



**Operating Instructions
TX-1 Series Digital
Wire / Filament Tension Meter**

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1. WARRANTY POLICY

Limited Warranty on Products

Any Cooper Instruments product which, under normal operating conditions, proves defective in material or in workmanship within one year of the date of shipment by Cooper will be repaired or replaced free of charge provided that a return material authorization is obtained from Cooper and the defective product is sent, transportation charges prepaid, with notice of the defect, and it is established that the product has been properly installed, maintained, and operated within the limits of rated and normal usage. Replacement or repaired product will be shipped F.O.B. from our plant. The terms of this warranty do not extend to any product or part thereof which, under normal usage, has an inherently shorter useful life than one year. The replacement warranty detailed here is the buyer's exclusive remedy, and will satisfy all obligations of Cooper whether based on contract, negligence, or otherwise. Cooper is not responsible for any incidental or consequential loss or damage which might result from a failure of any and all other warranties, express or implied, including implied warranty of merchantability or fitness for particular purpose. Any unauthorized disassembly or attempt to repair voids this warranty.

Obtaining Service under Warranty

Advance authorization is *required* prior to the return to Cooper Instruments. Before returning the item, contact the Repair Department c/o Cooper Instruments at (540) 349-4746 for a Return Material Authorization number. Shipment to Cooper shall be at buyer's expense and repaired or replacement items will be shipped F.O.B. from our plant in Warrenton, Virginia. Non-verified problems or defects may be subject to a \$150 evaluation charge. Please return the original calibration data with the unit.

Repair Warranty

All repairs of Cooper products are warranted for a period of 90 days from date of shipment. This warranty applies only to those items that were found defective and repaired; it does not apply to products in which no defect was found and returned as is or merely recalibrated. It may be possible for out-of-warranty products to be returned to the exact original specifications or dimensions.

* Technical description of the defect: In order to properly repair a product, it is *absolutely necessary* for Cooper to receive information specifying the reason the product is being returned. Specific test data, written observations on the failure and the specific corrective action you require are needed.

