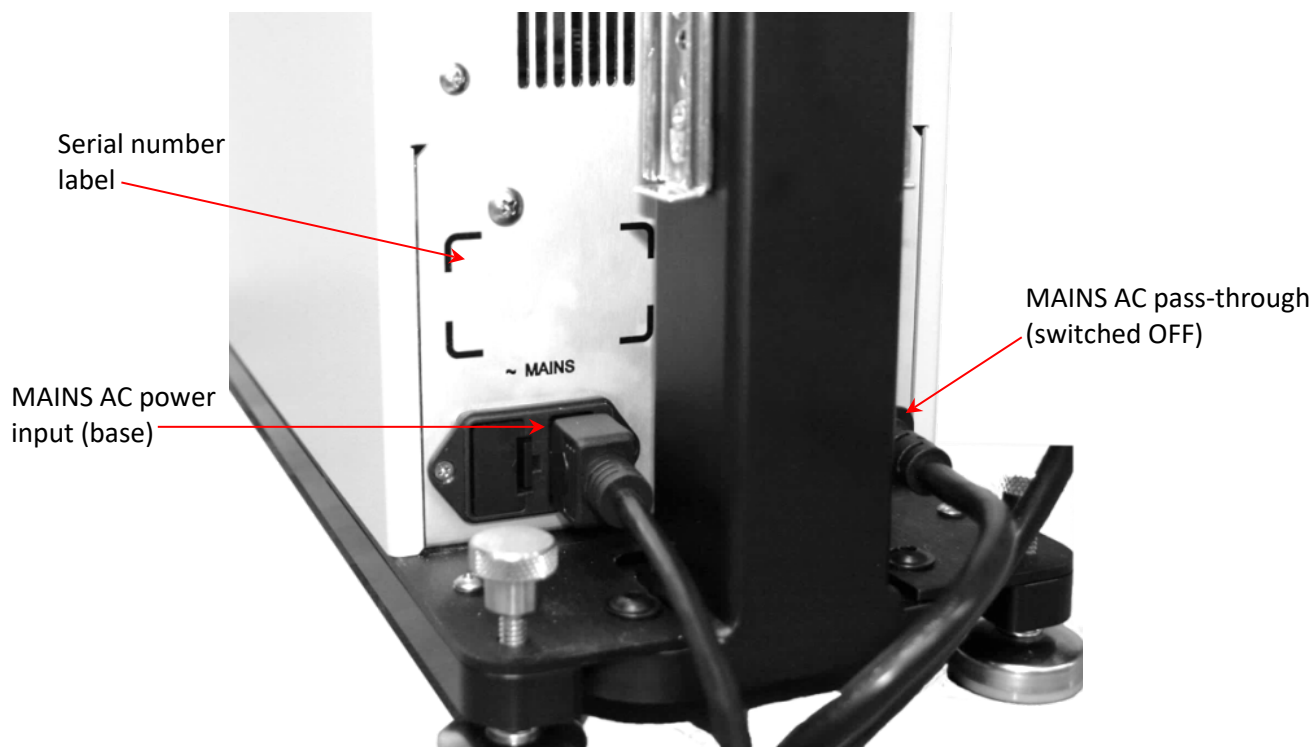


Figure 10: TESC-5133 Base Unit Connections

Configure USB Power Settings

Due to the extensive length of time for the D5133 test (40 hours), it is vital to configure the power settings for the TESC-controlling PC before running a sample. The TESC-5133 controlling PC, loaded with the TESC software, must be set to provide constant power to the USB port to ensure it does not close during the 40-hour D5133 test, thus invalidating results. A power loss requires a complete test restart. To avoid this issue, ensure the following power settings are configured in the controlling PC prior to starting a test.



Note: *The following instructions are designed for Windows®10 operating system, the CANNON-recommended OS.*

1. Open the Windows® Start menu and search for Power Options. Refer to Figure 11.

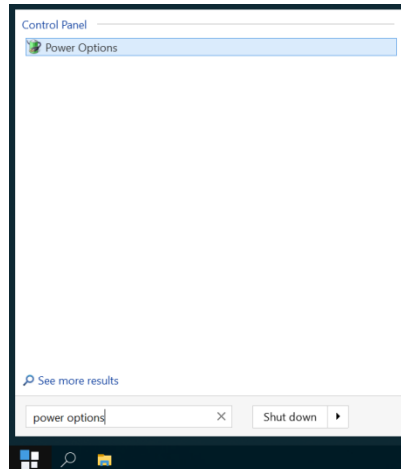


Figure 11: Search for Power Options

2. Select the **Power Options** to open.
3. Select **Change plan settings** for your power plan. Refer to Figure 12.

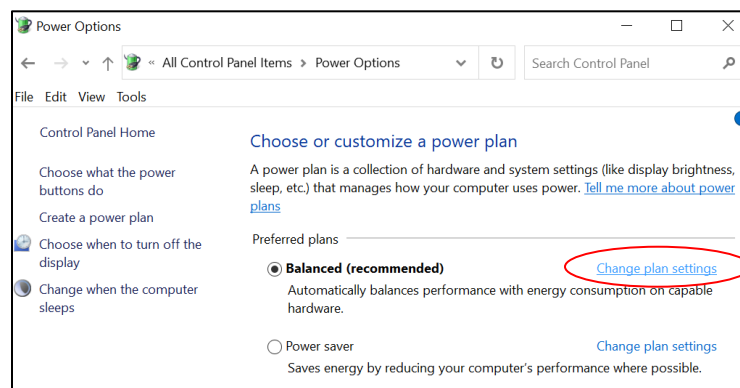


Figure 12: Power Options Window

4. Select **Change advanced power settings**. Refer to Figure 13.

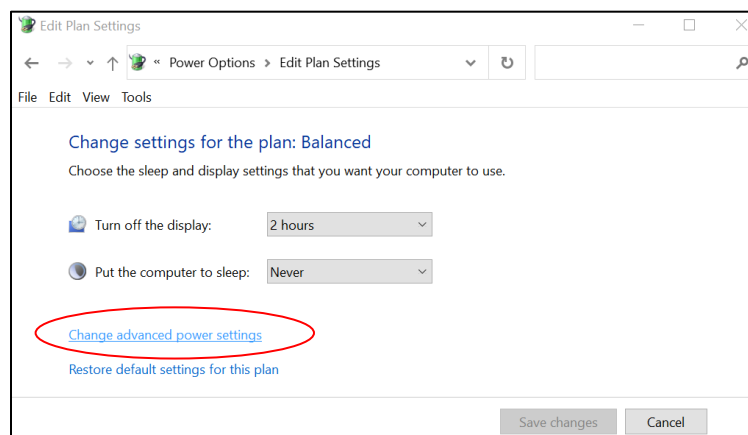


Figure 13: Power Plan Window

- Click the plus sign next to **Hard Disk** to access the dropdowns. Under **Turn off hard disk after**, change the **Setting (Minutes)** to **Never**. Reach **Never** by pressing the down arrow key until the box reads one (1), and then press the down arrow key one more time so it displays **Never**. Refer to Figure 14.

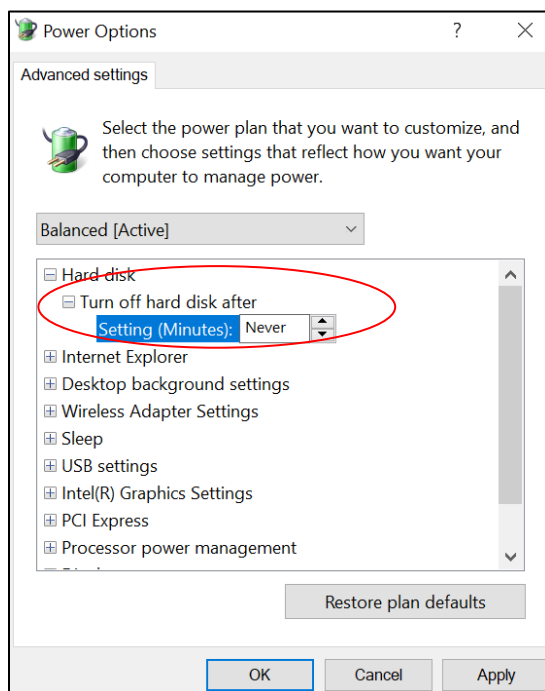


Figure 14: Turn Off Hard Disk Setting to Never

- Below the Hard disk options is the USB settings. Click the plus sign in the **USB settings** to open **USB selective suspend setting**. Change the setting to **Disabled**. Refer to Figure 15.

