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TENSITRON INC.

OPERATING INSTRUCTIONS

Model: TX-Series

Digital Tension Meter

Sec 1. SAFETY.

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

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

1. **KNOW YOUR INSTRUMENT.** Read this manual carefully to learn your tension meter's applications and limitations, as well as the potential hazards associated with this type of instrument.
2. **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.
3. **USE THE RIGHT TOOL OR INSTRUMENT.** Do not use this instrument to do a job for which it is not recommended.
4. **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 Tensitron, Inc.
5. **GUARD AGAINST ELECTRIC SHOCK.**
6. **MAINTAIN INSTRUMENT CAREFULLY.** Keep handles dry, clean and free from oil and grease. Do not lubricate. All roller bearings are sealed.
7. **DO NOT USE INSTRUMENT IF** it has received a sharp blow, been dropped or damaged in any way. Do not disassemble. Incorrect reassembly may result in the risk of electric shock, fire or exposure to battery fluids. If instrument is damaged return it to Tensitron, Inc. for repair.
8. **STANDARD POWER SUPPLY IS RATED FOR 120 VOLT AC ONLY** and must be plugged into an appropriate receptacle. For input voltages between 100 – 240V, use power supply P/N: TX-15-PS-240.
9. **DO NOT USE INSTRUMENT WHEN TEMPERATURE** is below 40º F (5ºC) or above 105º F (40ºC). Charging in direct sunlight or near a heat source will not produce a full charge and may permanently damage battery pack.
10. **STORE INSTRUMENT AND CHARGER** in a cool, dry place. Do not store where temperatures may exceed 120ºF (50ºC) for storage times less than one month. The storage temperature should not exceed 35ºC for storage times of more than one year. Never let LCD display or battery pack assembly freeze.
11. **WARNING:** Only use battery pack assemblies provided by Tensitron, Inc. with your meter (P/N: TX-15). Other types of batteries may explode, causing personal injury and damage.

COPPER WIRE DIAMETERS
CONVERSION TABLE

	Diameters (nominal)			Diameters (nominal)	
AWG	millimeters	inches	AWG	millimeters	inches
25.0	0.455	0.01790	37.5	0.107	0.00421
25.5	0.429	0.01688	38.0	0.102	0.00396
26.0	0.404	0.01590	38.5	0.094	0.00370
26.5	0.381	0.01499	39.0	0.089	0.00353
27.0	0.361	0.01420	39.5	0.084	0.00330
27.5	0.340	0.01339	40.0	0.079	0.00314
28.0	0.320	0.01260	40.5	0.076	0.00299
28.5	0.302	0.01188	41.0	0.071	0.00280
29.0	0.287	0.01129	41.5	0.066	0.00259
29.5	0.269	0.01059	42.0	0.064	0.00249
30.0	0.254	0.01000	42.5	0.061	0.00240
30.5	0.241	0.00948	43.0	0.056	0.00222
31.0	0.226	0.00893	43.5	0.053	0.00208
31.5	0.213	0.00838	44.0	0.051	0.00198
32.0	0.203	0.00795	44.5	0.048	0.00188
32.5	0.191	0.00751	45.0	0.0447	0.00176
33.0	0.180	0.00708	46.0	0.0399	0.00157
33.5	0.170	0.00669	47.0	0.0356	0.00140
34.0	0.160	0.00630	48.0	0.0315	0.00124
34.5	0.150	0.00590	49.0	0.0282	0.00111
35.0	0.142	0.00561	50.0	0.0251	0.00099
35.5	0.135	0.00531	51.0	0.0224	0.00088
36.0	0.127	0.00500	52.0	0.0198	0.00077
36.5	0.119	0.00468	53.0	0.0178	0.00070
37.0	0.114	0.00445	54.0	0.0157	0.00061

CHECKING ACCURACY. *If you want to verify the accuracy of your instrument, simulate a tension load on your material by suspending known weights to a sample length of the same type of fine wire or filament. When you engage the meter this weight value should display. Thus when a 500 gram weight is freely suspended from the material the tension will be 500 grams, and your instrument should indicate 500 g.*

Custom Calibrations for the TX-Series of Digital Tension Meters

Warning: The **Custom Calibration** feature is password protected. In order to perform a **Custom Calibration** a series of key inputs are required. If you enter the password sequence and the press Enter while an existing calibration in the menu is selected/highlighted, it will void that current calibration selection.

