ETMX & ETMPX
TENSION METERS

Operating Instructions

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1.0 INTRODUCTION

Three long, closely-spaced slender shafts with precision guide rollers or pins at their ends combine with the latest in microprocessor technology to make this instrument top choice for all limited-access, tension measuring applications.

Store up to 4000 displayed tension values in memory and statistics (Last, AVG, MIN, MAX, MIN-PEAK, MAX-PEAK), which can be transmitted using the serial output port.

Choice of miniature, high speed rollers for filament speeds up to 2000 m/min or non-rotating, ceramic pins for speeds to 6000 m/min. Uses part number ETMX or ETMPX to designate model with ceramic pins.

Available Models - The standard series is also available with the following modifications. (Special calibration using customer supplied material.)

Model	Tension Ranges g or cN	*Measuring Head Width mm	FACTORY Calibration with running filament 100 m/min
ETMX-100	0.5 - 100.0	24	PA: 0.20 mm Ø
ETMX-200	1 - 200	24	PA: 0.20 mm Ø
ETMX-500	1 - 500	24	PA: 0.20 mm Ø
ETPX-100	0.5 - 100.0	24	PA: 0.20 mm Ø
ETPX-200	1 - 200	24	PA: 0.20 mm Ø
ETPX-500	1 - 500	24	PA: 0.20 mm Ø

*   Outer distance between outside guide rollers / pins
**   Suitable for 95% of all applications. PA = Polyamide Monofilament.
    If the material to be measured differs significantly from the factory calibration material in diameter, rigidity, shape, etc., we recommend calibration using customer supplied material.
    For this purpose a material sample of about 5 m should be supplied.
    International unit of tensile force: 1 cN = 1.02 g = 0.01 N

1.1 Unpacking

Unpack the tension meter and inspect it for any shipping damage. Notice of defect must be filed immediately, in writing, at the latest, within 10 days of receipt of the goods.

Delivery includes:
• Tension meter with 9V long life battery
• 1 Open end wrench (4mm jaw width)
• 1 screwdriver (1.5mm blade width)
• 1 ETMX-CC: Digital connecting cable
• 1 ETMX-P2: TENSON INSPECT software (Win 95 or higher) for viewing and storing the measured data on a PC
• 1 Operating instructions
• 1 carrying case

5. Slide the FILAMENT GUIDE up the ROLLER SHAFTS in the direction of the arrow.

To mount the filament guide:
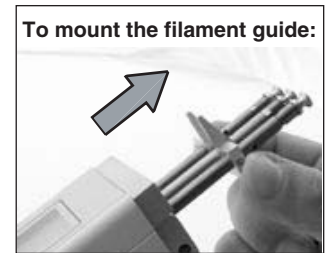
6. Push the FILAMENT GUIDE upward far enough to ensure that the ROLLERS do not rub against the FILAMENT GUIDE and that the process material can slide unhindered into the roller grooves. (Center Line.)

CENTER LINE
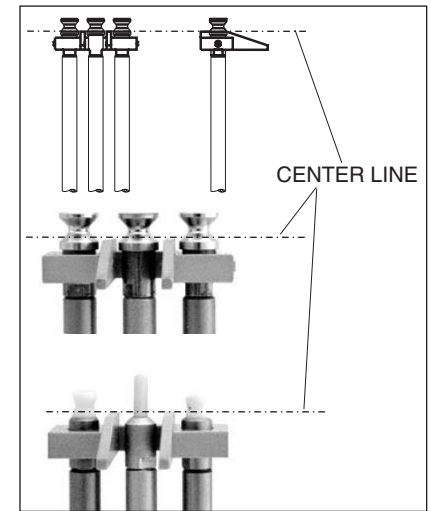
7. Tighten the GRUB SCREWS with the supplied screwdriver

14.0 APPENDIX C - REPLACING THE ROLLERS/CERAMIC PINS

NOTE: Replacing ceramic pins or converting from rollers to ceramic pins can only be performed at the factory

FILAMENT GUIDE

GUIDE ROLLERS (2x)

MEASURING ROLLER

SETSCREWS (3x)

GRUB SCREWS (2x)

ROLLER SHAFTS (2x)
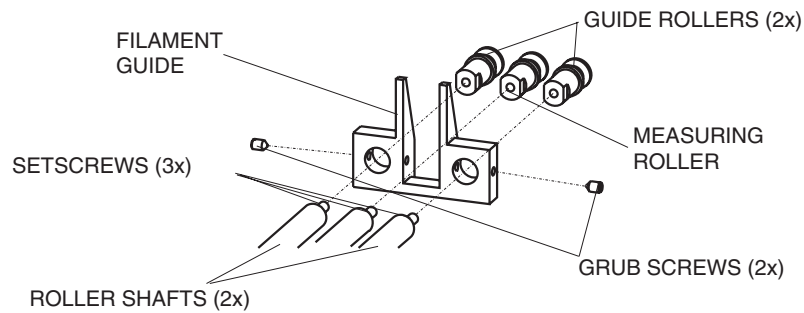
Procedure:

1. Remove the FILAMENT GUIDE by loosening the GRUB SCREWS using the supplied screwdriver (1.5m blade width).

2. Unscrew and remove the GIUDE ROLLERS (2X) using the supplied open end wrench (4mm jaw width)

3. Slide the FILAMENT GUIDE down the ROLLER SHAFTS in the direction of the arrow.

4. Carefully screw the new GUIDE ROLLERS onto the ROLLER SHAFTS using the supplied open end wrench (4mm jaw width) until hand tight.
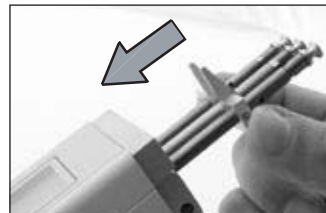
IMPORTANT: When tightening the rollers, steady the roller bolts with the suppplied scrrewdriver to prevent the ROLLER SHAFTS from being twisted off.

