## `Warranty

ELECTROMATIC Equipment Co., Inc. (ELECTROMATIC) warrants to the original purchaser that this product is of merchantable quality and confirms in kind and quality with the descriptions and specifications thereof. Product failure or malfunction arising out of any defect in workmanship or material in the product existing at the time of delivery thereof which manifests itself within one year from the sale of such product, shall be remedied by repair or replacement of such product, at ELECTROMATIC's option, except where unauthorized repair, disassembly, tampering, abuse or misapplication has taken place, as determined by ELECTROMATIC. All returns for warranty or non-warranty repairs and/or replacement must be authorized by ELECTROMATIC, in advance, with all repacking and shipping expenses to the address below to be borne by the purchaser.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE OR APPLICATION. ELECTROMATIC SHALL NOT BE RESPONSIBLE NOR LIABLE FOR ANY CONSEQUENTIAL DAMAGE, OF ANY KIND OR NATURE, RESULTING FROM THE USE OF SUPPLIED EQUIPMENT, WHETHER SUCH DAMAGE OCCURS OR IS DISCOVERED BEFORE, UPON OR AFTER REPLACEMENT OR REPAIR, AND WHETHER OR NOT SUCH DAMAGE IS CAUSED BY MANUFACTURER'S OR SUPPLIER'S NEGLIGENCE WITHIN ONE YEAR FROM INVOICE DATE.

Some State jurisdictions or States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. The duration of any implied warranty, including, without limitation, fitness for any particular purpose and merchantability with respect to this product, is limited to the duration of the foregoing warranty. Some states do not allow limitations on how long an implied warranty lasts but, not withstanding, this warranty, in the absence of such limitations, shall extend for one year from the date of invoice.

ELECTROMACTIC Equipment Co., Inc.
600 Oakland Ave. Cedarhurst, NY 11516—USA
Tel: 1-800-645-4330/ Tel: 516-295-4300/ Fax: 516-295-4399



## TABLE OF CONTENTS

## 1.0 Introduction

Thank you for selecting the CHECK•LINE WTTM Wire Terminal Pull Tester for your requirements. With correct use and proper care this product should provide many years of precise and accurate testing. Please read the entire operation manual thoroughly before using this instrument for the first time. The information contained herein will help users to achieve accurate and repeatable results as well as prevent damage through improper set-up or operation.

This instrument is designed for measuring tensile strength of soldered or solder-free cable joints with end sleeves, pins, solder pins or similar wire terminal components in the field of quality control or design validation.

### Safety Precautions

***Wear appropriate eye protection at all times.***

The load cell can be damaged if the internal measuring system is overloaded. Do not exceed the maximum measuring limit of 50 Kg (110 lbs., 500N) or 100 Kg (220 lb., 1000N), respectively

Transport and store the instrument with care. This reduces the risk of damage to the load cell or other minor mechanical problems which can cause inaccurate measurement results.

Operate the instrument in appropriate environments only. The instrument is equipped with a temperature compensation for a temperature range of 32 to 120 °F (0° to 40°C) and should be used in this temperature range only. Do not expose this device to liquid or operate in high-humidity environments.

