Series 5
DIGITAL FORCE GAUGES

User's Guide

Thank you…

Thank you for purchasing a Mark-10 Series 5 digital force gauge, designed for tension and compression force testing applications from 0.12 lb to 500 lb (0.5 N to 2,500 N) full scale. The Series 5 is an essential component of a force testing system, typically also comprising a test stand, grips, and data collection software.

With proper usage, we are confident that you will get many years of great service with this product. Mark-10 force gauges are ruggedly built for many years of service in laboratory and industrial environments.

This User's Guide provides setup, safety, and operation instructions. Dimensions and specifications are also provided. For additional information or answers to your questions, please do not hesitate to contact us. Our technical support and engineering teams are eager to assist you.

Before use, each person who is to use the Series 5 force gauge should be fully trained in appropriate operation and safety procedures.

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1   OVERVIEW

1.1 List of included items

Qty.	Part No. M5-012 – M5-20	M5-50 – M5-100	M5-200 – M5-500	Description
1	12-1049	12-1049	12-1049	Carrying Case
1	08-1022	08-1022	08-1022	AC adapter body with US, EU, or UK prong
1	08-1026	08-1026	08-1026	Battery (inside the gauge)
1	G1024	G1024	G1031	Extension rod
1	G1026	G1026	G1033	Cone
1	G1025	G1025	G1032	Chisel
1	G1027	G1027	G1034	V-groove
1	G1029	G1029	G1036	Flat
1	G1028	G1038	G1035	Hook
1	N/A	G1039	G1037	Coupling
1	-			Certificate of calibration
1	09-1165			USB cable
1	-			Resource CD (USB driver, MESURgauge DEMO, User's Guide)

1.2 Safety / Proper Usage

Caution!
Note the force gauge's capacity before use and ensure that the capacity is not exceeded. Producing a force greater than 150% of the gauge's capacity can damage the internal load cell. An overload can occur whether the gauge is powered on or off.

Typical materials able to be tested include many manufactured items, such as springs, electronic components, fasteners, caps, films, mechanical assemblies, and many others. Items that should not be used with the gauge include potentially flammable substances or products, items that can shatter in an unsafe manner, and any other components that can present an exceedingly hazardous situation when acted upon by a force.

The following safety checks and procedures should be performed before and during operation:

1.   Never operate the gauge if there is any visible damage to the AC adapter or the gauge itself.

2.   Ensure that the gauge is kept away from water or any other electrically conductive liquids at all times.

3.   The gauge should be serviced by a trained technician only. AC power must be disconnected and the gauge must be powered off before the housing is opened.

4.   Always consider the characteristics of the sample being tested before initiating a test. A risk assessment should be carried out beforehand to ensure that all safety measures have been addressed and implemented.

5.   Wear eye and face protection when testing, especially when testing brittle samples that have the potential to shatter under force. Be aware of the dangers posed by potential energy that can accumulate in the sample during testing. Extra bodily protection should be worn if a destructive failure of a test sample is possible.

6. In certain applications, such as the testing of brittle samples that can shatter, or other applications that could lead to a hazardous situation, it is strongly recommended that a machine guarding system be employed to protect the operator and others in the vicinity from shards or debris.

7. When the gauge is not in use, ensure that the power is turned off.

2   POWER

The gauge is powered either by an 8.4V NiMH rechargeable battery or by an AC adapter. Since these batteries are subject to self discharge, it may be necessary to recharge the unit after a prolonged period of storage. Plug the accompanying charger into the AC outlet and insert the charger plug into the receptacle on the gauge (refer to the illustration below). The battery will fully charge in approximately 8 hours.

USB connector

Power input jack   **Serial connector**

Caution!
Do not use chargers or batteries other than specified or instrument damage may occur.

If the AC adapter is plugged in, a corresponding icon appears in the lower left corner of the display, as follows:

If the AC adapter is not plugged in, battery power drainage is denoted in a three step process:

1. When battery life is greater than 30%, no indicator is present.

2. When battery life drops to approximately 30%, an indicator appears as follows:

3. When battery life drops to approximately 10%, the indicator will appear as follows:

4. When battery life drops to approximately 2%, the indicator from step 2 will be flashing. Several minutes after (timing depends on usage and whether the backlight is turned on or off), a message will appear, "BATTERY VOLTAGE TOO LOW. POWERING OFF". A 4-tone audio indicator will sound and the gauge will power off.