2.0 OVERVIEW

2.1 Operating Elements
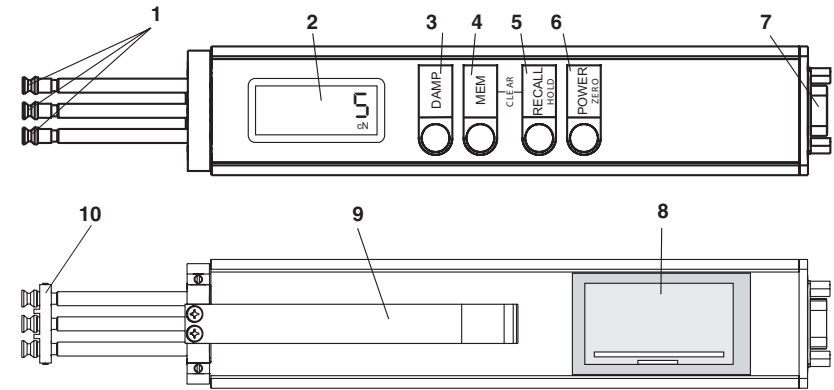
1. Rollers or ceramic pins	**6.** POWER / ZERO key
2. DISPLAY	**7.** Interface
3. DAMP key	**8.** Battery Compartment
4. MEM key	**9.** Lever
5. RECALL / HOLD key	**10.** Filament Guide

2.2 Installling and Replacing the Battery

Before first use of your tension meter, you need to insert the battery as described below:

1. Open the BATTERY COMPARTMENT (8) on the rear side of the tension meter.

2. Insert a 9 V battery (E block) into the BATTERY COMPARTMENT. Please ensure proper polarity.

3. Close the BATTERY COMPARTMENT.

NOTE: If the ⊟ symbol appears on the DISPLAY, the battery is low and must be replaced immediately. Operating the tension meter with a low battery may cause measurement errors.

NOTE: If the instrument will not be used for a lengthy period of time, the battery should be removed

2.3 Turning the Power On and Off

Power On: To turn the power ON, press the POWER key (6) until all symbols are shown on the display. When you release the key, the DISPLAY momentarily shows the tension range, followed by random values or "0."

Manual Power Off: To turn the power off, press and hold the POWER key for five seconds.

Auto Power Off: The tension meter switches off automatically after three minutes of non-use.

2.4 Reversing the Display

When you shift the tension meter from the right to the left hand, you can rotate the readings on the DISPLAY by 180°.

Measuring with the left hand

If you would like to use the left hand for measuring, you should reverse the readings on the DISPLAY to make them easier to read. To acomplish this, follow the procedure below:
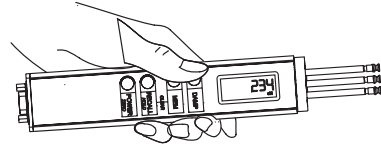
1. Press and hold the POWER key for five seconds until the gauge turns itself off.

2. Press and hold the DAMP and POWER keys until the DISPLAY shows the readings reversed ("upside down").

Returning to right hand measurement (default)

1. If the gauge is turned on, press and hold the POWER key for five seconds until the gauge turns itself off.

2. Press and hold the DAMP and POWER keys until the DISPLAY shows the readings reversed.
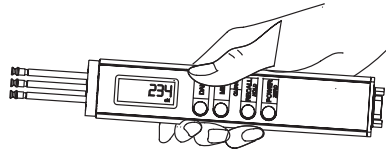
NOTE: The selected display orientation remains stored in the gauge memory even after the instrument is switched off.

2.5 Selecting the Unit of Measure

You can set the ETMX to the cN (default) or g (gram) unit of measure, depending on the required tension range, by following the procedure below:

1. Switch off the tension meter.

2. Press and hold the RECALL and POWER keys until the new unit of measure is indicated on the DISPLAY.

NOTE: The selected unit of measure remains stored in memory even after the instrument is switched off.

12.0 APPENDIX A - PIN ASSIGNMENTS AND SIGNALS OF THE INTERFACE
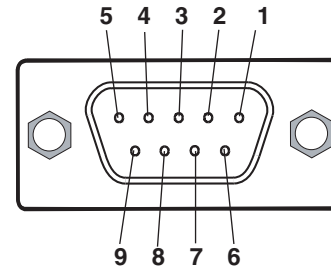
Signal	RS-232-C
Data Bit	8
Stop Bit	1 bit
Parity	None
Baud Rate	19200

Pin Number	Signal	Description
1		Not assigned
2	TXD	TRANSMITTED DATA
3	RXD	RECEIVED DATA
4		Not assigned
5	GND	Ground
6		Not assigned
7	RTS	READY TO SEND
8		Not assigned
9	2 V DC	Analog signal

Pin assignment of the analog cable (option ETXM-CA)

9-pin male D-sub connector

Pin 9 = Analog signal

Pin 5 = Ground (GND)
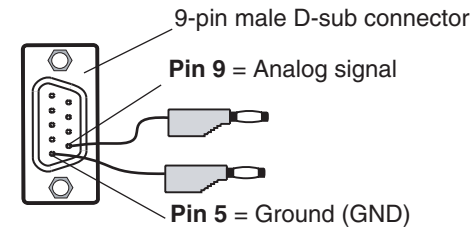
13.0 APPENDIX B - OPTIONAL ACCESSORIES

ETMX-CA	Conecting cable for analog signal
ET-AC-115	Battery charger for 115 V AC
ET-AC-230	Battery charger for 230 V AC