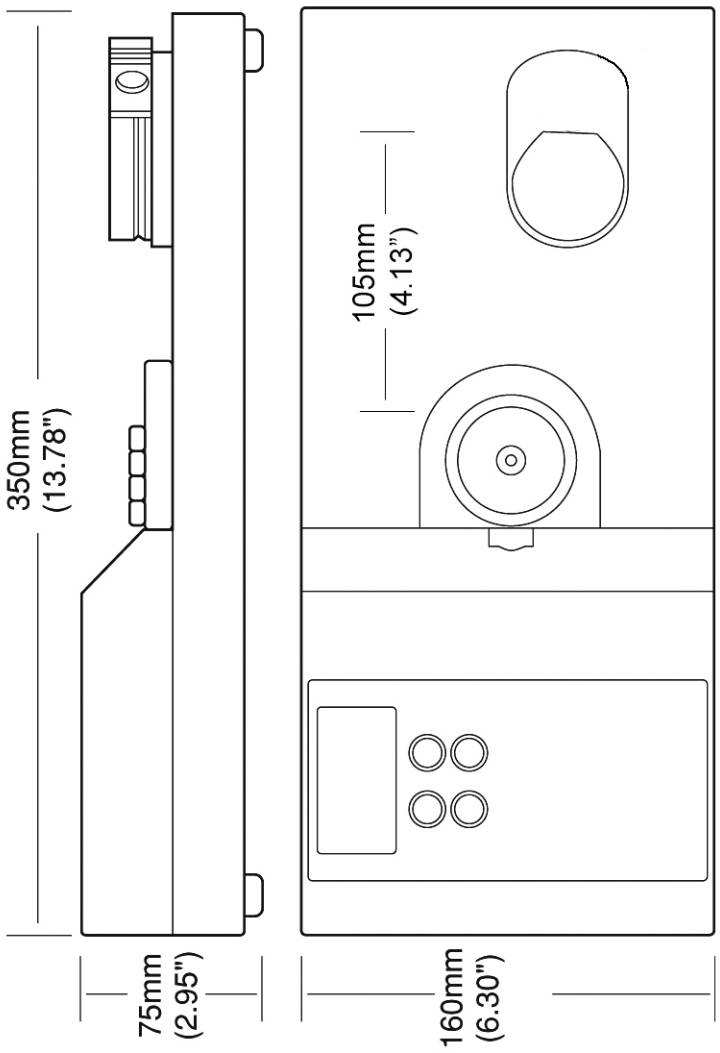


## Appendix: Pull Test Specifications for UL, MIL and SAE

**Pull Test Specifications for UL, MIL and SAE**

| Size of Conductor | | UL 486A Table 12.1 | | SAE AS7928 Table II | |
|---|---|---|---|---|---|
| AWG | ($mm^2$) | Pounds | (N) | Pounds | (N) |
| 30 | 0.050 | 1–1.5 | 6.7 | N/A | N/A |
| 28 | 0.080 | 2 | 8.9 | N/A | N/A |
| 26 | 0.130 | 3 | 13.4 | 7 | 3.12 |
| 24 | 0.200 | 5 | 22.3 | 10 | 44.5 |
| 22 | 0.324 | 8 | 35.6 | 15 | 66.8 |
| 20 | 0.519 | 13 | 57.9 | 19 | 84.6 |
| 18 | 0.823 | 20 | 89.0 | 38 | 169.1 |
| 16 | 1.310 | 30 | 133.5 | 50 | 222.5 |
| 14 | 2.080 | 50 | 222.5 | 70 | 311.5 |
| 12 | 3.310 | 70 | 311.5 | 110 | 489.5 |
| 10 | 5.261 | 80 | 356.0 | N/A | N/A |

## 12.0 Dimensions






## 2.0 Unpacking & Contents

Remove the unit carefully and check that it appears undamaged.
Check that all of the supplied items are contained in the box (see below).
Retain packaging materials in the case that the unit needs to be returned to the manufacturer or distributor.

- Main instrument with integrated electronics.
- 12 VDC power supply: 100–240 VDC (50 – 60Hz) with U. S. cord (Part No.: 20133-US)
- Software CD Fmi-Connect (Part No.: FMI-972)
- Operating instruction manual
- Connection cable for RS232C (Part No.: 20073)

## 3.0 Setup

Place the WTTM Wire Terminal Tester on a level and stable work area where the user can perform the testing in a comfortable manner. The surface should be clean and grease-free, so that the instrument does not slip.

*Make sure that there is no residue from the pack-aging materials stuck under and around any of the operating components especially in the recessed area around the rotating terminal fixture (see photo). Use of compressed air to clear any debris from these areas is recommended.*

Please note that the instrument weighs approximately 42 pounds (19 kg), so take care when lifting and moving. We suggest that the instrument be located in close proximity to an AC-Power outlet.