PERFORMING A 5-POINT, MULTILINERIZATION CALIBRATION

Step 1: From the Main Display press ↑ or ↓ arrows until you reach **Setup.** Press **ENTER.** Press the ↓ arrow button until you reach **Cal Tension.** Press **ENTER**. The screen will display: **Setup, Calibrate Tension, Enter Password**. Press the **ENTER** button once, the ↑ arrow button once and the **ENTER** button once more**.** *(These three inputs are the password.)* Now the screen will display **Setup, Calibrate Tension** and you will be able to scroll down the list to select the description that you want to use for the new calibration. When this new description is highlighted, press **ENTER**.

Step 2: Next you will be prompted **ENTER WEIGHT 1.** Using the ↑ and ↓ arrows select a minimum tension value (*do not use zero*). Press **ENTER**. Select increasing weight values for **WEIGHT 2 THRU 4** (No. 4 being the maximum weight value). At each weight number select your weight value using the ↑ and ↓ arrows. **ENTER** each selection. *Next you will calibrate the instrument to the weight values you just selected. (To simulate tension loads for calibration, take a sample length of your material and suspend it from above. Next hang weights from your material in the weight values you previously selected in "enter weights 1 through 4".)* Your instrument will now prompt you **PLACE WEIGHT 0.** With zero tension applied to the instrument press **ENTER.** Next you will be prompted **PLACE WEIGHT 1.** Suspend the exact weight value from your material that you previously selected. Engage instrument to the tensioned material and then press **ENTER.** Next suspend weight value 2 from your material, engage the instrument to your tensioned material and press **ENTER.** Repeat procedure for steps 3 and 4. Once you have entered the value for **WEIGHT 4** you have finished the calibration and will be returned to the Main Display. Your main display will now indicate the description of the calibration you've just entered. This indicates you have now selected the calibration you just performed. To change calibration use the ↑ or ↓ arrows until you reach **SELECT MATERIAL.** Follow procedures outlined in Section 3.5. To change the description or name of your new calibration, see Section 4, No. 11

Sec. 2. CHARGING INSTRUMENT BATTERIES.

1. Connect power supply cable to instrument.
2. Plug the power supply into a 120V AC outlet. (For input voltages between 100 – 240V, use P/N: TX-15-PS-240.)
3. Full charge of battery assembly takes approximately 8 hours.
4. Battery pack assembly cannot be overcharged, however instrument will remain on while plugged into power supply.
5. Fully charged battery assemblies will operate approx. 9 hours +/- 20% depending upon usage.
6. Battery charge level is indicated in the upper, right hand corner of display.

Sec. 3. OPERATION: *QUICK START*.

1. **TURN UNIT ON** by pressing **ON** button. Main display will indicate: **Tension** (in grams, Newtons, cN or lbs), **Material (**with description of calibration selected), and **Min** and **Max** values.
2. **MOVE BETWEEN SCREENS** by pressing either the **UP** or **DOWN** arrows. To make, or enter a selection, depress the **ENTER** key. To exit a setting, depress the **ESCAPE** key.
3. **ZERO THE INSTRUMENT** before taking readings by pressing the key marked **ZERO.** When zeroing the unit hold the instrument in the attitude in which it will be used, with no load or speed applied to the instrument.
4. **READING OF TENSION.** Variations in materials and diameters affect tension readings. It is essential to select the correct material and size (whether it be AWG wires, Filaments, or Custom Materials) from the calibration menu before use , or values may be incorrect. For Textile use, either approximate your material diameter from the **filament** selection or (preferably) use a custom calibration made directly to your material.
5. **SELECT MATERIAL.** From the Main Display (first screen seen when unit is turned on) use the **UP** or **DOWN** keys until **SELECT MATERIAL** is displayed. Press **ENTER**. Next select your material from: Wire, Filaments or Custom. After you've entered this selection you can now select your material size (diameter) in Inches, mm or AWG (for wires). Remember to **ENTER** your selection.
6. **SELECTING TENSION UNITS IN LBS, NEWTONS OR GRAMS.** Depress the **UP** or **DOWN** keys until **TENSION UNITS** is displayed. Press **ENTER**. Next, select from: **Grams**, **Newtons**, **LBS,** or **cN (**for the Models TX-125 only**)** and **ENTER** selection.
7. **ENGAGE INSTRUMENT TO TENSIONED MATERIAL.** For best accuracy hold the instrument in the attitude the measurement will be taken in and depress **ZERO**. Then engage the tensioned material by separating the rollers (squeeze the trigger assembly) and inserting onto your material. Once material is in line with the three rollers slowly release the trigger until it makes a full stop. Then note your reading.