11.0 SPECIFICATIONS

Calibration	According to factory procedure
Units of Measure	cN / g, user selectable
Accuracy	± 1% FS* ± 1 digit (typically ± 0.5% FS*)
Overrange	10% FS*, without accuracy guarantee
Overload Protection	200% FS*
Measuring Principle	Strain gauge bridge
Meas. Roller Deflection	0.5mm, max
Signal Processing	Digital, 12 bit A/D converter
Damping	Adjustable electronically (averaging)
Measuring Frequency	Approx. 5 kHz internally
Display Update Rate	2x per second
Display	4-digit LCD, height of digit 0.43" *(11mm)*
Memory	Average, last value, maximum, minimum, MAXPEAK, MINPEAK
Memory Modes	3 (up to 4000 readings total)
Temperature Coefficient	Gain: less than ± 0.01% FS*/°C
Analog Output Signal	0 - 2 V DC (linearized) R_{Load} > 1 kW ± approx. 1% Converter frequency 100 Hz
Digital Output Signal	RS232 (9600, 8, N, 1) (2 readings per sec.)
Temperature Range	50 - 113 °F *(10 - 45 °C)*
Air Humidity	85% RH, max.
Auto Power Off	Automatically after approx. 3 min. of non-use
Power Supply	9 V E block e.g.: long life 9 V lithium for about 80 hours of continuous use
Housing Material	Aluminium profile with plastic outer casing (PVC)
Housing Dimensions L x W x H	9.10" x 2.44" x 1.89" *(230mm x 62mm x 48mm)*
Weight (net /gross)	Approx. 370 g / 1050 g

*FS = Full Scale

ETMX Guide Rollers

V-Groove	Line Speed m/min ... max.	Roller Material
Standard	2000	Hardcoated aluminium

ETMPX Guide Pins

V-Groove	Line Speed m/min ... max.	Roller Material
Standard	6000	Oxide ceramic

2.6 Zero Adjustment of the Measuring Position (Auto Zero)

Each time the tension meter is turned on (before starting measurement), you need to carry out zero adjustment, as described below. This procedure is necessary to compensate for the weight of the measuring roller in the measuring position. The zero adjustment for the new measuring path only remains effective until the instrument is switched off.

NOTE: Zero adjustment must be repeated whenever the material path is changed or the tension meter does not display "0."

NOTE: Before beginning the zero adjustment, you must select the unit of measure as described in section 2.5.

1. Turn off the tension meter. Process material must not be inserted at this point.

2. Hold the gauge in the desired measuring position. Be careful to hold the gauget absolutely steady.

3. Press the POWER key. The DISPLAY momentarily shows ⎕⎕⎕⎕ and then switches to ⎕. The gauge is now adjusted for the new material path and is ready to measure.

3.0 REMOVING AND REMOUNTING THE FILAMENT GUIDE

The tension meter is supplied with a filament guide for fast and easy material acquisition. For application in hard-to-reach areas with limited access space, you can remove the filament guide.


GUIDE ROLLERS (2x)

FILAMENT GUIDE

MEASURING ROLLER

ROLLER SHAFTS (2x)   GRUB SCREWS (2x)
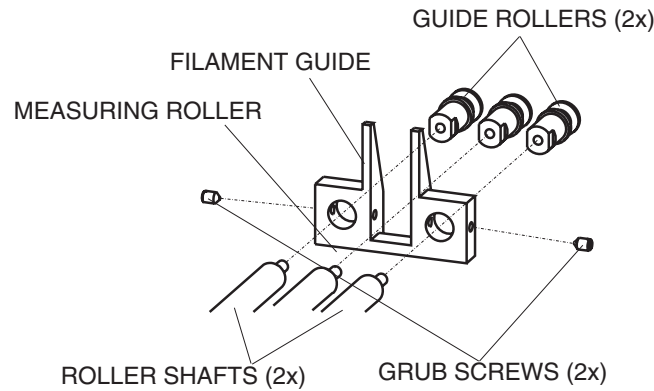
Removal Procedure

1. Loosen the GRUB SCREWS (2x) with the supplied screwdriver (blade width 1.5mm).

2. Unscrew and remove the GUIDE ROLLERS (2x) with the supplied open-end wrench (jaw width 4 mm).

3. Slip the FILAMENT GUIDE off the ROLLER SHAFTS.

4. Screw the GUIDE ROLLERS (2x) back on to the ROLLER SHAFTS and carefully tighten them with the supplied open end wrench (jaw width *4mm*) until hand tight.

Re-Mounting Procedure

1. Unscrew and remove the GUIDE ROLLERS (2x) with the supplied open-end wrench (jaw width 4 mm).

CENTER LINE

2. Slip the FILAMENT GUIDE onto the ROLLER SHAFTS.

3. Screw the GUIDE ROLLERS (2x) back on to the ROLLER SHAFTS and carefully tighten them with the supplied open-end wrench (jaw width *4mm*) until hand tight.

4. Push the FILAMENT GUIDE forward far enough to ensure that the rollers do not rub against the FILAMENT GUIDE and that the process material can slide unhindered from the FILAMENT GUIDE into the roller grooves

5. Carefully tighten the GRUB SCREWS (2x) with the supplied screwdriver until hand tight.
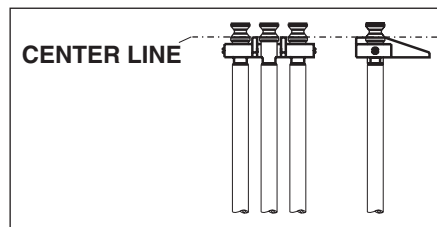
9.4 Restoring Factory Calibration

You can restore the factory calibration at any time with the following procedure:

1. Switch off the tension meter.

2. Press and hold the MEM and POWER keys until the Display shows E-0 cN .

3. Release first the POWER key and then the MEM key.

4. Press and hold the DAMP and RECALL keys, then additionally press and hold MEM until the Display shows - - - -cN .
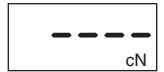
The factory calibration is restored.