## 4.0 AC-Operation

The WTTM must be operated using the AC-Adapter.



## 11.0 Specifications

| | |
|---|---|
| **Measuring Range*** | 0–50 Kg / 0–110 lbs / 0–500N or<br>0–100 Kg (0–220 lbs / 0–1000N)<br>(units selected via keypad) |
| **Resolution** | 0.01Kg / 0.1 lbs / 0.1 N |
| **Terminal adapter slot width (mm)** | 0.5, 0.8, 1.0, 1.4, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0 |
| **Accuracy** | ±0.5% F.S. or better |
| **Operating Mode** | |
| Continuous | Displays actual value in Kg, lbs. or N |
| Peak-Hold | Displays peak value in Kg, lbs. or N |
| **Wire Diameter** | |
| SAE AS7928 II | AWG 8. . .30 |
| IEC 60352-2 | Cross section 0.05. . .10mm$^2$ |
| Maximum | 0.236" *(6mm)* |
| **Overload** | 120% |
| **Display** | LCD, 4–1/2 digit, 12mm high |
| **Update Time** (msec) | |
| Standard | 1000, 500, 333, 200, 100, 50 (selectable) |
| Peak | 1 |
| **Memory** | Peak Value |
| **Power Supply** | AC adapter (100-240V/50-60 Hz) |
| **Interface (RS232C)** | Baud rate: 2.4, 4.8, 9.6, 19.2 Kb (selectable) |
| **Temp. Range** | |
| Operating | 32 to104 °F *(0 to 40 °C)* |
| Storage | –4 to 140 °F *(–20 to 60 °C)* |
| **Weight, approx.** | 42lbs. *(19 Kg*) |
| **Dimensions** | 14.2" x 6.3" x 3.33" *(360 x 160 x 110 mm)* |
| **Protection Code** | IP40 |
| **Material** | Anodized aluminum, steel and stainless steel |

* Low-range model available on special order basis.