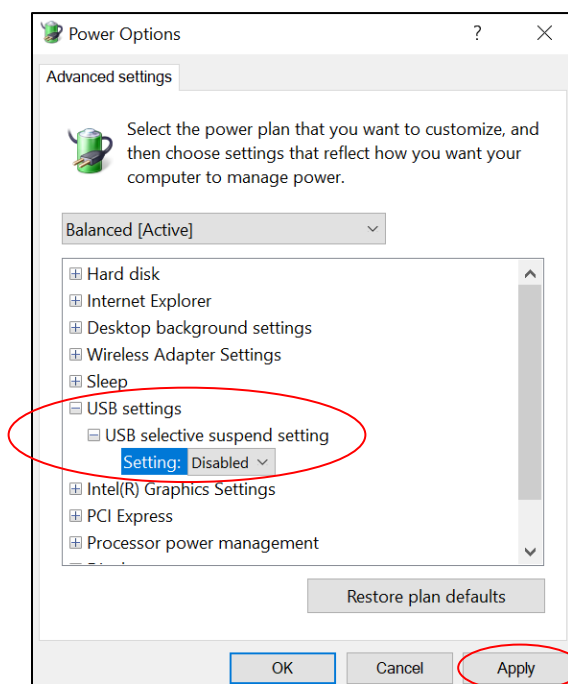


Figure 15: Disable USB Selective Suspend Setting

7. Select **Apply** to save the settings, as shown in Figure 15. Then click **OK** to close the window.
8. Ensure **Put the computer to sleep** is set to **Never**. This activates the **Save changes** button. Click **Save changes**. Refer to Figure 16.

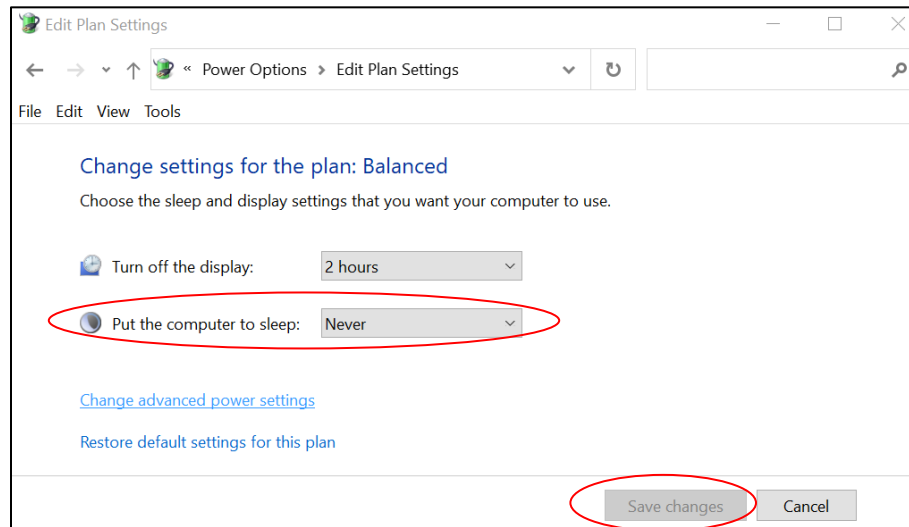


Figure 16: Put the Computer to Sleep Timer

9. Close the window by clicking the X in the top right corner.
10. Open the Start menu and search for **Device Manager**. Select **Device Manager** to open. Refer to Figure 17.

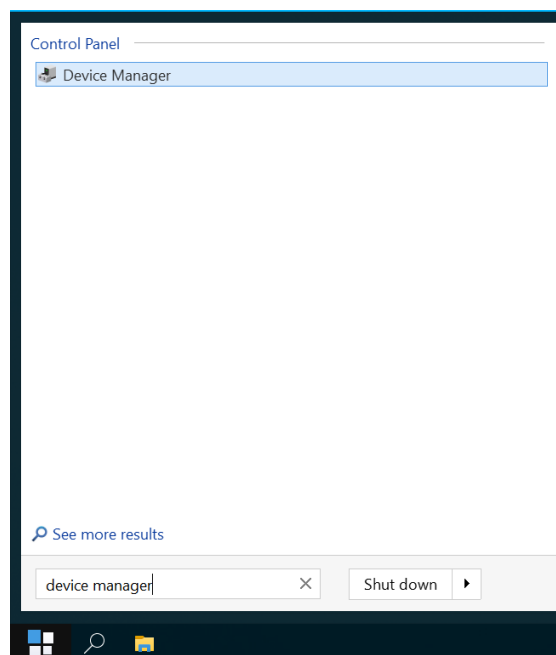


Figure 17: Search for Device Manager

11. Ensure that the USB cable connecting the computer with the Brookfield Head Unit of the TESC, and that the Brookfield Head Unit is powered ON. Click on the plus sign to open the dropdowns under **Ports (COM & LPT)** and identify which USB port is associated with the TESC. It likely reads something similar to **USB Serial Device (COM3)**, as shown in Figure 18.



Note: In order to identify which USB port is associated with the TESC, unplug the USB cable that connects the computer and TESC to view which one disappears, thus displaying the appropriate port.

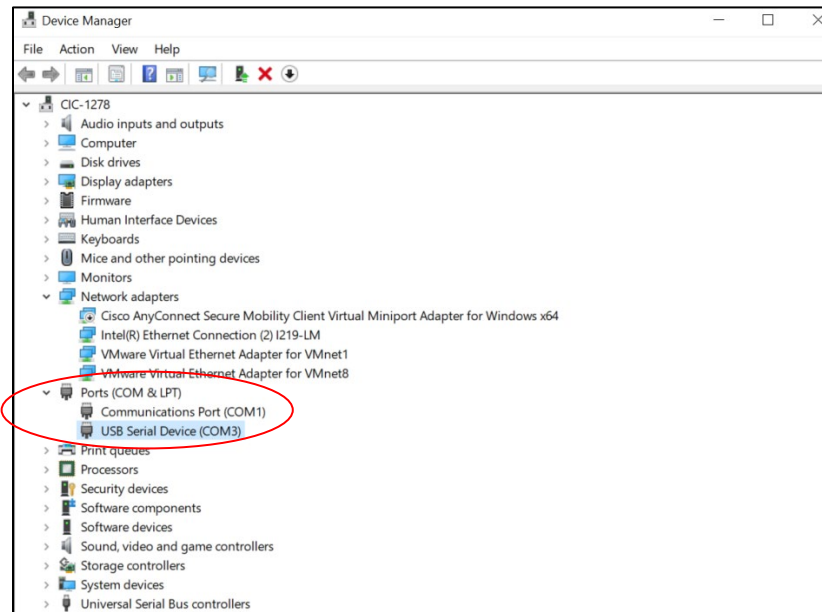


Figure 18: Device Manager Window

- Double-click the USB port identified in the previous step to open its properties. If your computer shows a **Power Management** tab on the top, select that tab. Uncheck the option **Allow the computer to turn off this device to save power**. Then press **OK** to apply the changes and close this window. Refer to Figure 19.



Note: Some computers may not have a **Power Management** tab. In this case, skip this step.