2. SPECIFICATIONS

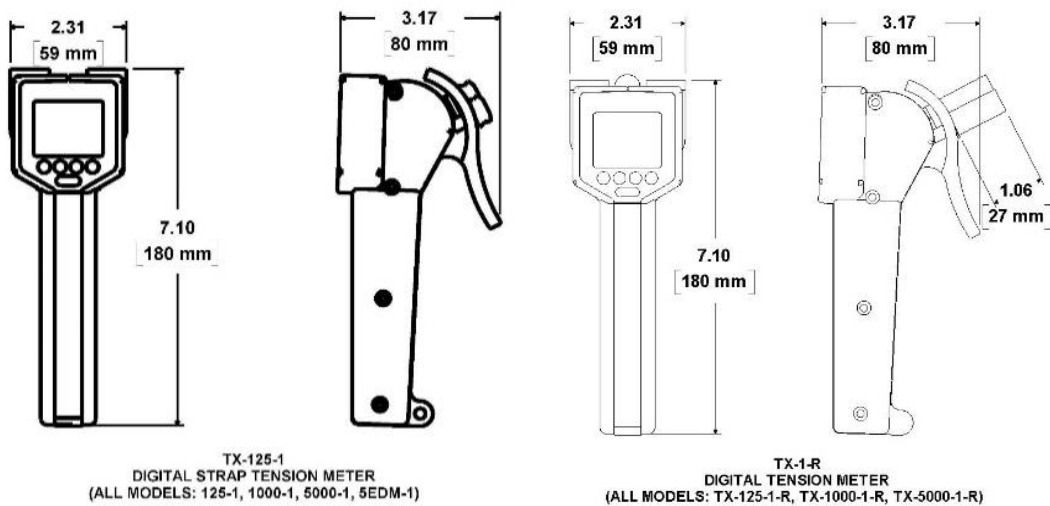


Figure 1: TX-1 Dimensions

- **Full Scale Accuracy**
For all models up through 5000 grams: 1%
Accuracy for custom calibrations is material specific
- **Power Requirements**
For Instrument Input: 9 VDC...2.2A
For AC Adapter: 100-240V~50-60Hz 0.48A
Power Supply operates with input voltages from 100 –240V and includes several interchangeable adapters allowing use with European, U.S., Australian, British, and other plug configurations.
Battery: Rechargeable NiMH, custom proprietary design
- **Battery Life**
Approximately 12 hours depending on backlighting intensity
- **Operating Temperature**
32° F to 120 ° F
If these values are exceeded, battery charge/discharge rates will decline. However, this could be offset by using the power supply. Charging in direct sunlight or near a heat source will not produce a full charge and may permanently damage battery pack.
- **Storage Temperature**
20° F to 158° F (instrument and charger)
- **Ambient Humidity**
10% to 90% non-condensing
- **Dimensions**
All models without cylindrical rollers: 2.31" x 3.17" x 7.10"
All models with cylindrical rollers: 2.31" x 3.70" x 7.10" (See Figure 1)
- **Weight**
.75 lb. (depending on instrument configuration)
- **Environment:**
Indoor or outdoor use, dust-free environment

3. SAFETY

WARNING: When using cordless, electronic instruments, always follow basic safety precautions to reduce the risk of fire, electric shock, or personal injury

READ AND SAVE ALL INSTRUCTIONS FOR FUTURE USE. Before using this meter, make sure all users read and understand this manual, as well as any labels packaged with or attached to the instrument.

- Know your instrument. Read this manual carefully to learn your tension meter's applications and limitations, as well as potential hazards associated with this type of instrument.
- Avoid dangerous environments. Do not use your instrument in the presence of explosive atmospheres (gaseous fumes, dust or flammable materials). Do not submerge your instrument in liquids.
- Use the right tool or instrument. Do not use this instrument to do a job for which it is not recommended.
- Check for damaged parts. Inspect instrument before use. Check for any binding of moving parts, improper mountings, broken parts, and any other condition that may affect operation. Do not use a damaged instrument. Tag damaged instrument "DO NOT USE" until repaired. For repair, send instruments directly to Cooper, Inc.
- Guard against electric shock.
- Maintain instrument carefully. Keep handles dry, clean, and free from oil and grease. Do not lubricate. All roller bearings are sealed.

- Do not use instrument if it has received a sharp blow or been dropped or damaged in any way. Do not disassemble. Incorrect reassembly may result in damage to the instrument and risk of electric shock and fire. If instrument is damaged return it to Cooper, Inc. for repair.
- Unplug charger when not in use.
- WARNING: Only use battery pack assemblies provided by Cooper, Inc. with your meter (P/N: TX-BATT). Other types of batteries might explode, causing personal injury and damage.

4. INSTRUMENT OPTIONS

Standard Instruments

Model	Material Selection (Wire / Filaments)	Resolution (grams)	Range (grams)
TX-125-1	37 to 54 AWG or finer / .0002" to .0044" Filaments	0.1 or 1	0-125
TX-1000-1	32 – 40 AWG or finer / .002" to .008" Filaments	1 or 5	10-1000
TX-5000-1	28 – 40 AWG or finer / .02" to .120" Filaments	5 or 10	50-5000
TX-5EDM-1	EDM Wires (.10, .15, .20, .25, & .30mm)	5 or 10	50-5000

Add-On Options

Instruments can be configured with any of the options below. Meters can be equipped with either –A or –E, but not both.

- **- R Custom Roller option**
Choose from numerous sizes of cylindrical, flanged or U-shaped rollers.
- **- S Speed and Length option**
Indicate real-time speed in FPM or MPM. Maximum measurable speed is 9,999 FPM or 9,999 meters per minute. (Note: Line speeds exceeding 2,000 FPM are generally unsafe for hand-held applications.) Read length measured up to 9,999 meters.
- **- A Analog Output option**
For both speed and tension values.
0-5 VDC of 4-20mA with software definable ending sequences.
Data output at 40 Hz.
Provided with 10' cable to interface with your receiving device.
- **- E RS-232 Serial Output option**
Select data sampling rate from 1, 2 or 5 Hz.
Provided with 10' cable to interface with your receiving device.