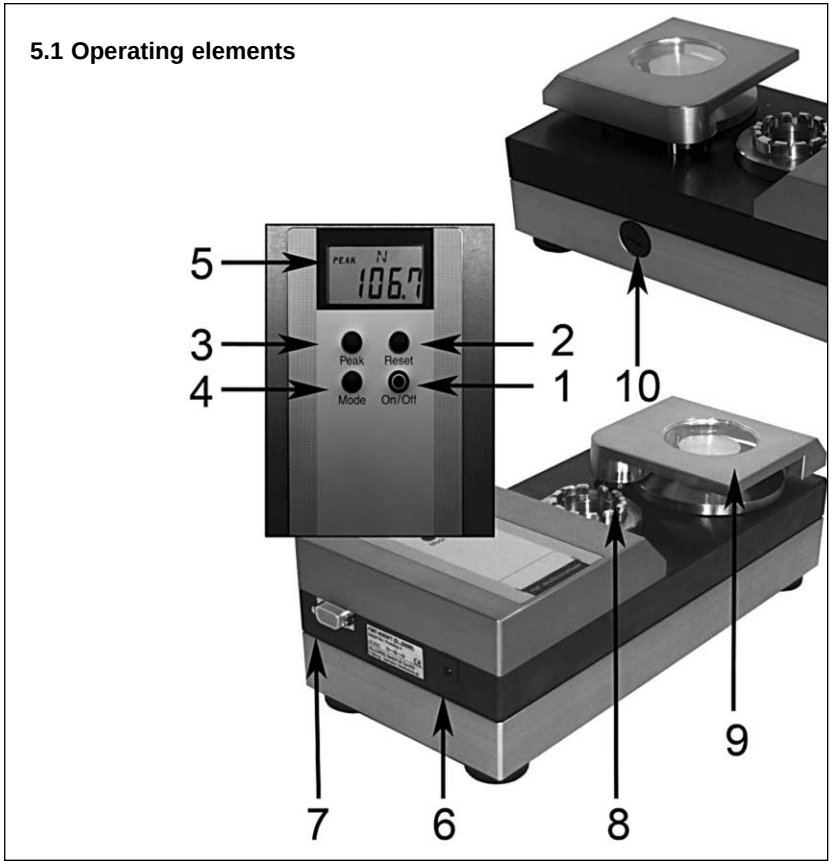
## 10.0 Troubleshooting

| | |
|---|---|
| **No indication on display** | Plug in the AC-adapter and check the electrical connections. |
| **RS-232C communication is disturbed** | Check the wiring of the connection cable and the compliance of wiring within the input terminals of the PC-card. |
| ***Error Code Indications:*** | |
| **OV+** | Overload of +120%. Reduce the load until the instrument indicates a value within the admissible measuring range. |
| **OV-** | Overload of –120%. Reduce the load until the instrument indicates a value within the admissible measuring range. |
| **OVP** | Overload +!! The load cell can be damaged. Remove the excessive load immediately and check the instrument. If the indicated measuring values are obviously incorrect, the load cell must be replaced by the manufacturer. |
| **OVM** | Overload -!! The load cell can be damaged. Remove the excessive load immediately and check the instrument. If the indicated measuring values are obviously incorrect, the load cell must be replaced by the manufacturer. |
| **ERR –3-** | Reading error of the E_proms. Switch off the instrument and turn it on again. Should the error still exist, the microprocessor may need to be replaced by the manufacturer. |
| **ERR –4-** | Reading error of the E_proms. Switch off the instrument and turn it on again. Should the error still exist, the microprocessor may need to be replaced by the manufacturer. |
| **Pull force fixture does not work** | Remove the AC-adapter/charger, close the protection cover and wait for approx. 5 minutes. Plug in the AC-adapter again and switch on the instrument. If the display does not show any of the error codes above and still does not work, please send the instrument back for inspection to your dealer or directly to the manufacturer. |



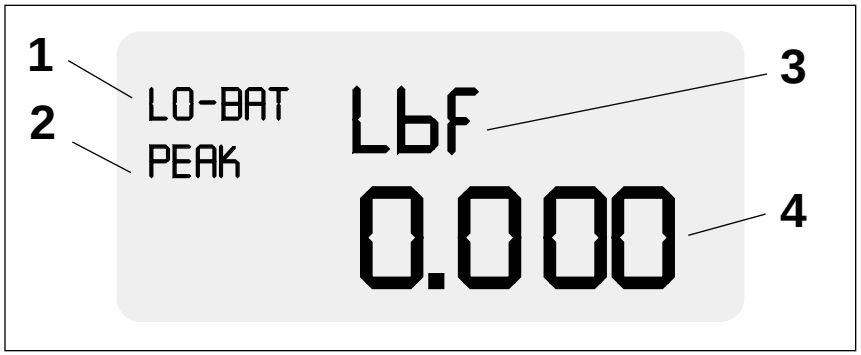
## 5.0 Overview

### 5.1 Operating elements




1. **ON/OFF Button** Switches the instrument on/off
2. **RESET Button** For zero-setting after inserting the test sample
3. **PEAK Button** For selecting the display function, current measurement result or peak value of the tractive force (drag indicator function), and for calling up the peak value of the measurement
4. **MODE Button** For selecting the desired measurement unit
5. **Display**
6. **Outlet** For AC Adapter
7. **Outlet** For data transfer
8. **Terminal adapter** with 12 slots for inserting the cable joint
9. **Tractive force fixture** for inserting the free cable end (with protection cap)
10. **Selector switch for pull speed** (access protected by screw connection)

## 5.2 Display




1 **Low Battery Indicator.** Flashes when batteries need charging, turns off when fully charged. Remains on while charging.

2 **Peak Mode Indicator.** Shown on display when configured for peak mode (stores highest peak force until it is reset by pressing zero key)

3 **Units Indicator.** Displays currently selected units of measure (pounds, newtons or kilograms). Changed by pressing UNITS key.

4 **Force Value.** Displays current or peak force value in user-selected units of measure.