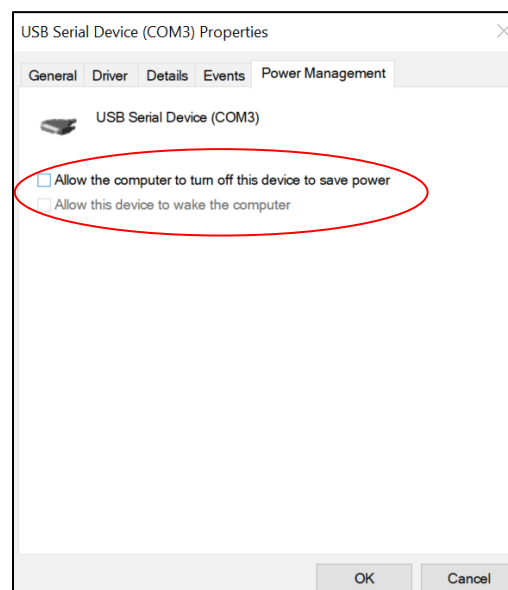


Figure 19: Allow Computer to Turn Off USB Port Window

13. Close the Device Manager window.

The power settings are now properly configured to run a 40 hour test without the computer going into sleep mode or cutting off power to the USB, allowing for a proper ASTM D5133 test.

Direct questions or concerns regarding Getting Started procedures to CANNON service at 814-353-8000 or service@cannoninstrument.com.

Now that the Getting Started procedures are complete, continue to the next section, ***Running a Sample***, to proceed with sample testing.



Running a Sample

The instrument is calibrated in the factory and shipped ready to run samples. The following section provides step-by-step instructions for running samples in the TESC-5133. The TESC-5133 low temperature viscometer is a thermoelectric sample conditioner applying method ASTM D5133 for engine oils. Please follow all instructions carefully. Only qualified personnel should operate the TESC-5133 instrument.

Install Software

Install the software from the included flash drive. Windows® 10 is the recommended operating system for this software.

1. Insert flash drive into computer. Three items appear in the pop-up window, as shown in Figure 20.

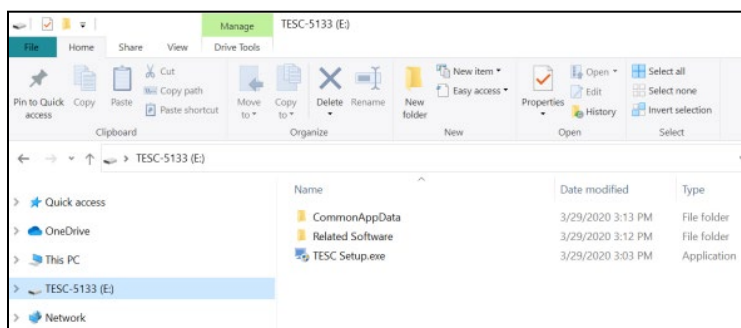


Figure 20: Flash Drive File Menu

2. Install the TESC Setup.exe file by following the on-screen prompts and using the default/recommended settings:
 - TESC Setup.exe
3. Open the Related Software folder and install the two .exe files by following the on-screen prompts and using the default/recommended settings:
 - VisDisk Setup.exe
 - Watlow EZ-Zone Configurator Setup.exe



Note: The Watlow EZ-Zone Configurator is provided as a courtesy by CANNON, but is not necessary for operation as the unit is configured prior to shipping.

This software is opened and used in future steps.

Sample Preparation

1. Fill the glass vial 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. Refer to Figure 21. Screw down the support ring into the sample chamber as follows:
 - a. Hold the test tube down while turning the retaining ring clockwise until resistance is felt.
 - b. Hand-tighten an additional $\frac{1}{4}$ turn. Do not overtighten.



Figure 21: TESC 5133 Base Unit Sample Chamber with Support Ring and Orange O-Ring



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.

1. Turn on TESC Base and Brookfield Head Units. At this point, the spindle is not attached to the head or in the unit at all.
2. Lower the Head Unit until it clicks, indicating it is resting on the support ring at its proper, lowest point. Refer to Figure 22 and Figure 23.



Figure 22: TESC Brookfield Head Unit



Figure 23: TESC in Fully Lowered Position

3. Ensure the Head Unit 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. Refer to Figure 24.



Figure 24: Bubble Level and Levelling Legs on TESC

4. Press **Next** on the Auto Zero screen on Head Unit and wait for the machine to complete the auto-zero process. Refer to Figure 25.



Figure 25: Auto Zero Screens on Head Unit

5. When the Auto Zero process is complete, press the green **Next** button, shown Figure 26.

Auto Zero Complete

Green **Next** button

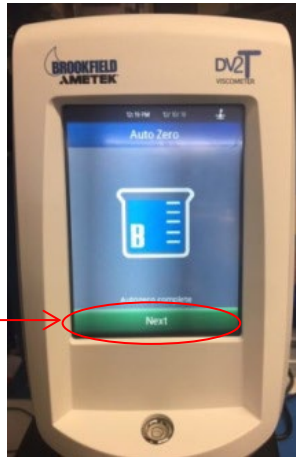


Figure 26: Auto Zero Complete Screen

- Next, the **Configure User Test** screen appears. Press the **Home** button on the top left corner to access the Main Menu. Refer to Figure 27.

Home button

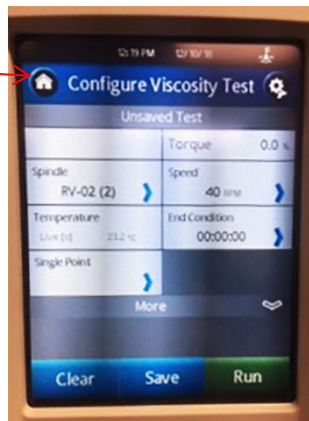


Figure 27: Configure User Test Screen

- This opens the Main Menu. Press the **External Mode** button, as shown in Figure 28.

External Mode

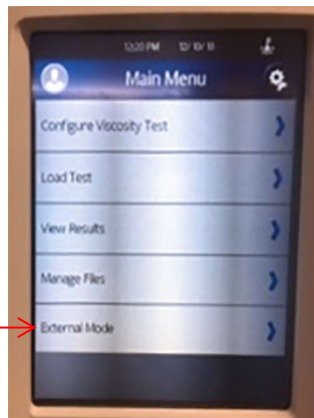


Figure 28: External Mode in Main Menu

- Once **External Mode** is pressed, the screen displays **Not Connected**. Refer to Figure 29.

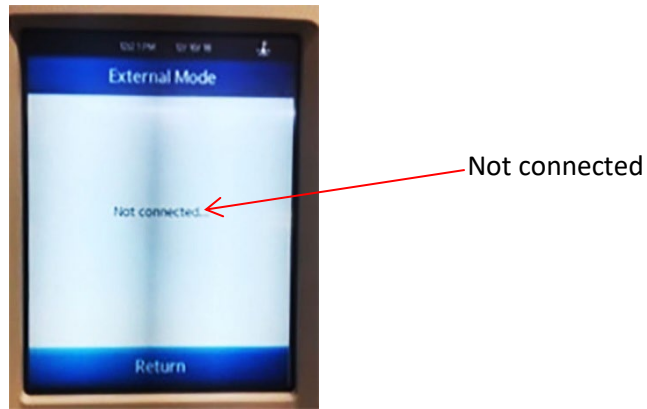


Figure 29: Not Connected Display

9. Connect the instrument by plugging in the serial cable to the PC. The Head Unit now displays **Connected**, as shown in Figure 30.

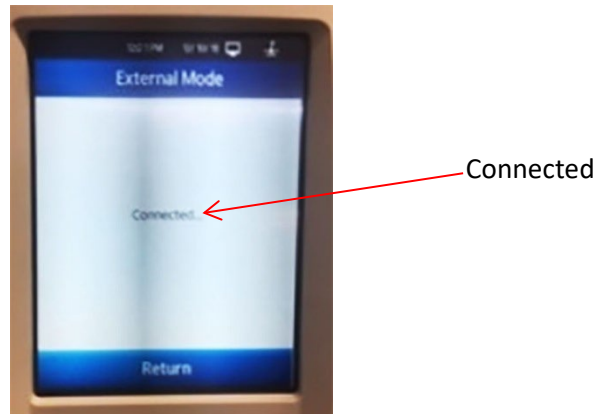



Figure 30: Connected Display

Run a Sample

1. On the PC desktop, click on the grey **TESC** icon to open the instrument software. Once opened it  should read **Connected** with a **COM#** in the display box. If there is no **COM#**, press the grey refresh button and the instrument **COM#** should appear. Refer to Figure 31.