Features of all Instruments

- Large, easy-to-read, color display with adjustable backlighting.
- Display shows tension, material selected, minimum and maximum tension values, and a dynamic color bar graph that indicates changing tensions and battery charge levels.
- Select tension values to display in grams, lbs, Newtons or cN (cN only available on TX-125-1-series instruments).
- Instrument includes calibrations for numerous wires and filaments.
- Extremely accurate custom calibration using up to a 10-point linear calibration procedure.
- All calibrations are password protected.
- Choose your calibration by first highlighting and selecting the material (Wire, Filaments or Custom). Next define material size using choices such as AWG, inches or mm and push "Enter". The instrument automatically adjusts to the calibration you've selected with a full-scale accuracy of +/- 1%. Note: Full-scale accuracy for custom calibrations is material-specific.
- Adjustable LCD refresh rates allowing for stable, digital readouts.
- Automatic shutoff after several minutes of non-use.
- Instruments may be operated continuously while connected to power supply.
- Data Logging: Select either Continuous or Single Point data logging mode and record tension or (optional) speed values to the instrument memory.
- Data Averaging: Stabilizes your displayed tension readings. This feature calculates and displays a rolling average of the readings taken over a user-defined time period. Options are: 1, 2, 5, or 10 seconds. (Only the readings taken in the most recent period will be averaged and displayed.)

- Data Statistics: Monitor your process by viewing count, average, minimum/maximum, and standard deviation values of your logged data.
- Set-Point feature: allows user to specify high and low tension points which are then shown on the main display as an active, color-changing bar graph.
- Rechargeable NiMH batteries with power supply provided. Approximately 12 hours of continuous use depending on backlighting intensity.
- Power supply operates with input voltages from 100 – 240V and includes several interchangeable adapters allowing use with European, Australian, US, British, and other plug configurations.
- Optional features, including: Custom Rollers, Speed and Length monitoring, Analog Output or Serial Output.
- Optional magnetic or rigid Mounting Bracket.
- All models typically available from stock.
- Numerous application-specific models available.
- Durable, lightweight carrying case with protective foam inserts. (See Figure 2.)
- All instruments are factory-calibrated and ready to use. Calibration certificate is included. All calibration values are traceable to National Standards.



Figure 2: Carrying case with instrument, calibration certification, power supply (charger), and adapters.

5. BASIC OPERATION

Charging Instrument Batteries

1. Connect power supply cable to the instrument.
2. Plug the power supply into a power source with input voltages between 100 – 240 VAC.
3. A full charge of the battery assembly requires several hours of charging.
4. The battery pack assembly cannot be overcharged.
5. The instrument will remain on while connected to its power supply.
6. The battery charge level is indicated in the upper, right-hand corner of the display.

Quick Start Instructions

1. Power the unit on by pressing ON button. Main display will indicate: Tension, Material, Min and Max tension readings. (See Figure 3.)
2. Select a screen:
 - a. Move between screens by using the up (↑) and down (↓) buttons.
 - b. Make or enter a selection by pressing the Enter/Zero button.
 - c. Exit a setting by pressing the Escape (ESC) button.

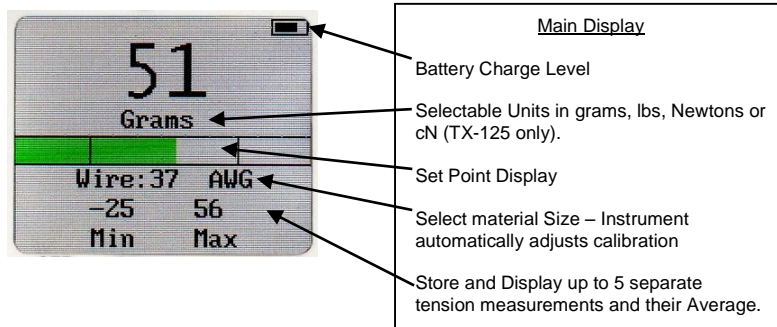
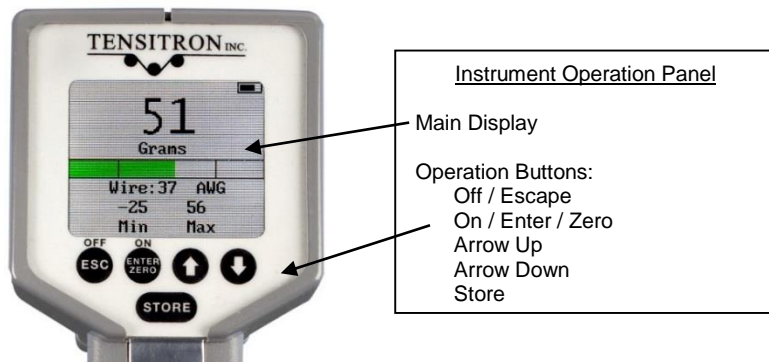
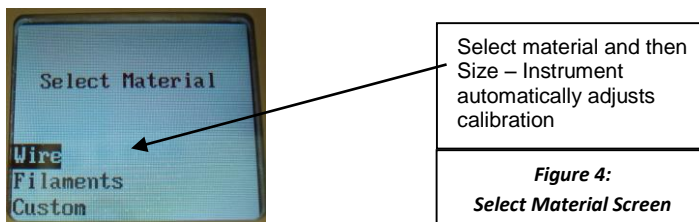