## 5.3 Operating modes

The WTTM can be set to operate in one of two distinct operating modes: Peak Capture or Average. In **Peak Capture Mode**, the system measures the force at a frequency of 1000 Hz (1000 times per second) and displays the highest force measurement. The peak value remains on the display until a higher force value is measured or until the user presses the ZERO key.

In **Average Measurement Mod**e, the system measures the force at a frequency of 1000 Hz (1000 times per second) and displays the average each time the display is updated. The factory default display update rate is 3 times per second (1 time every
1/3 second).

**Note:** Refer to section 7.3, page 8, for additional information and to change the update rate.



## Recalibration Procedure

For recalibration, you would need a solid and vibration-free rack and a test weight (50kg or 100kg), preferably Class M1, which complies with the international standard.

Before calibrating the load cells, the pull force fixture must be brought back to the zero-position. In order to do this, adjust the selector switch for the pull speed to “0” and switch on the instrument.

1. Switch off the instrument using **ON/OFF** button.
2. Press and hold **MODE, PEAK** and **RESET** buttons simultaneously.
3. While keeping the above buttons pressed, press the **ON/OFF** button until **CAL** is indicated in the display and the calibration weight code (??) is shown. Then release all buttons. The WTTM is now in calibration mode

   **CAL**
   **–00–**

4. Press the **MODE** button. The signs **SNC** and **–00–** flash for approx. 10 seconds followed by the indication ZER 88888.

   **“SCN” –00–** → **ZER 88888**

5. To confirm the calibration of the zero point press the **RESET** button. The indication **SCN 88888** flashes on the display for approx. 15 seconds, followed by **PEK 88888.** The first step of the calibration is now complete.

   **“SCN” 88888** → **PEK 88888**

6. Hang the calibration weight on the terminal adapter. When the weight hangs perpendicular and still, you may save the full-scale value.
7. Press the PEAK button. The display flashes for approx. 15 sec. with the sign **SCN 88888** followed by the sign **END 88888**. After a further period of approx. 5 sec., the sign **OK 88888** indicates that the calibration was successful. The instrument switches off automatically.

   **“SCN” 88888** → **“End” 88888** → **“oK” 88888**

8. Should the calibration fail, the display will show **ERR 88888** instead. The original calibration datas are still saved in the memory. You may remove the weight and repeat the recalibration procedure

## 10.0 Calibration

The WTTM Pull Tester has been calibrated in accordance with factory procedures and is certified to perform within the stated accuracy specifications shown in the Specifications section found on page 18. Assuming the unit is handled with care and operated as detailed in this manual it should remain accurate for an extended time period. If however, it is subjected to forces that exceed its maximum range or if it is not properly cared for, it might need to be recalibrated.

It is recommended that the calibration is verified at least on an annual basis and more frequently if feasible. Normally, instruments of this type go out of tolerance from one day to the next and rarely on a regular periodic basis.

A calibration procedure is provided in this manual, however it should only be performed by individuals properly trained for this type of service and with the appropriate certified standards (known weights or secondary force measuring system such as a load cell, etc.).

### Re-Calibration Set-up

1. Remove the lever by unscrewing it in a counter-clockwise direction and move the Wire Clamp assembly out from the path of the hanging sample.
2. Position the WTTM in a vertical position so that the keypad & display are at the top (refer to photo). Be sure to secure it so it can not topple over when the weight is attached.
3. Using a heavy-duty monofilament (fishing line), wire or similar, suspend a 50 Kg weight from one of the teeth on the wire terminal fixture by hooking a loop of the material over the selected tooth.
4. Temporarily, remove the weight and follow the Re-Calibration Procedures shown on page 16.

- Make sure that the WTTM is well secured in the vertical position.