The gauge can be configured to automatically power off following a period of inactivity. Refer to the **Other Settings** section for details.

If battery replacement is necessary, the battery may be accessed by separating the two halves of the gauge. Refer to the **Mechanical Setup** section for details.

3 MECHANICAL SETUP

3.1 Loading shaft orientation

In order to accommodate a variety of testing requirements, the orientation of the loading shaft may be set up in either of the two positions shown below. In order to change the loading shaft orientation, loosen the two captive screws on the back side of the housing, separate the two housing halves, rotate one half 180 degrees, and reassemble. Contact between the two halves is made by the spring pins and contact pads on the printed circuit boards.
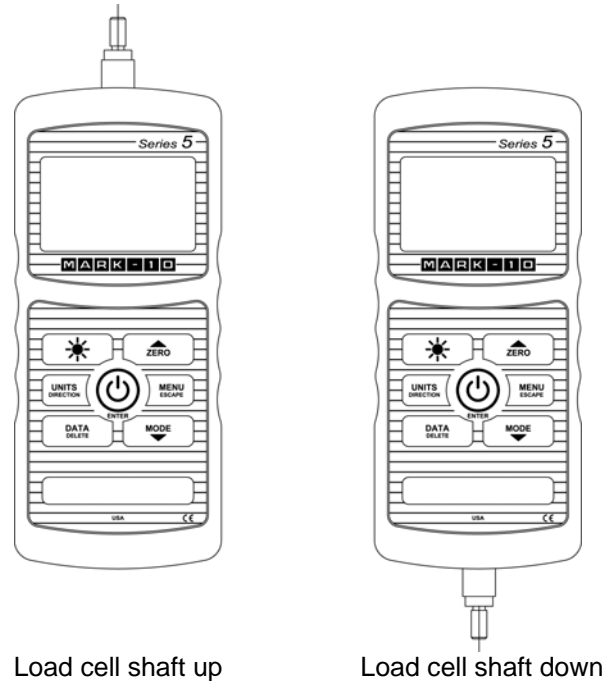

Load cell shaft up   Load cell shaft down

3.2 Mounting to a plate

Although the gauge may be used by hand, proper mounting is important if attached to a fixture or test stand. The round steel insert with a hole in the back of the housing is provided to withstand the load during a test. A mating dowel pin should be used (see illustration below). Mounting plates on Mark-10 test stands include a dowel pin and clearance holes for the four threaded holes located near the corners of the housing. These holes are designed to accommodate screws in order to hold the gauge in place (Mark-10 test stands include a set of thumb screws for gauge mounting). The screws must **<u>not</u>** be used for load bearing purposes. Failure to use a dowel pin properly can result in a hazardous situation.
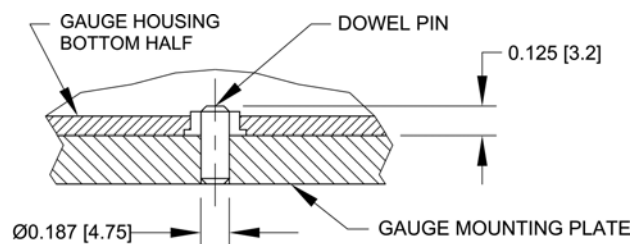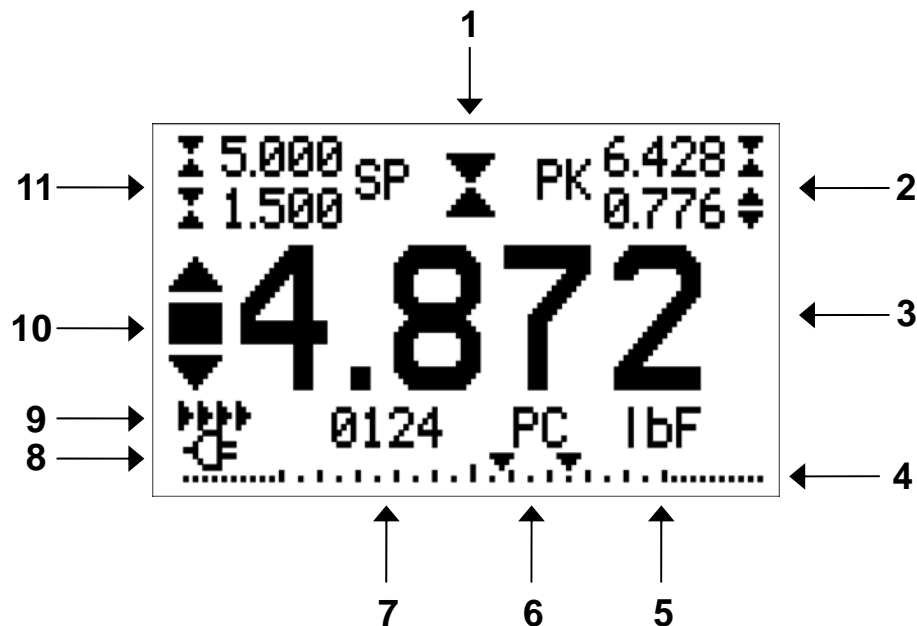