Sec. 4. ADDITIONAL TECHNICAL INFORMATION.

1. **INDICATING SPEED.** *(Optional feature).* From main display press the **UP** arrow once. Your display will now show either feet per minute or meters per minute with both high and low values recorded.
2. **LENGTH OF PART RUN.** *(Optional feature)*. From the main display press the **UP** arrow twice. Your display will now indicate length of material run in either feet or meters.
3. **CHANGING LENGTH OR SPEED UNITS.** *(Optional feature).* From the main display depress either the **UP** or **DOWN** keys until the display indicates: **SETUP.** Press Enter. Next use the **UP** and **DOWN** keys until **Length Units** is displayed. Press **ENTER** and make your selection from **Feet** or **Meters. Enter** Selection.
4. **DATA LOGGING.** *(Optional feature).* From the Main display use the **UP** or **DOWN** keys until **Data Logging** is displayed. Press **ENTER**. Next, select **Logging Rate** and select Hz rate which your data will be collected in (choices are from 1Hz to 100Hz). Next select **Duration** and select the time period the data will be collected over by using the **UP** or **DOWN** keys. Finally select **Begin Logging** when you are ready to collect your data. Note: You can stop collecting data at any time by simply depressing **ESC** (escape). Collected data will remain in memory, regardless if instrument is turned off, and will only be overwritten once new data is collected. To view collected data select **View Data Log** and press **ENTER.** Logged Data can also be uploaded to your computer via the RS-232, serial port. Refer to **Sec 4.16, Uploading logged data**, for specific instructions.
5. **SPEEDING UP OR SLOWING DOWN DISPLAY LCD REFRESH RATES—DAMPENING ADJUSTMENT.** To help control oscillating tension display values the user can either speed up or slow down the rate at which tension values refresh on the display. Using the **UP** or **DOWN** keys select **SETUP** and press **ENTER.** Next select **Dampening** and after entering this selection, choose the refresh rate from: 1Hz, 2Hz or 5Hz. Remember to **ENTER** your selections.
6. **AUDIO.** Turn on or off Audio beep (with key inputs) by selecting: **SETUP**, then select **Audio**, and finally either select **ON** or **OFF**.
7. **BACKLIGHTING INTENSITY**. Increase or decrease Backlighting intensity by selecting: **SETUP**, then **BACKLIGHT**, and finally intensity level.
8. **DISPLAY CONTRAST**. Increase or decrease LCD display contrast by selecting: **SETUP**, then select **CONTRAST**, and finally manipulate contrast using the **UP** or **DOWN** keys. Remember to **ENTER** your new setting.
9. **VERSION**. Instrument Model No. along with Software version information can be viewed under **SETUP** and then selecting **Version**.
10. **CUSTOM CALIBRATIONS.** Calibrations are password-protected to prevent unintended changes and can only be preformed on Custom Calibration selections. All other calibrations under Wire and Filament selections can only be reset by Tensitron. See Page 10 for step-by-step instructions to perform this 5 point, dead weight calibration, or contact your Metrology Department or Tensitron, Inc. for assistance. Note 1. If you simply want to verify your instrument's accuracy refer to **Checking Accuracy** on Page 10.
11. **CUSTOM CALIBRATION NAMES.** Custom Calibrations (listed as Custom 0 - 9) can be renamed so that the Main Display indicates your name for the calibration instead of Custom 1, 2, etc. From the Main Display use the **UP** and **DOWN** keys until **SETUP** is selected. Press **ENTER.** Using the **UP** and **DOWN** keys select **Custom Names.** Press **ENTER.** Next, using the **UP** and **DOWN** arrows select calibration number, or previous name you wish to rename. Press **ENTER.** Using the **UP** and **DOWN**

MODEL	RANGE	RESOLUTION
TX-125	0-125 Grams	0.1 to 1 Grams
TX-1000	10-1000 Grams	1 to 5 Grams
TX-5000	50-5000 Grams	5 to 10 Grams

APPLICATION-SPECIFIC METERS

TX-5EDM 50-5000 Grams - For use on EDM wires.
Note: For tapes, webs and custom materials please provide thickness, width, or diameter with order.