**Caution**

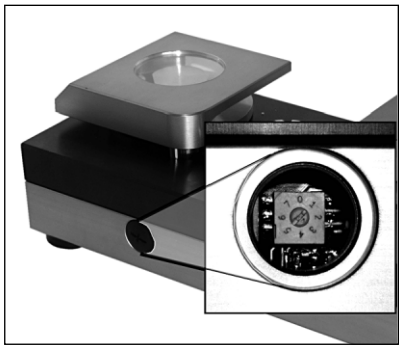
- Select a material that is strong enough to support 50 Kg of weight.

need photo



## 6.0 Basic Procedures

### 6.1 Changing the pull speed (default: 50mm/min)



The pull speed can be adjusted according to the testing standards. You need a small and a large screw driver to do this. The selector switch is protected by a screw thread cap, in order to avoid an unintentional manipulation of the pull speed.

To adjust the pull speed:

1. Switch off the instrument and unplug the power supply.
2. Loosen the protection cap with the large screw driver (flat or phillips head?).
3. Adjust the selector switch to the desired pull speed (How? Using the small screw driver?)
4. Replace and tighten the protective cap.

| Standard | Speed | Switch Position |
|---|---|---|
| DIN IEC 60352 Part 2*<br>UL 486 C | 25 mm/min | 1 |
| DIN IEC 60352 Part 2<br>UL 486 C | 37.5 mm/min | 2 |
| DIN IEC 60352 Part 2<br>UL 486 C<br>SAE AS7928 Table II | 50 mm/min | 3 |
| SAE AS7928 Table II**<br>SAE/USCAR-21 | 100 mm/min | 4 |
| SAE/USCAR-21 | 150 mm/min | 5 |
| SAE/USCAR-21 | 200 mm/min | 6 |
| SAE/USCAR-21 | 250 mm/min | 7 |

* DIN IEC 60352 Part 2 replaces DIN 4161/3
BS5B178 corresponds to IEC 60352 Part 2

** SAE AS7928 Table II replaces MIL-T-7928
UL486A corresponds to IEC 60352 Part 2

### 6.2. Selecting the baud rate of the RS232C interface (Default: 19200)

The speed of the data transfer for the RS232C interface can be adjusted to match your data acquisition rate by changing the baud rate as follows:. This is possible by changing the baud rate:

1. Switch off the instrument.
2. Press and hold **RESET** button.
3. Press the **ON/OFF** button.
4. Wait until **f01** is displayed, then release **RESET** button.
5. Select function **f04** by repeating to press the **PEAK** button until **f04** is shown on the display.
6. Press the **MODE** button repeatedly until the appropriate baud rate (2400 / 4800 / 9600 / 19200) shows on the display.
7. Press the **RESET** button to save your settings.

### 6.3. Changing the up-date (refresh) rate of the display (Default: 3/sec)

The force applied to the load cell of the instrument is internally processed at a rate of 1000Hz, which allows the precise capturing of the peak values. The readings on the display, however, are refreshed at a default rate of 3 times/sec. You may increase or decrease the factory settings to match your personal demands as follows:

1. Switch off the instrument.
2. Press and hold the **RESET** button.
3. Press the **ON/OFF** button.
4. Wait until **f01** is displayed, then release the **RESET** button.
5. Select function **f02** by repeatedly pressing the **PEAK** button until **f02** is shown on the display.
6. Press the **MODE** button repeatedly until the desired refresh rate (1 / 2 / 3 / 5 / 10 / 20 times/sec) appears on the display
7. Press the **RESET** button to save your settings.

### 6.4 Temperature Compensation (default: SET = on)

In general, it is recommended to have the this function turned on as long as it does not effect your measuring results. Only when measuring very minute forces over a longer period of time at a slow rate and under stable environmental conditions might it be useful to switch this off.