Figure 3: Instrument Operation Panel and Display

3. Log Data:
 - a. Press the STORE button to store tension readings along with the Minimum and Maximum of these values.
 - b. Clear the data displayed on the Main Screen by pressing and holding the STORE button, or power the instrument off.
 - c. For additional information on logging and viewing data, refer to Sec 6 - Display Screens - Data Logging.
4. Read Tension: Variations in materials affect tension readings. It is essential to select the correct material and size before use, or tension values may be incorrect.
5. Select Tension Units:
 - a. Using the up or down arrows, scroll to TENSION UNITS, then press ENTER.
 - b. Next, select from: Grams, Newtons, or LBS, and then press ENTER.
6. Select material:
 - a. Using the up or down arrows, scroll to SELECT MATERIAL, then press ENTER.
 - b. Next select your material from: Wire, Filaments or Custom and press ENTER. Next select your material size (diameter) in AWG (for wires), Inches, mm or description for Custom entries and then ENTER your selection. (See Figure 4.)
 - c. If your specific material is not listed, add it to the menu by following the calibration instructions included at the end of these instructions. Or, send a 15' sample of your material and the instrument to Cooper and ask to have it added to the menu.



**Figure 4:
Select Material Screen**

7. Zero Instrument: Hold the instrument in the attitude your reading will be taken before you engage it to the tensioned material. Then, press ZERO.

Engaging Instrument onto Material

WARNING: DO NOT EXCEED THE MAXIMUM TENSION RANGE OF THE INSTRUMENT OR DAMAGE WILL OCCUR.

- Engage the Instrument onto the tensioned material by separating the rollers (squeeze the trigger assembly) and inserting your material between the fixed roller and the two rollers on the trigger assembly. (See Figure 5.)
- Once the material is in line with the three rollers, slowly release the trigger until it makes a full stop. Note tension reading (See Figure 6.)



Trigger and Guide Plate

Note the routing of the material.
Pull Trigger and engage instrument
onto material

Figure 5: Instrument ready to engage



Note the routing of the Cable.

Once material is properly routed,
gently release the Trigger until it stops
into the engaged position.

**Figure 6: Instrument engaged onto
material**

6. DISPLAY SCREEN

SETUP Screen

○ LCD Refresh Rate

To either speed up or slow down the instrument's LCD refresh rates:

- Scroll to SETUP and press ENTER.
- Scroll to LCD REFRESH RATE and press ENTER.
- Enter your preference: 1, 2 or 5 Hz and press ENTER.
Note: This feature is unrelated to Data Averaging.

○ Data Averaging

Use this feature to adjust the stability of your displayed tension readings. It allows users to select the duration the meter takes tension readings over before averaging all of the readings and posting that average to the display. The meter takes ~300 readings per second, so if a 1 second duration is selected, the meter will average all 300 readings before posting the average of those readings to the display. Likewise, if a 10-second duration is selected, the meter will average all 3000 readings before posting the average of those 3000 readings to the display. Options are: 1, 2, 5 and 10 seconds. This is a rolling average, meaning that only the readings taken in the last 1, 2, 5 or 10 seconds (your choice) will be averaged and displayed.