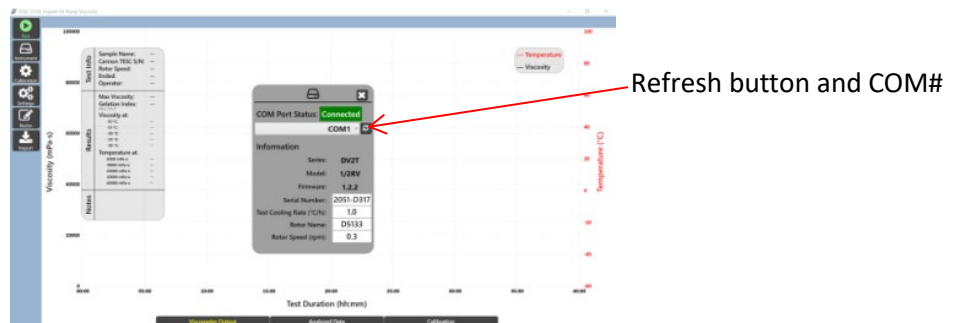


Figure 31: Connected Display on PC

2. Verify that the Serial Number is correct. This is labeled on the back of the instrument.



Note: Cannon calibrates each instrument prior to shipping and enters/creates the appropriate numbers and information; therefore customers do not need to calibrate the instrument initially. Calibrate instrument when needed and at the user's discretion.

3. Gripping the lever on front of the Head Unit, lift the Head Unit until it “clicks”, indicating that it’s at the proper upper-most position.
4. Insert the 5133 spindle into magnetic holder in the Head Unit. Refer to Figure 32.

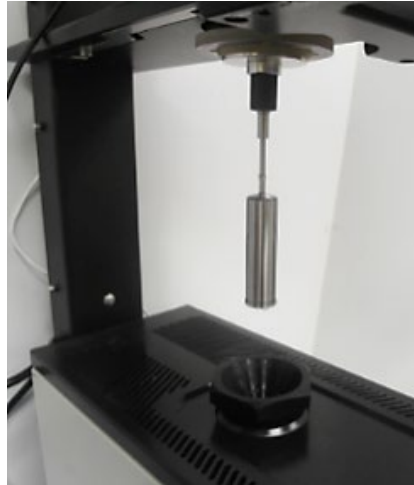


Figure 32: 5133 Spindle inserted into Instrument

5. Lower the Head Unit carefully until it clicks, ensuring the spindle is centered and does not make contact with the glass tube in the TESC Base Unit. The “click” sound indicates the Head Unit is resting on its support ring and is correctly positioned.

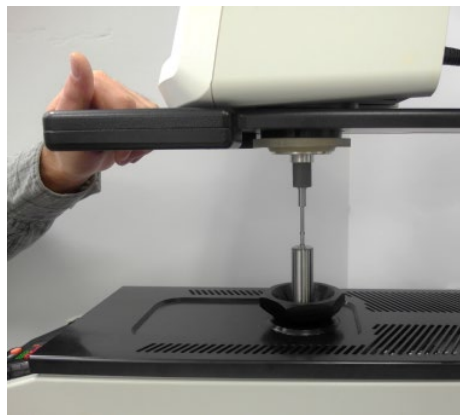


Figure 33: Lowering Head Unit to Ensure Spindle is Centered



Note: To improve performance, CANNON recommends lowering the head unit first so that the spindle is fully submerged in the oil, then lift the head unit so that the spindle is out of the test tube. Wait for the at least one drop of oil to drip back into the test tube. Then lower the head unit again so it clicks into position. This process minimizes the possibility of bubbles being trapped beneath the spindle due to inserting it dry into the oil.

6. Ensure the bubble level is centered. Refer to Figure 34.



Figure 34: Bubble Level

7. On the PC, select **Run** from sidebar column, as shown in Figure 35.

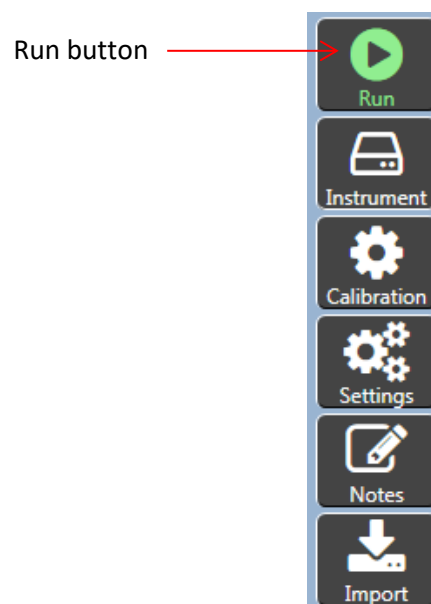


Figure 35: TESC Software Sidebar Column

8. Fill in the **Sample Name** and **Operator** fields. Then click the green **Run** button under the text fields. Refer to Figure 36.



Figure 36: Sample Name, Operator Field and Run Button

9. Press the red **EZ** button on the TESC. After pressing the red **EZ** button, the red Profile Indicator on the Watlow screen appears. Refer to Figure 37.

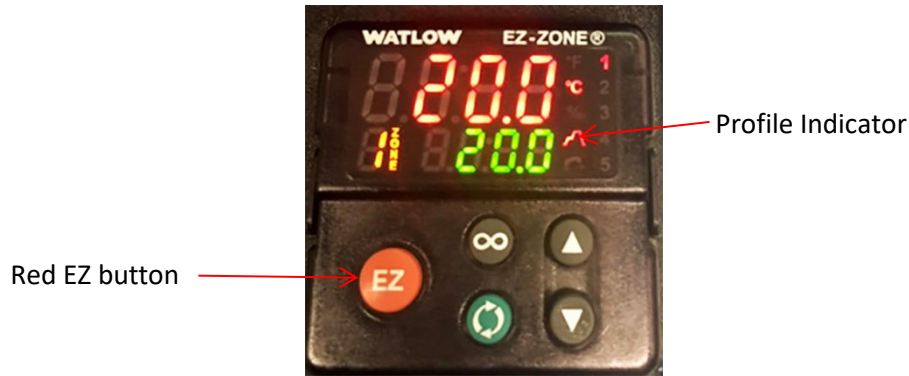


Figure 37: Red EZ Button and Profile Indicator on TESC

10. On the PC, press **Confirm** in the TESC software, as shown in Figure 38.

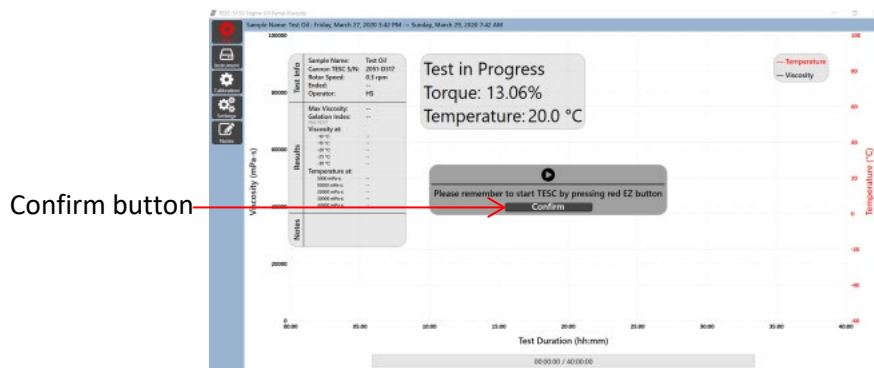


Figure 38: Confirm Test

11. Watch the torque values for the first minute to ensure the number does not vary by more than 10%. Torque value is displayed on-screen in a popup. This popup is moveable and can be dragged to another location on-screen for easier and more convenient use and viewing. Refer to Figure 39.