5. Release the DAMP, RECALL and MEM keys.

6. Press the POWER key. The instrument switches off.

10.0 WINDOWS TERMINAL PROGRAM

The measured values and the memory contents can be transmitted over the RS232 interface to a personal computer. You can connect the computer to the INTERFACE of the ETMX/ETMPX by using the ETX-CC special cable which is supplied. The pin assignment of the INTERFACE is described in Appendix A.

Requirements:

A communication program, such as Terminal or HyperTerminal (provided on MS Windows Version 3.0 or later), must be installed and configured on the computer.

ASCII Code	Function	Description
D	Continuous transmission	Continuous transmission of the readings, press any key to stop transmission.
d	Send	Transmit current reading to PC once.
m	Save	Start logging of measured data. Stop data logging.
r	Output	Output the memory contents to the PC.
c	Clear memory	Delete the memory contents.
a	Damping ON / OFF	Switch damping on or off.
z	Zero	Carry out zero adjustment of the instrument.
u	Toggle unit of measure	Switch from g to cN, and vice versa.

5. Release the MEM key when the value shown on the Display is stable. (The reading might fluctuate greatly).

6. The Display shows E-90 cN. If the display shows E-50cN again, the value was not accepted. Check the suspended weight and the material path between the MEASURING and GUIDE ROLLERS and repeat the procedure from step 4.

$$\boxed{\text{E-90}}\ \text{cN}$$

$$\boxed{\text{E-50}}\ \text{cN}$$

3rd calibration point:

1. Hang a weight which corresponds to 90% of the tension range from the measured material, vertically, as shown on page 21.

2. Press the LEVER down all the way. Thread the PROCESS MATERIALthrough the MEASURING and GUIDE ROLLERS. Slowly release pressure on the LEVER until the GUIDE ROLLERS return to their original position.

3. Before starting the calibration, move the instrument slowly up and down to compensate for possible mechanical friction losses and thus ensure repeatability of the measurements.

4. Press the MEM key. Release the MEM key. The Display shows - - - -cN . The new calibration has been stored.

$$\boxed{\text{- - - -}}\ \text{cN}$$

If the display shows E-90 cN again, the value was not accepted. Check the suspended weight and the material path between the MEASURING and and repeat the procedure from step 4.

$$\boxed{\text{E-90}}\ \text{cN}$$

5. Press the POWER key. The instrument switches off.

6. Verify the new calibration, following the directions in section 8.0. If this procedure shows a deviation, you can recalibrate the tension meter again or restore the factory calibration. (section 9.4)
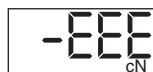
9.3 Error Messages During Calibration

The following error messages might be displayed during the calibration of the tension meter:

1. The Display shows EEE . The weight suspended from the process material is too heavy.

$$\boxed{\text{EEE}}\ \text{cN}$$

2. The Display shows –EEE. The weight suspended from the process material is too light.

$$\boxed{\text{-EEE}}\ \text{cN}$$

4.0 TAKING A MEASUREMENT

NOTE: Before taking a measurement, be sure that the correct unit of measurement (g or cN) has been selected and a zero adjustment has been performed.

4.1 Inserting the process material

1. Press the LEVER to tilt the outer GUIDE ROLLERS sidewards.

2. Thread the PROCESS MATERIAL through the MEASURING and GUIDE ROLLERS (filament guide).

3. Slowly release pressure on the LEVER until the GUIDE ROLLERS return to their original position.

NOTE: It is important to assure that the PROCESS MATERIAL runs smoothly between the MEASURING and GUIDE ROLLERS.
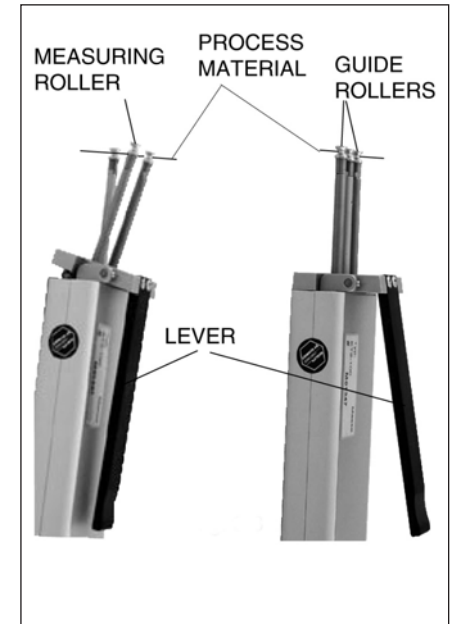
4.2 Measuring the process material

The DISPLAY now shows the measured tension values. Error messages which might be displayed are described in section 7.7.

4.3 Removing the process material

1. Press the LEVER and remove the PROCESS MATERIAL.

2. Slowly release pressure on the LEVER until the GUIDE ROLLERS return to their original position.

5.0 DAMPING MODE

The tension meter is equipped with an electronic damping that ensures steady readings when tension flucutates. This is achieved by averaging the measured values at the preset update rate.

5.1 Switching On the Damping Mode

NOTE: Before switching on the damping mode, it is recommended that you measure the first values without damping enabled.

1. Insert process material as described in section 4.1.

2. Press and hold the DAMP key. The display shows the currently set damping factor.

3. Release the DAMP key. The display shows DAMP below the currently measured value.

5.2 Switching Off the Damping Mode

1. Press and release the DAMP key. If display shows only the currently measured value, damping is off.

5.3 Changing the Damping Factor

The tension meter is factory preset to a damping factor of 12. The tension values are thereby averaged for the display in the following way:

$$\frac{12 \text{ old values} + 4 \text{ new values}}{16}$$

The damping factor can be modified in 15 steps from 01 = low damping:

$$\frac{1 \text{ old value} + 15 \text{ new values}}{16}$$

to 15 = high damping:

$$\frac{15 \text{ old values} + 1 \text{ new value}}{16}$$

1. Switch on the tension meter

2. Press and hold the DAMP key. The Display shows the set damping factor.

3. You can now increase the damping factor by pressing the MEM key and decrease it by pressing the RECALL key.

4. Release the DAMP key to return to the measuring mode.

NOTE: The selected damping factor remains stored in memory even after the gauge is turned off.