1. Switch off the instrument.
2. Press and hold **PEAK** and **MODE** buttons.
3. Press **ON/OFF** button.
4. Wait until **TRK oFF** is displayed.
5. Release **PEAK** and **MODE** buttons.




| PROTOCOL CODE | | |
|---|---|---|
| Extern >> | Average data output<br>3. digit: + /or –<br>4.-6. digit. Value incl. floating decimal point | NA®®®®®®cr |
| | Peak data output<br>3. digit: + /or –<br>4.-6. digit. Value incl. floating decimal point | NB®®®®®®cr |
| | Unit: 3 digit<br>0 = N<br>1 = kg (g)<br>3= lb (oz) | NH®cr |
| | Unit: 3 digit<br>0 = N<br>1 = kg (g)<br>3= lb (oz) | NH®cr |
| Error | OBcr | Command Error |
| | OEcr | Parity Error |
| | OFcr | Format Error |
| | OGcr | Summing Error |
| | OHcr | Overflow |

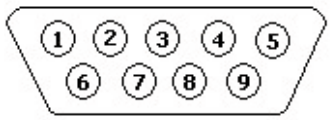
### 8.2 Analog Output

The analog output (-1...0...1 VDC) can be used for any data acquisition or data recording device. Pull Force data will be expressed as a negative voltage. The signal can be set to zero (reset) by performing a ZERO (tare) function. +1 VDC and – 1VDC refers to the maximum and minimum full scale (end of nominal measuring range).

| SPECIFICATION | |
|---|---|
| Amplitude | -1VDC / +1VDC |
| Signal generator | 12-bit D/A-Converter |
| Signal update | 100 Hz |

## 8.0 DATA TRANSFER

Model WTTM testers can transfer measuring data by means of an RS-232C interface. A 9-pin D-Sub connector is provided for this purpose, which can be found at the left side of the instrument. A connector cable for the serial port is included. If a custom serial cable must be used or if the user wishes to access the analog output, the pin designations are as follows:




| Pin | Description |
|---|---|
| 1 | 0...1 VDC (analog out) |
| 2 | Serial : TXD (RS-232C) |
| 3 | Serial : RXD (RS-232C) |
| 5 | Serial : CD (RS-232C) |
| 9 | Analog: Gnd (analog out) |

### 8.1 RS-232C Interface

The RS-232C interface can be used for the direct communication between an appropriate serial I/O-card of a computer and the instrument. The minimum requirement for the data transfer up to 19200 baud is the connection of the RXD, TXD and GND communication terminal.

| SPECIFICATION | |
|---|---|
| Baud rate | 2400, 4800; 9600 or 19200 (selectable, see general settings) |
| Data length | 8 bits |
| Stop bit | 1 |
| Parity | None |

| PROTOCOL CODE | | |
|---|---|---|
| Extern >> | AAcr | Tare |
| | ABcr | Stop Output |
| | ACcr | Change to Peak Mode |
| | ADcr | Change to Average Mode |
| | AEcr | Reset Peak |
| | AFcr | Change Units to kg (g) |
| | AGcr | Change Units to N |
| | AHcr | Change Units to lb (oz) |
| | BAcr | Data output request (single reading) |
| | BBcr | Data output request (10/sec) |
| | BB1cr | Data output request (20/sec) |
| | BB2cr | Data output request (50/sec) |
| | BB3cr | Data output request (100/sec) |
| | BDcr | Units confirmation request |
| | BEcr | Peak data output request |
| | BFcr | Minus peak data output request |
| | cr | (carriage return) |

**Chart continues on next page**

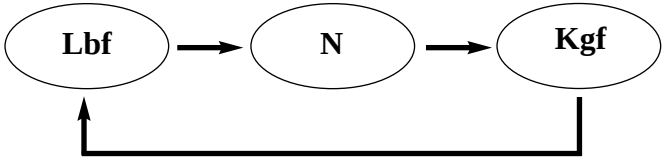


### 6.6 Changing Units of Measurement

The WTTM can display force measurements in any of the following three engineering units:

- lbf (pounds)
- N (Newtons)
- Kgf (kilograms)

To change the selected engineering units for display press UNITS key. Each time the key is pressed, the units will change from one to the other as follows:



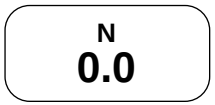
## 7.0 Operating Procedures

### 7.1. Switching on the instrument, selecting the measurement unit and operational mode

1. Switch on the instrument by pressing the **ON/OFF** button.
   After a power-up self test and calibration (approx. 20 sec.), the display will indicate the last selected measuring unit, function and the value 0.00.
2. Select the desired operation mode (indication of the current measurement value or the peak value) and the measuring unit by pressing the **PEAK** and **MODE** buttons simultaneously. The current settings will be indicated on the display. When you choose the **PEAK** mode, the peak value will be always indicated on the display (drag indicator function).