3.3 Mounting attachments to the gauge

The force gauge's threaded loading shaft is designed to accommodate common grips and attachments with female mounting holes. To mount a grip, gently thread it onto the shaft. Other mounting adapters are also available to prevent rotation. Ensure that the grip or fixture is positioned to ensure axial load with respect to the loading shaft of the force gauge. When using a grip, ensure that it secures the sample in such a way that it is prevented from slipping out during a test, preventing a potential safety risk to the

operator and others in the vicinity. If using a grip or fixture from a supplier other than Mark-10, ensure that it is constructed of suitably rugged materials and components.

Do not use jam nuts or tools to tighten grips or attachments onto the shaft. **<u>Finger-tighten only</u>**. Anti-rotation mounting adapters are available.

4 HOME SCREEN AND CONTROLS

4.1 Home Screen

No.	Name	Description
1	**Measurement direction**	⊼ - indicates a compression (push) direction ⊤ - indicates a tension (pull) direction These indicators are used throughout the display and menu.
2	**Peaks**	The maximum measured compression and tension readings. These readings are reset by pressing **ZERO** or by powering the gauge off and on.
3	**Primary reading**	The current displayed force reading. See **Operating Modes** section for details.
4	**Load bar**	Analog indicator to help identify when an overload condition is imminent. The bar increases either to the right or to the left from the midpoint of the graph. Increasing to the right indicates compression load, increasing to the left indicates tension load. If set points are enabled, triangular markers are displayed for visual convenience. This indicator reflects the actual load, which may not correspond to the primary reading (depends on operating mode). The **ZERO** key does not reset the load bar. See **Operating Modes** section for details.
5	**Units**	The current measurement unit. Abbreviations are as follows: lbF – Pound-force ozF – Ounce-force kgF – Kilogram-force gF – Gram-force

		N – Newton kN – Kilonewton mN – Millinewton **Note:** not all gauge capacities measure in all the above units. Refer to the capacity / resolution table in the **Specifications** section for details.
6	**Mode**	The current measurement mode. Abbreviations are as follows: RT – Real Time PC – Peak Compression PT – Peak Tension A – Average Mode ET – External Trigger Mode See **Operating Modes** section for details about each of these modes
7	**Number of stored data points**	The number of stored data points in memory, up to 1000. Displayed only if **Memory Storage** is enabled for the **DATA** key.
8	**Battery / AC adapter indicator**	Either the AC adapter icon, battery icon, or no icon will be shown, depending on power conditions. Refer to the **Power** section for details.
9	**Automatic data output indicator**	If **Auto Output** has been enabled under **Serial / USB Settings**, this indicator is displayed. When automatic data output is occurring, the icon becomes animated. See **Communications** section for details.
10	**High / low limit indicators**	Correspond to the programmed set points. Indicator definitions are as follows: ▲ – the displayed value is greater than the upper force limit ■ – the displayed value is between the limits ▼ – the displayed value is less than the lower force limit
11	**Set points**	The programmed force limits. Typically used for pass/fail type testing. 1, 2, or no indicators may be present, depending on the configuration shown in the **Set Points** menu item.