1st calibration point:

1. Hang a weight which corresponds to 10% of the tension range from the measured material, vertically, as shown.
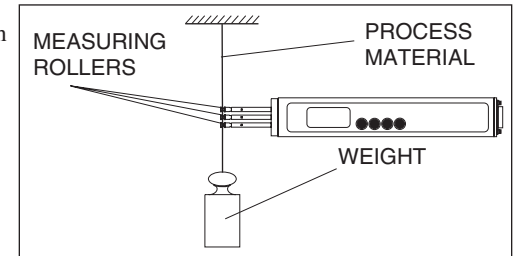
2. Press the LEVER down all the way. Thread the PROCESS MATERIALthrough the MEASURING and GUIDE ROLLERS. Slowly release pressure on the LEVER until the GUIDE ROLLERS return to their original position.

3. Before starting the calibration, move the instrument slowly up and down to compensate for possible mechanical friction losses and thus ensure repeatability of the measurements.
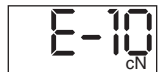
4. Press the MEM key. As long as the MEM key is depressed, the Display shows a decimal value which is higher by approx. 200 than the first decimal written down when setting the zero point, e.g. 1000 (800 + 200 equals approx. 1000).

5. This decimal value may vary from instrument to instrument. Write down the decimal value.

6. Release the MEM key when the value shown on the Display is stable. (The reading might fluctuate greatly.)

7. The Display shows E-50 cN. If the display shows E-10 cN again, the value was not accepted. Check the suspended weight and the material path between the MEASURING and GUIDE ROLLERS and repeat the procedure from step 4.

2nd calibration point:

1. Hang a weight which corresponds to 50% of the tension range from the measured material, vertically, as shown above.

2. Press the LEVER down all the way. Thread the PROCESS MATERIAL through the MEASURING and GUIDE ROLLERS. Slowly release pressure on the LEVER until the GUIDE ROLLERS return to their original position.

3. Before starting the calibration, move the instrument slowly up and down to compensate for possible mechanical friction losses and thus ensure repeatability of the measurements.

4. Press the MEM key. As long as the MEM key is depressed, the Display shows a decimal value which is higher by approx, 800 than the second decimal value, (1000 + 800 equals approx. 1800). The decimal value may vary fron instrument to instrument. Write down the value.

9.0 CALIBRATION

9.1 Dynamic Calibration of the ETX

All tension meters are calibrated with standard materials—such as polyamide monofilament (PA)—ccording to the factory procedure. The diameters are given in section 1.0. In 95% of all industrial applications, the factory calibration has been proven to provide the best results and is used for comparative purposes. The basic setup for a dynamic calibration is shown below.

Line speed Vmax. = ETX 100 m/min - Vmax. = ETXP 60 m/min
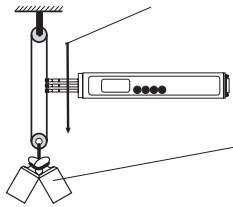
Hang twice the weight (pulley effect) which corresponds to the tension to be measured from the measured material, vertically, as shown here. Please keep in mind to include the weight of the lower deflection pulley when you calculate the suspended weight. Pay attention to the correct unit of measure **cN**.

9.2 Static Calibration

NOTE: The tension meter is factory calibrated for a vertical material path Recalibration thus also has to be carried out with a vertical material path.

Before beginning:

Acquire one cN weight each (or several weights adding up to the required value), corresponding to 10%, 50% and 90% of the tension range. Make sure the tension meter is switched off and that no process material is inserted between the rollers.

To select the calibration mode:

1. Press and hold the MEM and POWER keys until the Display shows

2. Release first the POWER key and then the MEM key.

To calibrate the zero point:

1. Press the MEM key. As long as the MEM key is depressed, the Display shows a random decimal value between 500 and 1200, e.g. 800 cN. This decimal value may vary from instrument to instrument.Write down the decimal value.

2. Release the MEM key when the value shown on the Display is fairly stable (the reading might fluctuate greatly).

3. The Display shows

6.0 MEMORY MODE

The tension meter features a data logger with a memory capacity for up to 4000 readings, with which you can store different measuring periods at one or more machine positions.

Memory Mode	S	C	L	F
Meas. periods, max.	255	255	255	255
Readings, max.	–	4000	4000	4000
Max. no. of readings per position	–	Any	10	Any
Statistics	Yes	Yes	Yes	Yes
Save readings	–	Yes	Yes	Yes

The readings are saved 2x per second, synchronously with the display update rate, in all memory modes except the "F" mode in which they are saved 100x per second. All saved readings and statistics can be shown on the display or transmitted to a PC (e.g. for further processing in Excel). The memory can be allocated to different measuring periods, depending on the memory mode.

Memory mode "S" STANDARD (default):

The following values of a measuring period are calculated and saved at a rate of 2 readings per second:

Average value
Last value
Maximum value (MAX)
Minimum value (MIN)
Minimum peak value (MIN PEAK)
Maximum peak value (MAX PEAK)
Individual readings are not saved.

You can save up to 255 measuring periods.

Memory mode "C" CONTINUOUS:

The following values of a measuring period are calculated and all readings are additionally saved at a rate of 2 readings per second:

Average value
Last value
Maximum value (MAX)
Minimum value (MIN)
Minimum peak value (MIN PEAK)
Maximum peak value (MAX PEAK)

You can save up to 4000 readings, split up into up to 255 measuring periods.

Memory mode "L" LIMIT:

The following values of a measuring period are calculated and 10 readings are additionally saved at a rate of 2 readings per second:

Average value,
Last value,
Maximum value (MAX)
Minimum value (MIN)
Minimum peak value (MIN PEAK)
Maximum peak value (MAX PEAK)

You can save up to 255 measuring periods with 10 readings each.