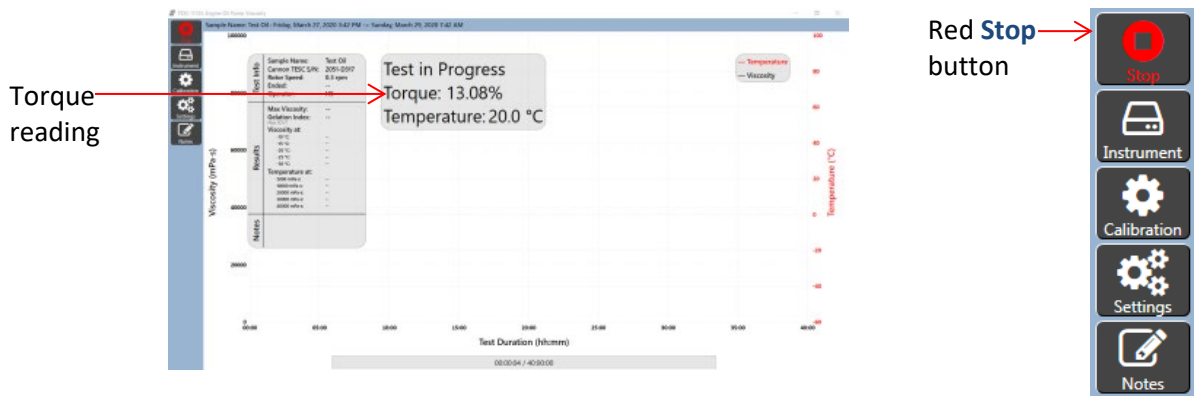


Figure 39: Test in Progress Screen with Torque Reading



Caution: If the torque varies by more than 10% in the first minute, stop the test by clicking the red **Stop** button on the PC sidebar column and pressing the Red **EZ** button on the TESC. Check that the instrument is set up and leveled properly, and start the test again.

12. When the sample run is complete, results are displayed in graph format on the PC screen as shown in Figure 40.

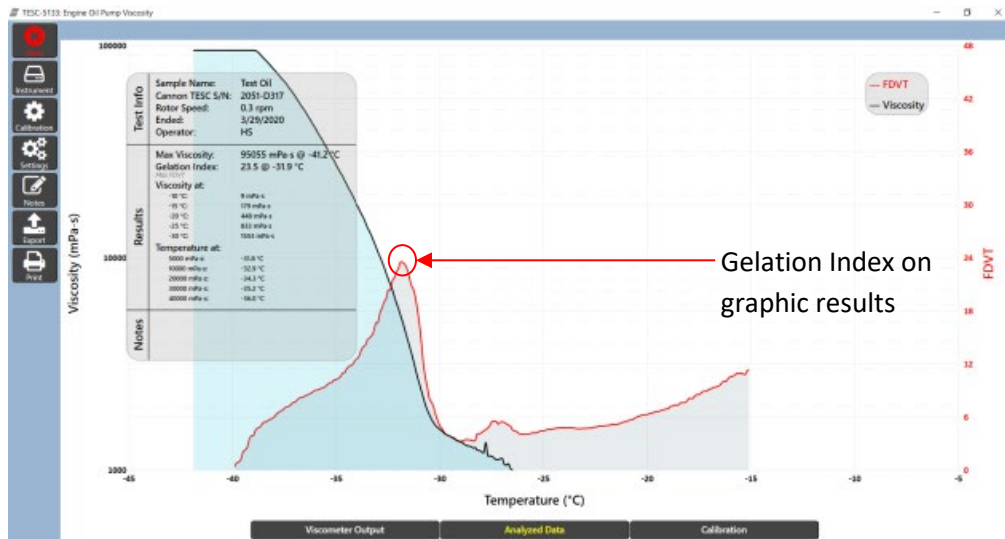


Figure 40: Results of Sample Run



Note: For an understanding as to how Gelation Index is found, the software displays a graph with temperature on the x-axis and FDVT (first derivative of viscosity with respect to temperature) on the y-axis. The peak of this curve is the Gelation Index, and is shown in Figure 31.

13. The TESC software allows users to export or print the results using the sidebar controls. Exported data is sent in .csv format. On-screen graphic results can be printed to available connected printers or to pdf. Refer to Figure 41.

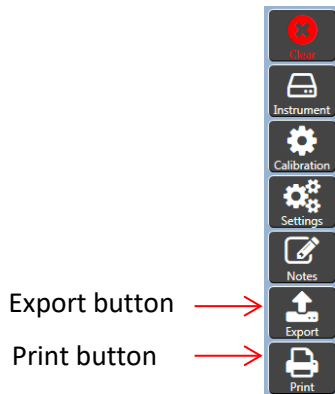


Figure 41: Results Options

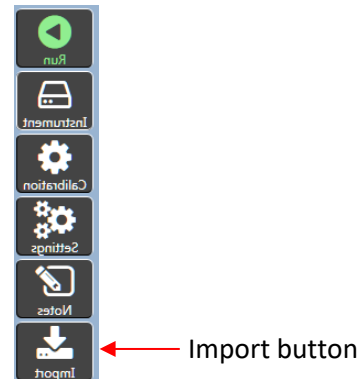


Figure 42: Import Button on Sidebar Column



Note: The **Clear** button appears in the sidebar column after a test finishes or is cancelled. It erases all existing data, but this data can be retrieved by using the **Import** button, which is shown in the TESC Software Sidebar Column (Figure 42).



Temperature Calibration

The instrument is factory-calibrated and shipped ready to run samples. However, in the case that you want to calibrate the temperature again, proceed with the steps in this section to ensure proper operation and results. Temperature calibration ensures that the Base Unit, Head Unit, and an external temperature probe all agree when the sample is at -30.0 °C.



Note: Prior to temperature calibration, follow the steps outlined in the section Sample Preparation using 35 mL of an appropriate standard (instead of 20 mL). The 35 mL volume corresponds with spindle fill volume in the test tube when running a TESC test. CANNON recommends using standard CL260 for TESC-5133 calibration.

1. Click **Calibration** from the TESC software sidebar column. Refer to Figure 43.

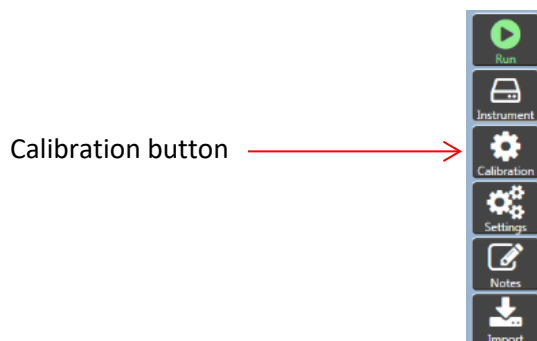


Figure 43: Sidebar Column on TESC Software

2. Click **Calibrate** in the software display window. Refer to Figure 44.

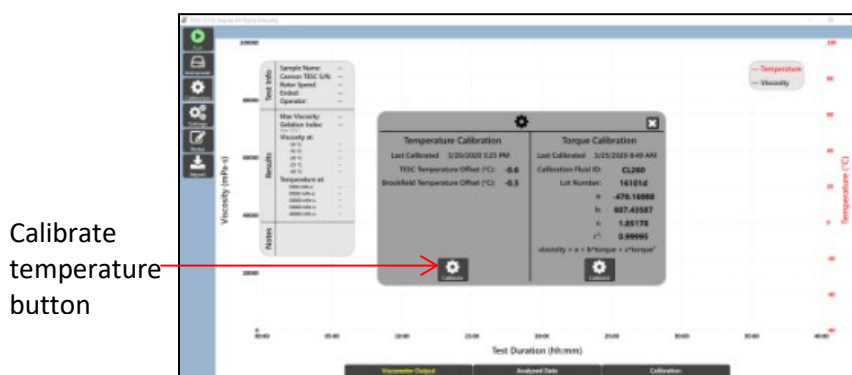


Figure 44: Calibrate Display Window

3. The first window to appear in a sequence of windows (shown in Figure 45) provides a guide on calibrating the instrument along with on-screen prompts. The calibration process may take several hours. Follow the instructions on each window, pressing the **Next** or **Yes** buttons accordingly.