Note: This feature is primarily used in processes where the material to be checked is constantly moving, such as coil winding and textiles.

○ Cal Analog (Optional feature)

Use this feature to calibrate the Analog Out option by hanging the weight specified on the screen then entering that numeric value on your Signal Conditioner (follow the instructions with your signal conditioner)

- Scroll to SETUP and press ENTER.
- Scroll to CAL ANALOG and press ENTER.
- Using the up and down arrows adjust the display to indicate the value at which the instrument should output maximum Voltage or current.
- Then press ENTER.

○ Cal Length (Optional feature)

Use this feature to calibrate the Length measurement option of your instrument.

- Scroll to SETUP and press ENTER.

- Scroll to CAL LENGTH and press ENTER.
- Next, using a precise 20-foot length of your material (20.0'), thread one end through the instrument's three rollers and slowly pull exactly 20.0' through the instrument.
NOTE: The material must be under tension to make good contact with the rollers on the instrument.
- Then press ENTER.

○ **Custom Names**

Custom calibrations, listed as Custom 0 – 9, can be renamed so your material appears as a selection on the Main Display. To rename a Custom Calibration:

- Scroll to SETUP and press ENTER.
- Scroll to CUSTOM NAMES and press ENTER.
- Scroll to the description to rename and press ENTER.
- Input your custom name by using the up and down arrows to select each number, letter, or character, followed each time by ENTER.
- Continue pressing ENTER until all spaces in the description have values, including blank spaces.
- Once your new name has been entered you will automatically be returned to the SETUP screen.

○ **Resolution**

To either increase or decrease the Resolution of the tension readings:

- Scroll to SETUP and press ENTER.
- Scroll to RESOLUTION and press ENTER.
- Select your preference: 5 or 10 Grams for the Model TX-5000 series, 1 or 5 Grams for the TX-1000 series, or 0.1 to 1 Grams for the TX-125 series. Then press ENTER.

○ **Length Units (Optional feature)**

Use this feature to select the unit for measuring length.

- Scroll to SETUP and press ENTER.
- Scroll to Length Units and press ENTER.
- Select your preference: Meters or Feet, and press ENTER.

○ **Re-Cal Tension: See description at the end of this booklet.**

ONLY PERFORM THIS IF YOU ARE A QUALIFIED CALIBRATION HOUSE USING NIST-CERTIFIED CALIBRATION WEIGHTS. NOT USED FOR CHECKING ACCURACY. TO CHECK ACCURACY, REFER TO SEC. 7: CHECK ACCURACY.

○ **Audio**

To turn the Beep ON or OFF:

- Scroll to SETUP and press ENTER.
- Scroll to AUDIO and press ENTER.
- Select ON or OFF and press ENTER.

○ **Backlight**

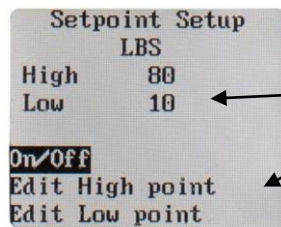
To adjust the visual intensity of the LCD screen:

- Scroll to SETUP and press ENTER.
- Scroll to BACKLIGHT and press ENTER
- Select Low, Medium or Full intensity and press ENTER.

○ **Set-Point Menu**

This feature displays tension as a colored bar on the main display. The colored bar advances as tension increases, and retracts as tension decreases. You can define a safe operating tension range. For tension measurements within this range, the bar is green. Below the range, the bar is amber. Above the range, the bar is red. To adjust the Set Point Menu:

- Scroll to SETUP and press ENTER.
- Scroll to SETPOINT MENU and press ENTER.
- Follow and enter the prompts to turn this feature on or off, or to edit your high and low values. (See Figure 7.)



Set Point Setup Screen
See High and Low threshold values
Settings:
On / Off
Edit High Point Threshold
Edit High Point Threshold

Figure 7: Setpoint Setup

○ **Version**

Press this button to determine the instrument's model and what level of firmware is downloaded to the instrument.

DATA LOGGING Screen

Each time the instrument's STORE button is pressed, a log of that material tension will be stored in memory for later review.