Memory mode "F" FAST:

The following values of a measuring period are calculated and all readings are additionally saved at a rate of 100 readings per second:

Average value
Last value
Maximum value (MAX)
Minimum value (MIN)
Minimum peak value (MIN PEAK)
Maximum peak value (MAX PEAK)

You can save up to 4000 readings, split up into up to 255 measuring periods.

NOTE: The selected memory mode remains stored in memory even after the instrument is switched off.

6.1 Memory Mode Selection

1. Switch on the tension meter

2. Clear the memory by simultaneously pressing the MEM and RECALL keys.

3. Press and hold the MEM key.

The Display shows "**S".** This is the **Standard Memory Mode** (default). Press the DAMP or RECALL to display the other memory modes.

Memory mode C (CONTINUOUS):
If the Display shows C, the CONTINUOUS memory mode is set.

Memory mode L (LIMIT):
If the Display shows L, the LIMIT memory mode is set.

Memory mode F (FAST):
If the Display shows F, the FAST memory mode is set.

When you have selected the desired memory mode, you can release the MEM key. The selected memory mode is now active and the tension meter switches back to measuring mode.

NOTE: The selected memory mode remains stored in the memory even after the instrument is switched off.

6.2 Data Logging in Mode S (Standard)

1. Turn on the tension meter.

2. Memory Mode S set as described in section 5.1

3. Insert process material and begin measuring as described in section 4.0.

To Start Data Logging:

1. Press and hold the MEM key until the Display shows the memory mode "S" and the current memory number.

2. Release the MEM key. The tension meter starts logging the data.While the tension data are stored, the MEM indicator blinks on the Display and the currently measured value is displayed.
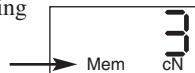
### 8.0 STATIC VERIFICATION OF MEASURING ACCURACY

All tension meters are calibrated with standard materials—such as polyamide monofilament (PA)—according to the factory procedure. The diameters are given in section 1.0. Any difference in process material size and rigidity from the standard material may cause a deviation of the accuracy.

In 95% of all industrial applications, the factory calibration has been proven to provide the best results and is used for comparative purposes.

NOTE: Before beginning, make sure that the tension meter is factory calibrated for a vertical material path. The required reference weight is available.

Verification procedure:

1. Switch on the tension meter.

2. Hang a weight which corresponds to the tension to be measured from the measured material, vertically, as shown.
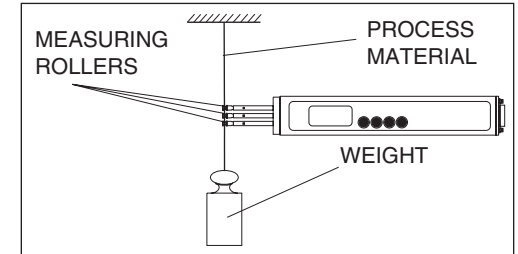
NOTE: Pay attention to the correct unit of measure cN or g (gram).

3. Press the LEVER down all the way and thread the process material through the MEASURING and GUIDE ROLLERS as described in section 4.1, then slowly release pressure on the LEVER until the GUIDE ROLLERS return to their original position.

4. Before verifying the calibration, move the instrument slowly up and down to compensate for possible mechanical friction losses and thus ensure repeatability of the measurements.

5. The tension value shown on the Display should be equal to the value of the suspended weight (pay attention to the measuring units).

If this procedure shows a deviation, you can recalibrate the instrument following the directions in secton 9.0

7.5 Clearing the Memory

If values are stored in the memory, the Display shows the MEM indicator.

```
  23
Mem    cN
```

To clear the memory:
Simultaneously press the MEM and RECALL keys. The mem indicator disappears from the Display and all values stored in the memory have been deleted.

7.6 Memory Function HOLD

When the tension meter memory is empty, you can retain the last reading on the Display by using the memory function HOLD.

To retain the last reading:
Press the RECALL / HOLD key once for about 1 second. The Display shows the last readingand the ":" colon symbol.

```
  2:2.8
        cN
```

To switch back to measuring mode:
Press the RECALL / HOLD key once for about 1 second. The tension meter switches back to measuring mode.

7.7 Error Messages

1. The Display shows EEE. The upper limit of the tension range was exceeded by more than 10%. Reduce the line tension.

```
  EEE
```

   OR

   AUTO ZERO is no longer possible. Recalibrate the instrument following the directions in section 9.0

2. The Display shows -E.E. The lower limit of the tension range was fallen below by more than 10%. Properly insert the process material.

```
  -E.E
```

   OR

   AUTO ZERO is no longer possible. Recalibrate the instrument following the directions in section 9.0.

3. The Display shows the battery symbol. The battery is low and must be replaced immediately. Operating the tension meter with a low battery may cause measurement errors.

```
 ⊟    6
      cN
```
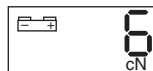
To Stop Data Logging:

1. When you want to stop data logging, press the MEM key once again. The statistical values are calculated from the logged tension data and stored in the following order:

   Average value
   Last value
   Maximum value (MAX)
   Minimum value (MIN)
   Minimum peak value (MIN PEAK)
   Maximum peak value (MAX PEAK)

The MEM Mem indicator is frozen on the display and the current reading is displayed. The tension meter has changed back to measuring mode.

```
        3
→  Mem    cN
```

To Save The Next Measuring Period:

1. Press the MEM key again. The Display shows the memory mode "S" and the next memory number.

```
  S    2
Mem    cN
```

6.3 Data Logging in Mode C (Continuous)

1. Turn on the tension meter.
2. Memory Mode C set as described in section 5.1
3. Insert process material and begin measuring as described in section 4.0.