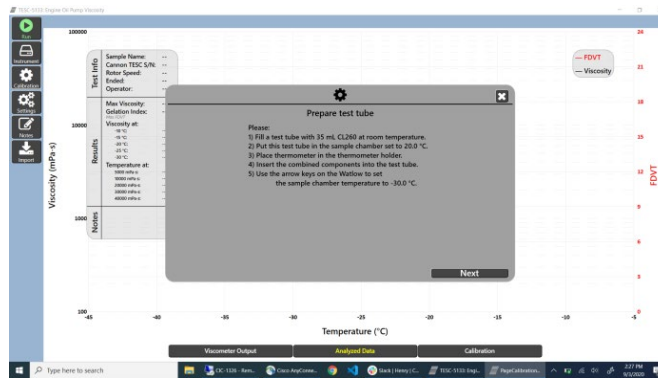


Figure 45: Calibrate Temperature Wizard

The following sections Prepare for Temperature Calibration and Temperature Calibration of Base Unit provide a more detailed explanation than the instructions on-screen, and can be used along with the software. This manual does not address all the details and components of temperature calibration, as the software maintains those processes and information, but provides the base information needed for an operator to understand and calibrate the instrument.

Prepare for Temperature Calibration

The following section provides step-by-step instructions for placing the thermometer and thermometer adaptor into position in order to calibrate the TESC instrument temperature.

1. If the red Profile Indicator (steps) symbol is highlighted on the Watlow controller on the Base Unit, press the red **EZ** button to turn it off. Refer to Figure 46.

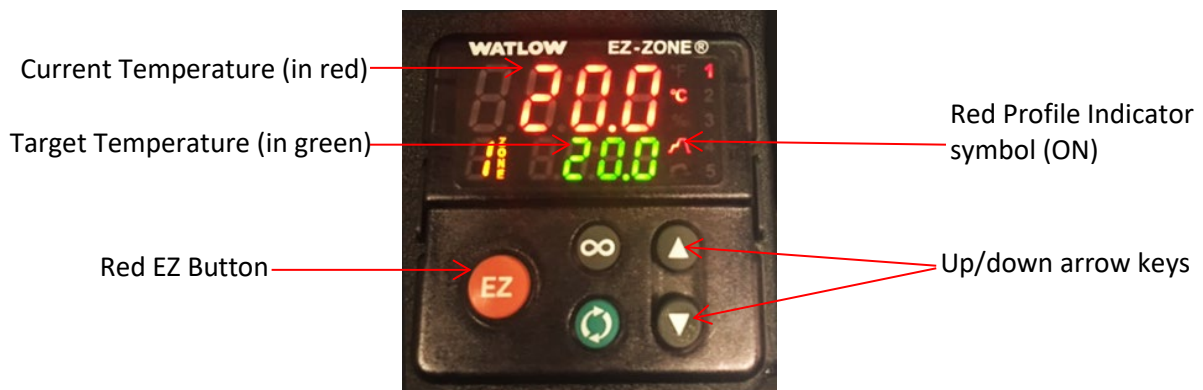


Figure 46: Watlow Controller on Base Unit

2. Use the up/down arrow keys to set the target temperature to 20.0 °C. The actual temperature is listed in Red.
3. Lift the Head Unit to its uppermost position until it “clicks.” Raise or lower the Head Unit by squeezing the grip on the front of the lever arm.
4. Place the thermometer adaptor onto the thermometer probe:
 - a. Holding the thermometer adaptor, gently lower the thermometer probe into the test tube until only the upper square part of adaptor is visible. Be cautious to not bump the Head Unit while placing the probe. Refer to Figure 47.

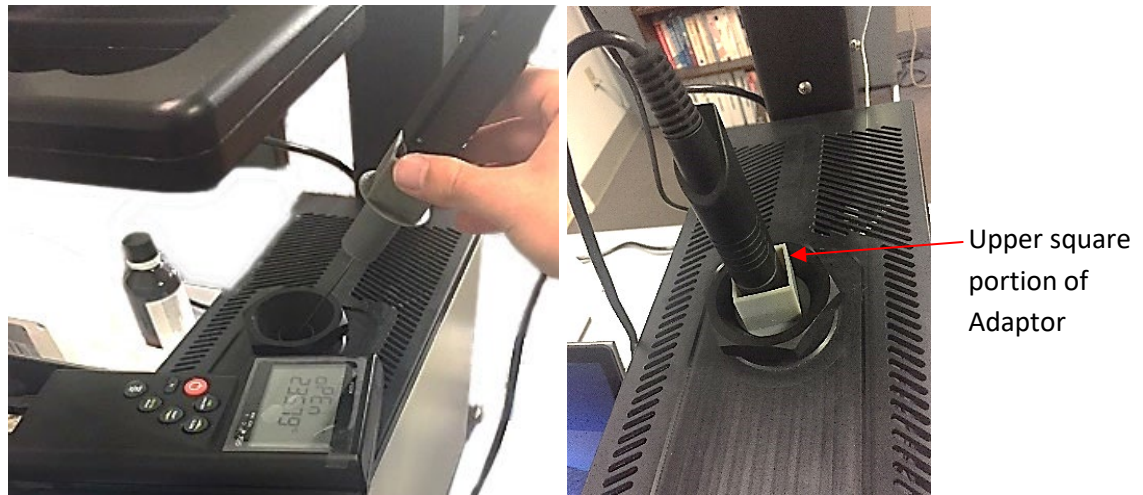


Figure 47: Inserting the Thermometer Probe into the Test Tube

5. Using the up/down arrow keys on the Watlow controller, set the target temperature to $-30.0\text{ }^{\circ}\text{C}$.
6. Wait two hours for the sample temperature to stabilize.

Temperature Calibration of Base Unit

The following section outlines the process of calibrating the TESC Base Unit's temperature sensor so that it properly reads $-30.0\text{ }^{\circ}\text{C}$ when the sample is at $-30.0\text{ }^{\circ}\text{C}$. Specifically, the calibration is for the Watlow temperature control unit, which is built into the Base Unit.

1. If not already completed, install the Watlow configuration software on to the controlling PC.
 - a. Insert the flash drive provided with the TESC System into the computer.
 - b. Follow the on-screen prompts to install the Watlow `EZ-Zone Configurator.exe`.
2. Connect the PC to the Watlow controller using the RS-485 to USB cable, as shown in Figure 48.



Figure 48: RS-485 to USB Cable



Note: The first time the RS-485 to USB cable is connected to a computer, allow the operating system to automatically install the proper device drivers. Windows®10 is the recommended operating system.

3. Launch the Watlow configurator program from the desktop shortcut, named **EZ-ZONE Configurator**.

4. From the opening window, click the radio dial for the first option, **Configure a device while communicating with it**. Then click **Next**.
5. The software automatically selects the correct COM port for the Watlow controller connection. Select **Next**.
6. The next window contains the list of available devices. Select the only item from the list of **Available EZ-ZONE Devices**, as shown in Figure 49.