○ **Logging Rate (when logging Continuous Data)**

To adjust the rate at which the tension readings are logged:

- Scroll to DATA LOGGING and press ENTER.
- Scroll to LOGGING RATE and press ENTER
- Select 1, 2, or 5 Hz and press ENTER.

○ **Duration (when logging Continuous Data)**

To adjust the duration that tension readings are logged:

- Scroll to DATA LOGGING and press ENTER.
- Scroll to DURATION and press ENTER
- Use the Up and Down arrows to change the Duration that you want data stored and press ENTER. (Minimum: 10 seconds; Maximum: 100 seconds)

○ **Select Mode**

To change the mode that tension readings are logged:

- Scroll to DATA LOGGING and press ENTER.
- Scroll to SELECT MODE and press ENTER
- Use the Up and Down arrows to select either CONTINUOUS or SINGLE POINT data collection.

○ **View Data Stats**

This feature allows the operator to view the basic statistics of the logged data (Count, Average, Min/Max, and Standard Deviation). (See Figure 8.)

Data Statistics Screen

See the Count, Average, Minimum/Maximum, and Standard Deviation of the logged data.

Figure 8: Data Statistics Screen

Data Statistics	
Count:	12
Avg:	293
StdDev:	30
Max:	352.8
Min:	231.6

○ **View Data Log**

When data is logged to the instrument memory, that data and the statistics of that data log (Count, Average, Minimum/Maximum, and Standard Deviation) can be seen under the Data Logging / View Data Stats screen. To view this logged data:

- Scroll to DATA LOGGING and press ENTER.
- Scroll to VIEW DATA LOG and press ENTER.

○ **Clear Single Point Log**

To clear stored data, scroll to CLEAR SINGLE PT LOG, press ENTER, and follow the prompts.

TENSION UNITS Screen

To change the unit of measure in which tension readings are logged:

- Scroll to Tension Units and press ENTER.
- Use the Up and Down arrows to Grams, Newtons and Pounds (CentiNewtons on TX-125 only) and press ENTER.

SELECT MATERIAL Screen

Press ENTER while this display is shown to show the available options for material types. The options are Wires, Filaments and Custom. Use the up or down arrow to scroll to the option you want and press ENTER to select it.

- **Select Material Wire Units**
This feature allows the operator to select the unit for describing diameter of wire to be measured for tension: AWG, Inches or mm.
- **Select Material Filaments Units**
This feature allows the operator to select the unit for describing diameter of filaments to be measured for tension: Inches or mm.
- **Select Material Custom Units**
This feature allows the operator to select the unit for describing diameter of the custom material to be measured for tension. For Custom, the operator inputs the options for units. Use the up and down arrows to scroll through all the available alpha-numeric symbols and press ENTER to choose that symbol.

LENGTH Screen

Scroll down to this screen to view the length that has traveled through the meter since enabled (or reset), measuring up to 9,999 meters. The units of measure will be shown in meters or feet. (These units are designated in the Setup screen under Length Units).

SPEED Screen

Scroll down to this screen to view the speed at which the material is passing through the meter at that instant. The meter will also store the Minimum and Maximum speeds logged. The units of measure will be shown in Meters/Minute or Feet/Minute. (These units are designated in the Setup screen under Length Units). Maximum measurable speed is 9,999 FPM or 9,999 meters per minute. Note: line speeds exceeding 2,000 FPM are generally unsafe for hand-held applications.

7. ADVANCED OPERATION

General Calibration Precautions

1. To verify the accuracy of your instrument, check the tension on a sample length of material by suspending known weights from the opposite end.
2. When performing this test, use a micrometer to measure your material diameter and ensure it is dimensionally within tolerance and not out of round.
3. Only use free-hanging weights which are traceable to National Standards, on correctly-sized materials. (See Figure 9.)
4. Never use any tensioning device that attempts to convert rotational torque values into tension loads, as these types of systems are highly inaccurate. Also, any load cell system must be routinely checked for accuracy using traceable weights, as these types of systems are also highly inaccurate and generally do not meet the minimum repeatable accuracy standards required by ISO-17025.
- 5.