To Start Data Logging:

1. Press and hold the MEM key until the Display shows the memory mode "C" and the current memory number.

```
  C    1
       cN
```

2. Release the MEM key. The tension meter starts logging the data.

While the tension data are stored, the MEM indicator blinks on the Display and the currently measured value is displayed.

```
        3
→  Mem    cN
```
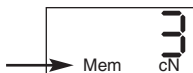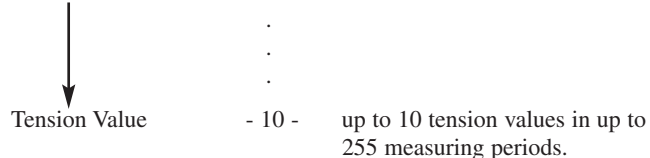
To Stop Data Logging:

1. To stop data logging, press the MEM key once again. The statistical values are calculated and stored in the following order:

   Average value
   Last value
   Maximum value (MAX)
   Minimum value (MIN)
   Minimum peak value (MIN PEAK)
   Maximum peak value (MAX PEAK)
   Tension Value   - 1 -
   Tension Value   - 2 -

   Tension Value   - N -   up to 4000 tension values in up to
                                      255 measuring periods

The MEM Mem indicator is frozen on the display and the current reading is displayed. The tension meter has changed back to measuring mode.

To Save The Next Measuring Period:

1. Press the MEM key again. The Display shows the memory mode "C" and the next memory number.

6.4 Data Logging in Mode L (Limit)

1. Turn on the tension meter.
2. Memory Mode C set as described in section 5.1
3. Insert process material and begin measuring as described in section 4.0.

To Start Data Logging:

1. Press and hold the MEM key until the Display shows the memory mode "L" and the current memory number.

2. Release the MEM key. The tension meter starts logging the data.

While the tension data are stored, the MEM indicator blinks on the Display and the currently measured value is displayed.

To Stop Data Logging:

1. To stop data logging, press the MEM key once again. The statistical values are calculated and stored in the following order:

Average value
Last value
Maximum value (MAX)
Minimum value (MIN)
Minimum peak value (MIN PEAK)
Maximum peak value (MAX PEAK)
Tension Value   - 1 -
Tension Value   - 2 -
                   .
                   .
                   .

Tension Value   - 10 -   up to 10 tension values in up to 255 measuring periods.

The MEM Mem indicator is frozen on the display and the current reading is displayed. The tension meter has changed back to measuring mode.

To Save The Next Measuring Period:

1. Press the MEM key again. The Display shows the memory mode "S" and the next memory number.

7.4 Recalling Stored Values in Mode F (Fast)

1. Turn on the tension meter and press the RECALL key, You can exit recall at any time by pressing the POWER key.

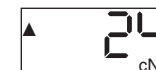| Memory Mode LIMIT							
Pos:	1	Pos:	2	Pos:	3	Pos:	4
AVG:	22.0	AVG:	12.0	AVG:	12.0	AVG:	12.0
LAST:	23.0	LAST:	22.1	LAST:	22.1	LAST:	22.1
MAX:	24.0	MAX:	22.1	MAX:	22.1	MAX:	22.1
MIN:	21.0	MIN:	5.4	MIN:	5.4	MIN:	5.4
PEAK $_{MAX}$:	26.0	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1
PEAK $_{MIN}$:	19.0	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8
	10.8		14.2		14.1		15.4
	10.0		19.4		11.2		18.3
	7.3		22.9		8.9		17.5
	6.1		17.3		10.2		7.8
	↓		↓		↓		↓
	n		10		10		10

2. The display blinks showing the **average value** (AVG) of the first measuring period (POS: 1) and the ▲ ▼ symbol.

3. Press the RECALL key. The Display blinks, showing the **last value** (LAST) of the measuring period

4. Press the RECALL key. The Display blinks, showing the **maximum value** (MAX) or the measuring period and the ▲ symbol.
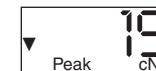
5. Press the RECALL key. The Display blinks, showing the **minimum value** (MAX) of the measuring period and the ▼ symbol.

6. Press the RECALL key. The Display blinks, showing the **maximum peak value** (PEAK$_{MAX}$) of the measuring period, the PEAK indicator and the ▲ symbol.

7. Press the RECALL key. The Display blinks, showing the **minimum peak value** (PEAK$_{MIN}$) of the measuring period, the PEAK indicator and the ▼ symbol.

8. Press the RECALL key. The measured values no. 1 — n of the first measuring period can be recalled.

9. Press the RECALL key. The next measuring period (POS: 2) is shown on the Display, starting with the **average value** (AVG).

7.3 Recalling Stored Values in Mode L (Limit)

1. Turn on the tension meter and press the RECALL key, You can exit recall at any time by pressing the POWER key.

Memory Mode LIMIT							
Pos:	1	Pos:	2	Pos:	3	Pos:	4
AVG:	22.0	AVG:	12.0	AVG:	12.0	AVG:	12.0
LAST:	23.0	LAST:	22.1	LAST:	22.1	LAST:	22.1
MAX:	24.0	MAX:	22.1	MAX:	22.1	MAX:	22.1
MIN:	21.0	MIN:	5.4	MIN:	5.4	MIN:	5.4
PEAK $_{MAX}$:	26.0	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1
PEAK $_{MIN}$:	19.0	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8
	10.8		14.2		14.1		15.4
	10.0		19.4		11.2		18.3
	7.3		22.9		8.9		17.5
	6.1		17.3		10.2		7.8
	↓		↓		↓		↓
	n		10		10		10

2. The display blinks showing the **average valu**e (AVG) of the first measuring period (POS: 1) and the ▲ symbol.

3. Press the RECALL key. The Display blinks, showing the **last value** (LAST) of the measuring period

4. Press the RECALL key. The DISPLAY blinks, showing the **maximum value** (MAX) or the measuring period and the ▲ symbol.