AVAILABLE OPTIONS FOR ALL INSTRUMENTS:

Note: Add option designator to the end of the Model Number. (For example a Model TX-1000-S denotes a standard TX-1000 with the optional Speed and Length function included.)

–**R** Custom Roller Option. Choose from numerous sizes of cylindrical, flanged, or U-shaped rollers. Note: For tapes, webs, and custom materials please provide thickness, width, or diameter with order.

–**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, however line speeds in excess of 2,000 FPM are generally unsafe for hand-held applications. Read length of part run in feet or meters. Maximum length measuring up to 9,999 meters or feet.

–**A** Analog Output Option. For both speed and tension values. 0-5 VDC or 4 -20 mA with software definable ending sequences. Provided with 10' cable. Data is outputted at a rate of 40 Hz.

–**E** RS-232 Serial Output Option. Provided with 10' cable to interface with your receiving device. Select data sampling rate from 1, 2 or 5 Hz.

–**D** Data Logging Option. Capture and play back data within a user-defined time window. Select the time window; then select the sampling rate (adjustable from 1-100 Hz). After capturing the data, review the data on the instrument's display or upload it using the 10' serial interface cable.

Instruments can be configured with any or all of these options.

ADDITIONAL OPTIONS FOR ALL METERS

- Input real-time serial data into any Windows® application using the optional software WinWedge Pro for Windows®.
- Euro Plug. P/N: TX-15-PS-240
- Magnetic or rigid mounting bracket. P/N: TX-350

SPECIFICATIONS

- Approximate weight .75 lbs (14 oz), depending upon configuration.
- (5) Re-chargeable NIMH battery assembly and power supply provided. (For input voltages between 100 – 240 V, use power supply P/N: TX-15-PS-240)
- Durable, lightweight carrying case with protective foam inserts.
- CE certification complying with heavy, industrial, immunity standards.

v. In the Connect To dialog box that pops up next, go to the drop down menu labeled "Connect Using:" and select the serial port you connected the cable to in step 2. It is most likely that you are connected to COM1.
vi. In the COMx Properties dialog box that pops up next, set the "Bits per second:" to 9600, the "Data bits:" to 8, the "Parity:" to None, the "Stop bits:" to 1 and the "Flow Control:" to None.
vii. Click the Apply button and then click the OK button.
viii. You should now see tension values appearing in the Hyper Terminal window.
ix. To download the data log data: Go to: Transfer > Capture text… and enter the name of the file that you wish to save the data to.
x. Next, click anywhere inside the Hyper Terminal window and then press 'd' on your keyboard. The data should download from the instrument to the file that you chose.
xi. When you are finished collecting data, close Hyper Terminal.
xii. To save the data in Microsoft Excel format, use Microsoft Excel to open the file you saved the data log to and save it as an Excel file.

16. **UPLOADING LOGGED DATA** *(Optional feature)***) via RS-232, SERIAL COMMUNICATIONS.**
    a. Refer to the previous section, Sec 4.15, Serial Data Collection (RS-232 option) and configure communication protocols as outlined. Note: step c has no effect on transferring stored data and can be adjusted to any setting.
    b. To retrieve, or upload logged data from the instrument, send a lower case d.
    c. Collected data will remain in memory, regardless if instrument is turned off, until overwritten with new data.