### 7.2. Resetting to zero before each measurement

It is necessary to zero-set the instrument before starting each pull force measurement. Press the **RESET** button for this purpose. The **RESET** button can also be used for deleting the peak value updated in the memory.




### 7.3 Taking Measurements

**NOTE:** Select the smallest suitable slot for the test sample diameter.

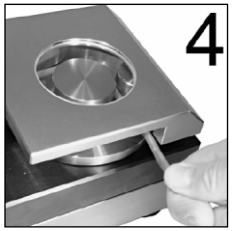
1. Place the cable connection into the adapter, so that the sleeve of the cable connector stays securely inside the ring and cannot be pulled out through the slot.


2. Insert the free cable end with slight tension into the clamping fixture. The nut in the pull force fixture will help you to find the right position for the cable.

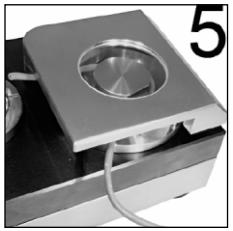

3. Holding the cable tight and securely, close the protection cover.




4. The motor starts and closes the pull force fixture. Hold the cable end securely until the pull force develops.




5. The rotational motion of the pull force fixture tears off the cable from the terminal joint. The motor stops when the maximal pull length has been reached.




6. When you open the protection cover, the pull force fixture returns back to the original position and releases the cable.
7. During the measurement, the force progression can be read off the display.


The peak value, which mostly appears before the connection breaks, is captured at 1000Hz and is indicated when the **PEAK** button is pressed (so long as the drag indicator function was not active).

**Depending on the wire strength and the related standard, the following tensile strength should at least be achieved.**

| AWG | Cross-Section | Cable Diameter | SAE AS7928 Table II | IEC 60352 Part2 | UL 486 C |
|---|---|---|---|---|---|
| 30 | 0.06 mm_ | 0.36 mm | | 6 N | 6 N |
| 28 | 0.09 mm_ | 0.38 mm | | 11 N | 11 N |
| 26 | 0.14 mm_ | 0.48 mm | 32 N | 18 N | 18 N |
| 24 | 0.22 mm_ | 0.61 mm | 45 N | 28 N | 28 N |
| 22 | 0.34 mm_ | 0.76 mm | 67 N | 40 N | 40 N |
| 20 | 0.56 mm_ | 0.97 mm | 85 N | 60 N | 45 N |
| 18 | 0.93 mm_ | 1.27 mm | 170 N | 90 N | 45 N |
| 16 | 1.25 mm_ | 1.44 mm | 223 N | 135 N | 68 N |
| 14 | 1.93 mm_ | 1.80 mm | 312 N | 200 N | 100 N |
| 12 | 3.16 mm_ | 2,29 mm | 490 N | 275 N | 138 N |
| 10 | 4.65 mm_ | 3.10 mm | | 355 N | |

* DIN IEC 60352 Part 2 replaces DIN 4161/3
BS5B178 corresponds to IEC 60352 Part 2

** SAE AS7928 Table II replaces MIL-T-7928
UL486A corresponds to IEC 60352 Part 2

XXXXX

CHECK·LINE®
BY ELECTROMATIC

# WTTM

# WIRE TERMINAL PULL TESTER


Operating Instructions

CHECK·LINE®
INSTRUMENTS

ELECTROMATIC
EQUIPMENT CO., INC.
600 Oakland Ave., Cedarhurst, NY 11516–U.S.A.
TEL: 516-295-4300 • FAX: 516-295-4399