5. Press the RECALL key. The DISPLAY blinks, showing the **minimum value** (MAX) of the measuring period and the ▼ symbol.

6. Press the RECALL key. The DISPLAY blinks, showingthe **maximum peak value** (PEAK$_{MAX}$) of the measuring period. the PEAK indicator and the ▲ symbol.

7. Press the RECALL key. The DISPLAY blinks, showing the **minimum peak value** (PEAK$_{MIN}$) of the measuring period, the PEAK indicator and the ▼ symbol.

8. Press the RECALL key. The measured values no. 1 — 10 of the first measuring period can be recalled.

9. Press the RECALL key. The next measuring period (POS: 2) is shown on the DISPLAY, starting with the **average value** (AVG).

6.5 Data Logging in Mode F (Fast)

1. Turn on the tension meter.
2. Set Memory Mode C as described in section 5.1
3. Insert process material and begin measuring as described in section 4.0.

To Start Data Logging:

1. Press and hold the MEM key until the Display shows the memory mode "F" and the current memory number.

2. Release the MEM key. The tension meter starts logging the data at a rate of 100 readings per second.

While the tension data is stored, the MEM indicator blinks on the Display and the currently measured value is displayed.

To Stop Data Logging:

1. To stop data logging, press the MEM key once again. The statistical values are calculated and stored in the following order:

Average value
Last value
Maximum value (MAX)
Minimum value (MIN)
Minimum peak value (MIN PEAK)
Maximum peak value (MAX PEAK)
Tension Value   - 1 -
Tension Value   - 2 -
.
.
.

Tension Value   - N -   up to 4000 tension values in up to 255 measuring periods.

The MEM indicator is frozen on the display and the current reading is displayed. The tension meter has changed back to measuring mode.

To Save The Next Measuring Period:

1. Press the MEM key again. The Display shows the memory mode "F" and the next memory number.

7.0 RECALLING TENSION VALUES STORED IN MEMORY

Tension values stored in built-in memory can be recalled to the Display (refer to instructions below), can be transferred to a PC using your own software (refer to ASCII commands, section 10.0) or transferred to the Tension Inspect software supplied with this tension meter (refer to separate Tension Inspect manual).

7.1 Recalling Stored Values in Mode S (Standard)

1. Turn on the tension meter and press the RECALL key, You can exit recall at any time by pressing the POWER key.

Memory Mode STANDARD

Pos:	1	Pos:	2	Pos:	3	Pos:	4
AVG:	22.0	AVG:	12.0	AVG:	12.0	AVG:	12.0
LAST:	23.0	LAST:	22.1	LAST:	22.1	LAST:	22.1
MAX:	24.0	MAX:	22.1	MAX:	22.1	MAX:	22.1
MIN:	21.0	MIN:	5.4	MIN:	5.4	MIN:	5.4
PEAK $_{MAX}$:	26.0	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1
PEAK $_{MIN}$:	19.0	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8

2. The display blinks showing the **average valu**e (AVG) of the first measuring period (POS: 1) and the ▲ ▼ symbol.

3. Press the RECALL key. The Display blinks, showing the **last value** (LAST) of the measuring period

4. Press the RECALL key. The Display blinks, showing the **maximum value** (MAX) or the measuring period and the ▲ symbol.

5. Press the RECALL key. The Display blinks, showing the **minimum value** (MIN) of the measuring period and the ▼ symbol.

6. Press the RECALL key. The Display blinks, showingthe **maximum peak value** (PEAK$_{MAX}$) of the measuring period, the PEAK indicator and the ▲ symbol.

7. Press the RECALL key. The Display blinks, showing the **minimum peak value** (PEAK$_{MIN}$) of the measuring period, the PEAK indicator and the ▼ symbol.

8. Press the RECALL key. The next measuring period (POS: 2) is shown on the Display, starting with the **average value** (AVG).

7.2 Recalling Stored Values in Mode C (Continuous)

1. Turn on the tension meter and press the RECALL key, You can exit recall at any time by pressing the POWER key.

Memory Mode LIMIT

Pos:	1	Pos:	2	Pos:	3	Pos:	4
AVG:	22.0	AVG:	12.0	AVG:	12.0	AVG:	12.0
LAST:	23.0	LAST:	22.1	LAST:	22.1	LAST:	22.1
MAX:	24.0	MAX:	22.1	MAX:	22.1	MAX:	22.1
MIN:	21.0	MIN:	5.4	MIN:	5.4	MIN:	5.4
PEAK $_{MAX}$:	26.0	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1	PEAK $_{MAX}$:	28.1
PEAK $_{MIN}$:	19.0	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8	PEAK $_{MIN}$:	1.8
	10.8		14.2		14.1		15.4
	10.0		19.4		11.2		18.3
	7.3		22.9		8.9		17.5
	6.1		17.3		10.2		7.8
	↓		↓		↓		↓
	n		10		10		10

2. The display blinks showing the **average valu**e (AVG) of the first measuring period (POS: 1) and the ▲ ▼ symbol.

3. Press the RECALL key. The Display blinks, showing the **last value** (LAST) of the measuring period

4. Press the RECALL key. The Display blinks, showing the **maximum value** (MAX) or the measuring period and the ▲ symbol.

5. Press the RECALL key. The Display blinks, showing the **minimum value** (MAX) of the measuring period and the ▼ symbol.

6. Press the RECALL key. The Display blinks, showingthe **maximum peak value** (PEAK$_{MAX}$) of the measuring period. the PEAK indicator and the ▲ symbol.

7. Press the RECALL key. The Display blinks, showing the **minimum peak value** (PEAK$_{MIN}$) of the measuring period, the PEAK indicator and the ▼ symbol.

8. Press the RECALL key. The measured values no. 1 — n of the first measuring period can be recalled.

9. Press the RECALL key. The next measuring period (POS: 2) is shown on the Display, starting with the **average value** (AVG).