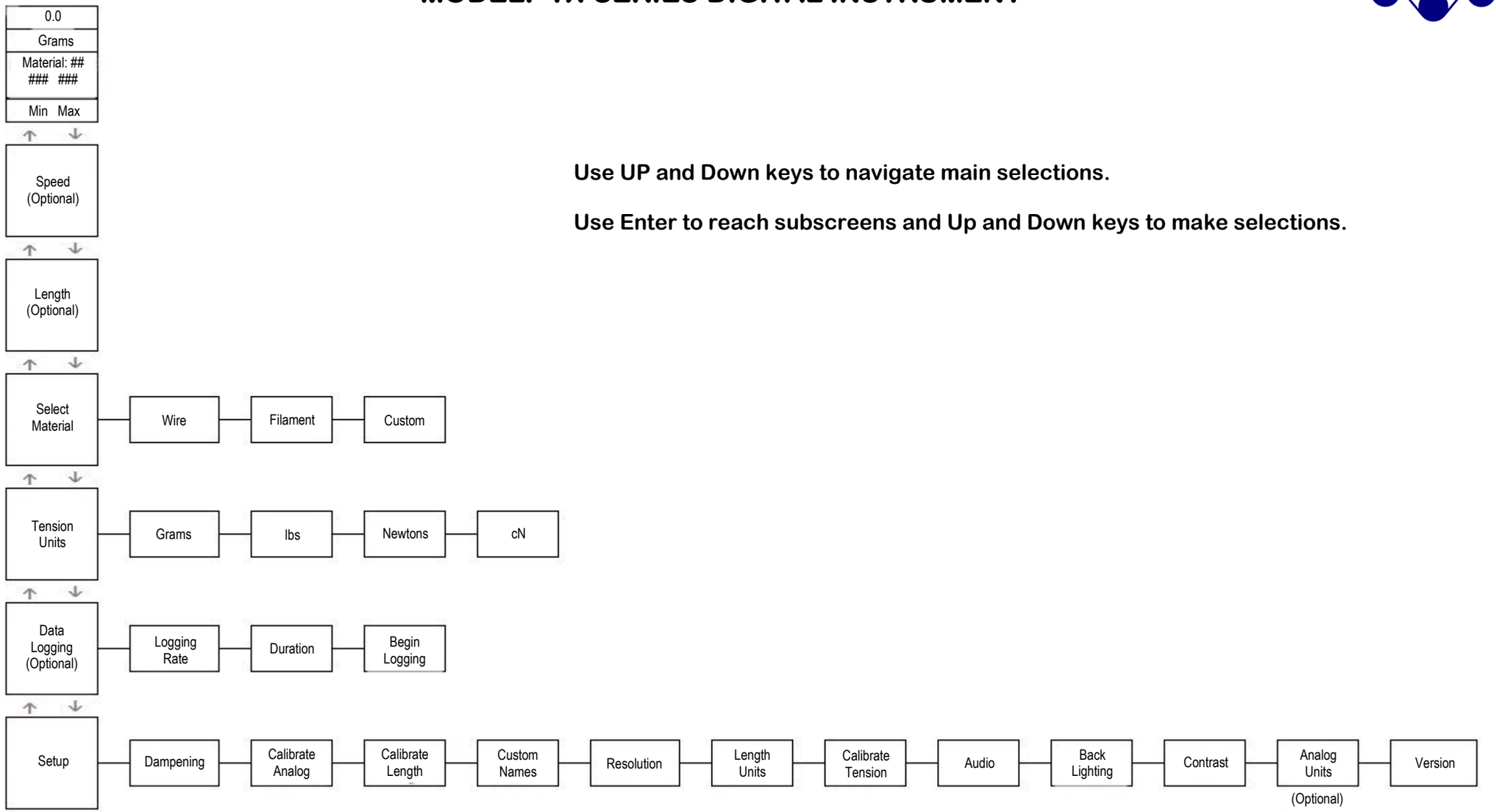
FEATURES

- Large, easy to read backlit, graphic display with adjustable backlighting and contrast.
- Display shows tension, name of calibration selected, running line minimum and maximum tension values, and battery charge level.
- Select tension values to display in Grams, lb, Newtons, or cN.
- Instruments come with calibrations for numerous wire and filament sizes.
- Up to 10 additional custom calibrations may be programmed into instrument. (All calibrations password protected.)
- Choose your calibration by first highlighting and selecting the material (either wires, filaments, or custom), then the units of measurement (inches, mm, AWG wire sizes, or custom). Lastly, select the material size or gauge number and push "Enter". The instrument automatically adjusts to the calibration you've selected with a full-scale accuracy of +/- 1%. (Full-scale accuracy for custom sizes is material specific.)
- Selectable LCD refresh rates allow for stable digital readings.
- Re-chargeable NIMH batteries and power supply provided. Approximately 9 hours of operation per battery charge. Automatic shut-off after 10 minutes of non-use.
- Instruments may be operated continuously while connected to power supply.
- Numerous application-specific models available.
- All instruments factory-calibrated and ready for use. Calibration certificate included. All calibration values traceable to National Standards.
- All models typically available from stock.