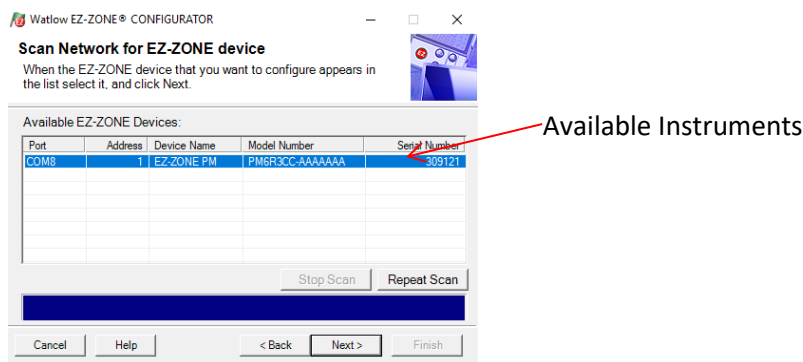


Figure 49: Available EZ-Zone Devices

7. If there is more than one device listed, determine which one is from the TESC System by unplugging the RS-485 to USB cable, clicking **Repeat Scan**, and noting which device disappears.
8. Plug the cable back in, click **Repeat Scan**, and select the proper TESC System.
9. If no devices are found, click **Back**. Repeat step 5, trying a different COM port.
10. Click **Next**.
11. In the **Parameter Menu** on the left side, click the plus signs to enlarge the **EZ-ZONE PM > Setup > Analog Input** and open the **Calibration Offset Field** screen, shown in Figure 50.

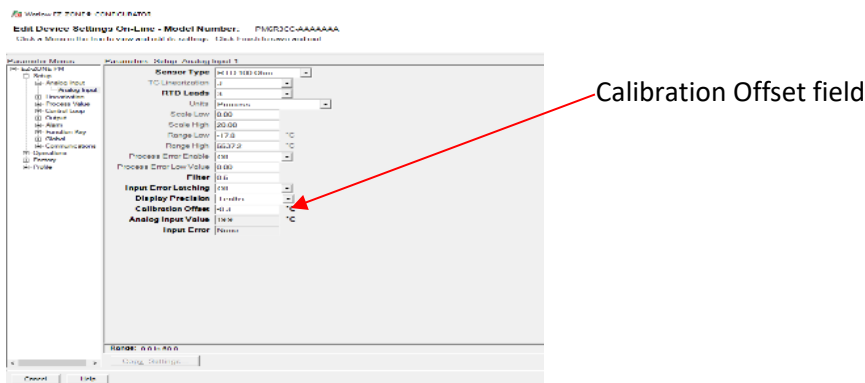


Figure 50: Calibration Offset Field in Watlow Configuration Software

12. Calculate the difference between the measured temperature from the thermometer and $-30.0\text{ }^{\circ}\text{C}$. Modify the **Calibration Offset** field, shown in Figure 50, by entering the difference between the two numbers.
13. If the number in the **Calibration Offset** field needs to be changed, click outside of the box to deselect the **Calibration Offset** field. This sends the changes to the Watlow controller. In ten

seconds, confirm that that number in the **Calibration Offset** field is still properly entered. This ensures that the changes are accepted. Wait one hour for the Watlow temperature to stabilize, and repeat this step.

14. In the **EZ-ZONE Configuration** software, click **Finish**.
15. Select **Exit and do not save the changes in a file**. Click **Finish**. Or to save a backup with the new offsets, select the radio button **Save the configuration in a file and exit**. Refer to Figure 51.

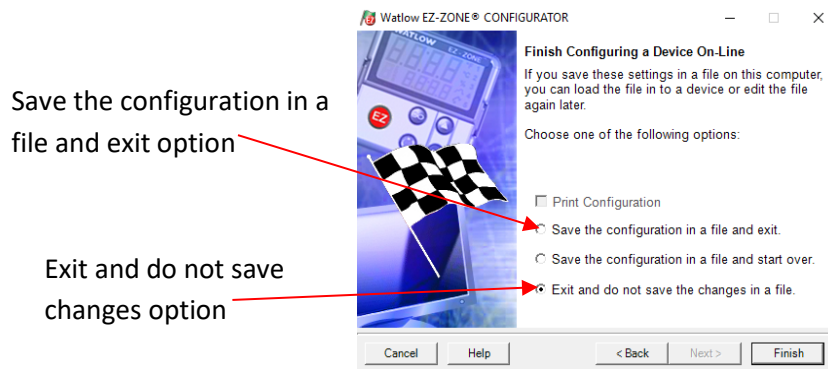


Figure 51: Final screen of Watlow Configuration Software

16. To reset the Watlow temperature control unit in the future, select **Download a configuration file in to a device** on the Welcome screen and download this file to the Watlow device. Refer to Figure 52.

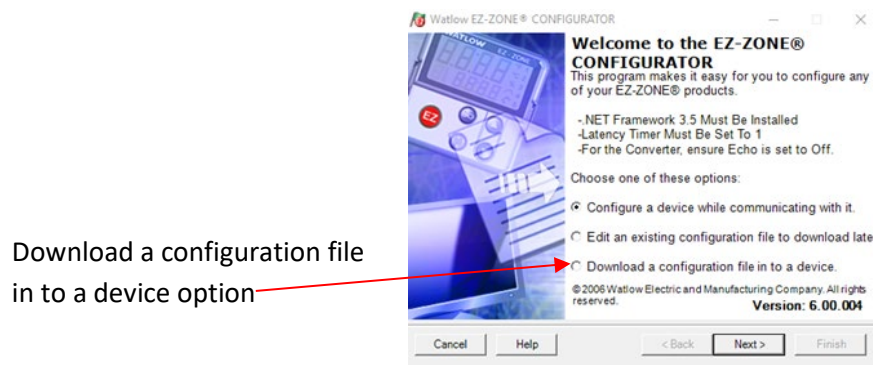


Figure 52: Watlow Options on Welcome Screen

Completion of Temperature Calibration

In the following section, the temperature calibration procedure for the TESC-5133 is completed.

1. Using the up/down arrow keys on the Watlow controller, set the target temperature to 20.0 °C.
2. Wait 1 hour (60 minutes) for the sample to warm to temperature. Holding the thermometer adapter, lift the thermometer probe out of the test tube. Store the thermometer and the thermometer adapter in a safe place for future use.
3. Unplug the RS-485 to USB cable from the TESC Base Unit and the computer. Store the cable away for future use.



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



Torque Calibration

The instrument is factory-calibrated and shipped ready to run samples. However, in the case that you decide the torque needs to be calibrated again, proceed with the steps in this section to ensure proper operation and results.

After the temperature is calibrated (as outlined in previous section) the TESC-5133 is now ready for torque calibration. Once the software is installed, the instrument is prepared, and the spindle is inserted into the Head Unit, proceed with the following steps to run a TESC-5133 calibration using an appropriate standard.



Note: Prior to torque calibration; follow the steps outlined in Sample Preparation to ensure instrument is properly set up.
CANNON recommends using standard CL260 for calibrating the TESC-5133.

1. Click **Calibration** from the TESC software sidebar column. Refer to Figure 53.

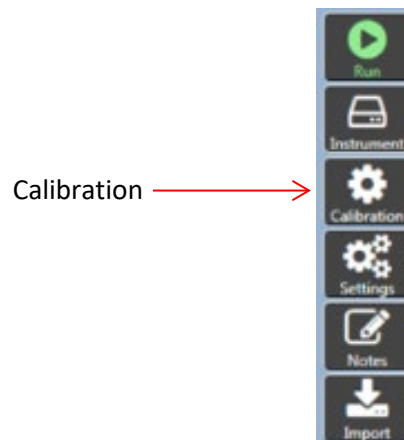


Figure 53: Sidebar Column on TESC Software

2. Press the **Calibrate** button in the Torque Calibration section of the software display window. Refer to Figure 54.

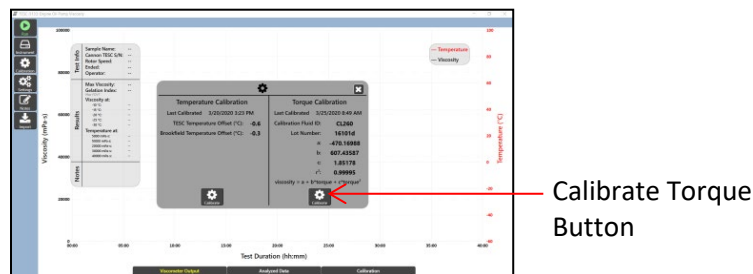


Figure 54: Calibrate Display Window

3. Install and open the VISDISK software, included in the instrument's flash drive. VISDISK should already be installed from previous sections and instrument operation.