Check Accuracy

1. Confirm that the size material you're working with is the same size selected in your instrument's display.
2. Before engaging the instrument onto the material, zero the instrument by holding it in the same attitude you'll be taking the readings, and pressing the "Enter" or "Zero" button. This will eliminate any small tare effects.
3. Take readings along the material. **FOR BEST RESULTS ALWAYS TAKE SEVERAL READINGS OF THE MATERIAL TENSION BY DISENGAGING AND THEN RE-ENGAGING THE INSTRUMENT ON THE MATERIAL.**
4. Verify the tension value. For example, if your suspended weight is 100.0 grams, your instrument should also indicate 100.0 gram +/- 1.0 gram once properly engaged to the material. This procedure confirms the instrument's accuracy, and it is now ready for use.

If you have additional questions, please contact Cooper for help.

Calibrate Instrument

***IMPORTANT: THIS FEATURE SHOULD ONLY BE USED BY A CALIBRATION FACILITY USING CERTIFIED AND TRACEABLE DEAD WEIGHTS. DO NOT USE THIS FEATURE FOR A SIMPLE ACCURACY CHECK.**

When calibrating these instruments tension values must be entered in grams.



**Figure 9: Free Hanging Weight
simulating cable tension.**

1. Scroll to **SETUP** and press **ENTER**. Next, scroll to **RE-CAL TENSION** and press **ENTER**. The screen will now display: **SETUP, RE-CALIBRATE TENSION, ENTER PASSWORD, CAL DATA WILL BE LOST!**
2. **Password.** To proceed with this re-calibration, enter the following key strokes: Press **ENTER** once, then press the **UP** arrow once, and then press **ENTER**. These inputs: **ENTER, UP, ENTER** are the password. It cannot be changed.
3. The display now indicates: **SETUP RE-CALIBRATE TENSION** with a list of the calibration names and custom names that are programmed into the instrument. Scroll to the description you wish to recalibrate, highlight it, and press **ENTER**.
4. The next screen will indicate: **CALIBRATE TENSION, NUMBER OF POINTS**. Using the up and down arrows select the number of calibration points you will be using, a minimum of 5 points. Zero is a calibration point and is already set, so define a minimum of 4 increasing tension values such as: 100, 250, 500 and 750. You can have between 5 and 10 calibration points. If 10 calibration points were selected the entries could look like: 100, 200, 300, 400, 500, 600, 700, 800, 900.
5. **ENTER WEIGHT.** You've selected the number of calibration points, so now define these weight values. Using the up or down arrows select your first tension (weight) calibration-point and then **ENTER**. *Note: Do not use 0 (zero), as this value is already programmed into the instrument.* Next, use the up or down arrows to select your **weight 2** value. Making sure the value entered is greater than **weight 1**. Next, select increasing weight values for the additional weight points. Do not exceed the maximum tension range of the instrument.
6. **CALIBRATE TENSION.** Next, calibrate the instrument using the weight values you previously selected. To properly simulate these tensions, suspend a single length of your material from above and add or suspend known weights onto the material in the values you've previously selected, when prompted. (See Figure 9.)
 - a. **CALIBRATE TENSION, NUMBER OF POINTS** ___, **ZERO UNIT.** Without any material engaged to the instrument hold it in the attitude you will be taking the reading in and press **ENTER** to calibrate zero weight. Next the display will prompt you to suspend the weight value you previously selected in step 5. If, for example you selected 100 grams for your first weight value the instrument will indicate: **PLACE WEIGHT 100.**
 - b. Suspend the exact weight value from your material that you've previously selected (in this example it would be 100 grams).
 - c. Next, engage the instrument to your tensioned material and then press **ENTER** once the reading has stabilized.
 - d. Repeat steps b. and c. for the remaining number of weight points by suspending additional weights onto your material in the values previously selected and entering these readings.
 - e. Once the last weight value has been entered, the instrument will return to the **SETUP** menu. Press the **ESCAPE** button to return to the main display.
 - f. The main display will now indicate the material you just finished calibrating. If the material name on the display is not the material you just recalibrated, you have re-programmed the incorrect description. If this happens, recalibrate both the material indicated on the display along with the material you thought you were calibrating.

After completing a calibration always recheck the values. Refer to "Check Accuracy" in Section 7.