keys select the number, letter or character for the beginning of your new name. Press **ENTER.** Follow the same procedure for each sequential letter or space of your new description. Continue pressing **ENTER** until all spaces in the description have entered values. Once your new name has been entered you will be returned to the **SETUP** screen. To select your new calibration follow the procedures outlined in Sec.3.5.

12. **CALIBRATION OF SPEED.** *(Optional feature)* From the Main Display press the **UP** and **DOWN** keys until you reach **SETUP.** Press **ENTER.** Using the **UP** and **DOWN** keys select **CALIBRATE LENGTH.** Press **ENTER.** Next calibrate the speed function as follows: 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. (While you are pulling your 20' length the instrument will count pulses on the display) Once you have finished pulling the 20' length, press **ENTER.** Your instrument speed calibration is now complete.
13. **MONITORING TENSION OR SPEED THROUGH THE ANALOG OUTPUT** *(Optional feature)*. Output values are: 0 – 5 VDC or 4 – 20 mA. Connect Analog Output Cable to receptacle located on the bottom side of instrument. Connect output cable leads to the analog input of your measurement or control device. The **RED** lead is Voltage +, the **WHITE** lead is mA, and the **BLACK** lead is ground. From the main display use the **UP** and **DOWN** keys until you reach **SETUP.** Press **ENTER**. Next using the **UP** and **DOWN** arrows select **ANALOG OUTPUT.** Press **ENTER.** Using the **UP** and **DOWN** arrows select from: **ANALOG SPEED CURRENT, ANALOG SPEED VOLTAGE, ANALOG TENSION CURRENT OR ANALOG TENSION VOLTAGE.** Once correct selection is made press **ENTER.**
14. **CALIBRATION OF ANALOG OUTPUT**. From Main Display press the **UP** and **DOWN** keys until you reach **SETUP.** Press **ENTER.** Press the **UP** and **DOWN** keys until you reach **CALIBRATE ANALOG.** Press **ENTER.** Using the **UP** and **DOWN** keys adjust display to show the value at which the instrument reads maximum current or voltage. Press **ENTER.**
15. **SERIAL DATA COLLECTION (RS-232 option).** Instruments outfitted with the optional RS-232 feature (designated with a -E or –D in the part number) support serial communications as follows:
    a. The baud rate is 9600 with no parity bit, 8 data bits and 1 stop bit (9600 8N1).
    b. Serial communications will work with most PCs with a cable up to 15 feet long.
    c. Setting the dampening rate on the instrument to "1 Hz + Serial", "2 Hz + Serial" or "5 Hz + Serial" will cause the instrument to output the tension values at a rate of once, twice or five times per second, respectively. The dampening rate can be set by going to the **SETUP** menu, selecting **DAMPENING**, adjusting the value of the dampening rate with the **UP** and **DOWN** buttons and then pressing the **ENTER** button.
    d. The units output serially will be the same units that are selected in the "Tension Units" menu. The currently selected tension units (such as Grams or Newtons) are also displayed on the main tension screen.
    e. Perform the following steps in order to log serial data from the instrument using Hyper Terminal on a PC and put it into a Microsoft Excel spreadsheet:
        i. Ensure the that the dampening rate is set to "1 Hz + Serial", "2 Hz + Serial" or "5 Hz + Serial".
        ii. Connect the serial cable from the instrument to a serial port on your PC.
        iii. Go to the Windows Start Menu and choose Programs->Accessories >Communications->Hyper Terminal
        iv. In the Connection Description, dialog box that pops up, type in a name for the new connection (any name will work) and press the OK button.

FLOW CHART
MODEL: TX-SERIES DIGITAL INSTRUMENT



Use UP and Down keys to navigate main selections.

Use Enter to reach subscreens and Up and Down keys to make selections.