- Fill in the appropriate fields with the values from VISDISK.
- Go to **Applications** then select **Kin Vis, Density, Temperature**, as shown in Figure 55.

Kin Vis, Density,
Temperature



Figure 55: VISDISK Applications

- Using the CANNON standards bottle label, enter the values for temperature and viscosity. CANNON recommends using CL260 to properly calibrate the TESC-5133. For this standard, use the data field on the bottle label named **Viscosity**, not Kinematic Viscosity, to fill in the data field on VISDISK named **Kin Vis**.

Refer to Figure 56, CL260 standard bottle, and Figure 57, the VISDISK data entry fields.

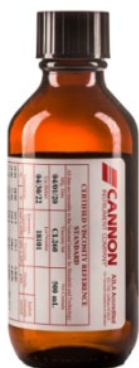


Figure 56: CL260 Standard



Figure 57: Kin Vis, Density, Temperature Display

- After entering all values, click **NBS Kin Vis**.
- This opens a popup window, just click **Done** in window. (**B** is for best fit and auto-populates, leave that as is.) Refer to Figure 58.

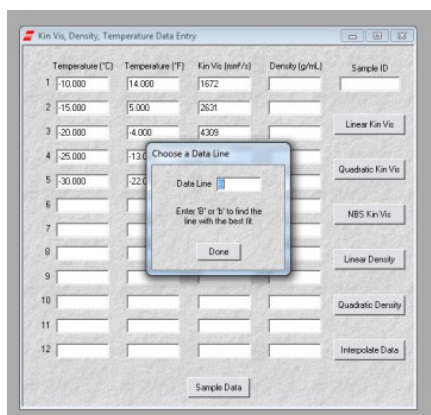


Figure 58: NBS Kin Vis Popup with B for best fit

- After clicking Done, the **NBS Regression Analysis of Kin Vis Data** window opens as shown in Figure 59.

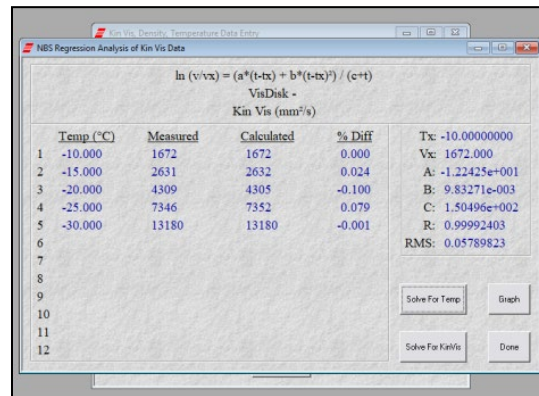


Figure 59: NBS Regression Analysis of Kin Vis Window



Note: VISDISK shows certain data written in scientific notation. For instance, in Figure 29, B is $9.83271 \times 10^{-3} = 0.00983$. This is equivalent to $9.83271e-003$.

- Using the values from this screen, enter the appropriate figures into the calibration window in the TESC software. Refer to Figure 60.



Figure 60: VISDISK Data in the TESC Software

- After all appropriate values are entered, click **Confirm**. Then click **Calibrate** in the software window. Refer to Figure 61.

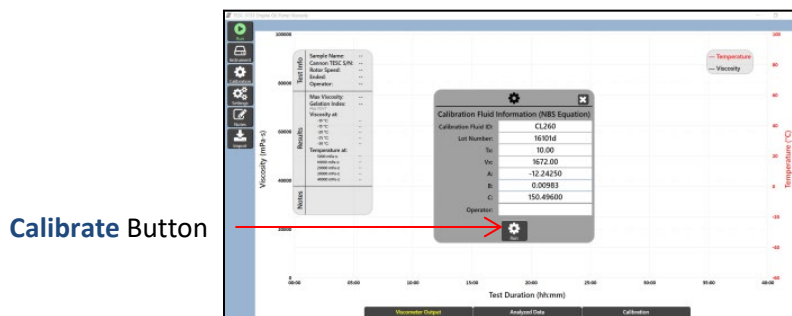


Figure 61: Calibrate Window in TESC Software

- Press the red **EZ** button on the TESC. After pressing the red **EZ** button, the red Profile Indicator (or steps symbol) on the Watlow screen appears. Refer to Figure 62.



Figure 62: Red EZ Button on TESC

13. In the TESC software on the PC, press the **Confirm** button. Refer to Figure 63.

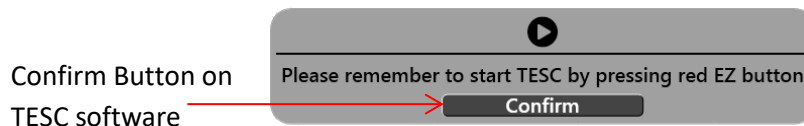


Figure 63: Confirm Button

14. Watch the torque values for the first minute to ensure the number does not vary by more than 10%. Torque value is displayed on-screen in a popup window. This convenient popup is moveable and can be dragged to another location on-screen for easier use and viewing. Refer to Figure 64.

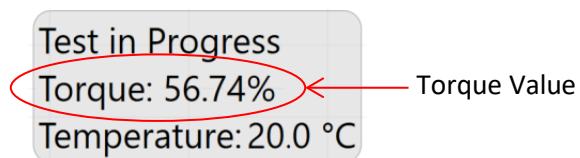


Figure 64: Torque Display Popup



Note: If the torque varies by more than 10% in the first minute, stop the test by clicking the red **Stop** button on the PC sidebar column and pressing the **Red EZ** button on the TESC. Check that the instrument is set up properly, re-level unit, and start the test again.

15. If torque is within the proper range (not varying by more than 10%), press the red **EZ** button on the TESC Base Unit. This displays the red Profile Indicator symbol when active. Refer to Figure 65.



Figure 65: Red EZ Button and Profile Indicator

16. After approximately 40 hours, the instrument finishes calibrating. A window appears displaying **Last Calibrated** with the current date along with a graph of results. Refer to Figure 66.

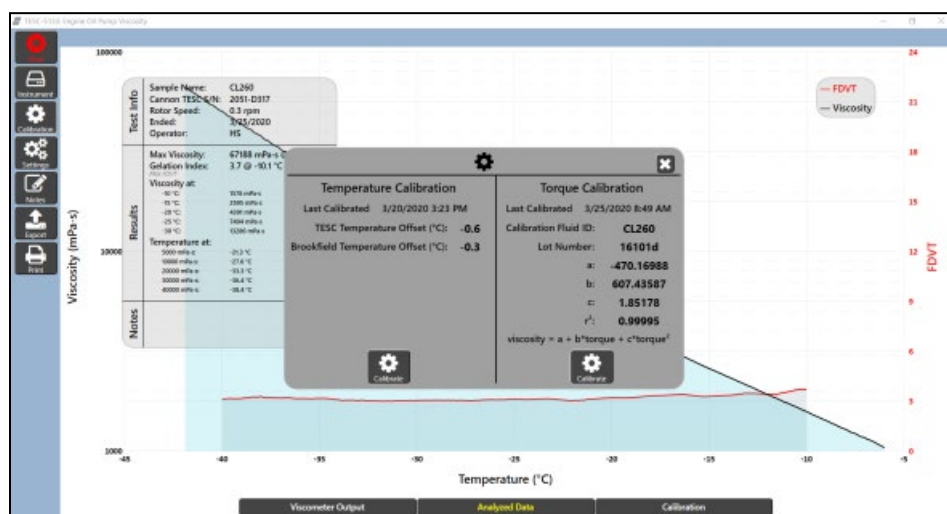


Figure 66: End Screen Graph Results of Calibration



Note: Ensure the r^2 value is equal to or greater than 0.999. If not, repeat calibration.



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