4.2 Controls

Primary Label	Primary Function	Secondary Label	Secondary Function
⏻	Powers the gauge on and off. Press briefly to power on, press and hold to power off. Active only when the home screen is displayed.	**ENTER**	Various uses, as described in the following sections.
ZERO	Zeroes the primary reading and peaks.	▲ **(UP)**	Navigates up through the menu and sub-menus .
MENU	Enters the main menu.	**ESCAPE**	Reverts one step backwards through the menu hierarchy.
MODE	Toggles between measurement modes.	▼ **(DOWN)**	Navigates down through the menu and sub-menus.
DATA	Stores a value to memory, transmits the current reading to an external device, and/or initiates automatic data output, depending on setup.	**DELETE**	Enables and disables **Delete** mode while viewing stored data.
UNITS	Toggles between measurement units.	**DIRECTION**	Reverses the display during calibration, and toggles between tension and compression directions while configuring set points and other menu items.
☀	Turns the LCD backlight on and off.	**N/A**	N/A

4.3 Menu navigation basics
Most of the gauge's various functions and parameters are configured through the main menu. To access the menu press **MENU**. Use the **UP** and **DOWN** keys to scroll through the items. The current selection is denoted with clear text over a dark background. Press **ENTER** to select a menu item, then use **UP** and **DOWN** again to scroll through the sub-menus. Press **ENTER** again to select the sub-menu item.

For parameters that may be either selected or deselected, press **ENTER** to toggle between selecting and deselecting. An asterisk (*****) to the left of the parameter label is used to indicate when the parameter has been selected.

For parameters requiring the input of a numerical value, use the **UP** and **DOWN** keys to increment or decrement the value. Press and hold either key to auto-increment at a gradually increasing rate. When the desired value has been reached, press **ENTER** to save the change and revert back to the sub-menu item, or press **ESCAPE** to revert back to the sub-menu item without saving. Press **ESCAPE** to revert one step back in the menu hierarchy until back into normal operating mode.

Refer to the following sections for details about setting up particular functions and parameters.

5   OPERATING MODES

Caution!
In any operating mode, if the capacity of the instrument has been exceeded by more than 110%, the display will show "OVER" to indicate an overload. A continuous audible tone will be sounded until the MENU key has been pressed or the load has been reduced to a safe level.

Five operating modes are possible with Series 5 gauges. To cycle between the modes, press **MODE** while in the home screen.

5.1 Real time (RT)
The primary reading corresponds to the live measured reading.

5.2 Peak Compression (PC)
The primary reading corresponds to the peak compression reading observed. If the actual force decreases from the peak value, the peak will still be retained in the primary reading area of the display. Pressing **ZERO** will reset the value.

5.3 Peak Tension (PT)
Same as Peak Compression, but for tension readings.

5.4 Average Mode (AVG)
Average mode is used to obtain an average force reading over a specified period of time. Applications include measurement of peel force, muscle strength, frictional force, and other tests requiring time-averaged readings.

Before the parameters of Average Mode can be configured, it must be enabled. To do so, select **Average Mode** from the menu, scroll to **Enable** and press **ENTER**. The display appears as follows:

```
        AVERAGE MODE

     Disabled
  *  Enabled
  + Settings
```
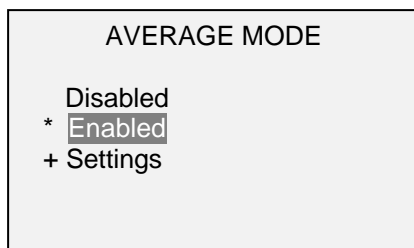
Then, scroll to **Settings**, and press **ENTER** to configure the parameters. The parameters are as follows:

```
 AVERAGE MODE SETTINGS
        Initial Delay
           0.0
        Averaging Time
           5.5
        Trigger Force
           ▼
         ▲ 1.200
```

Parameter	Description
Initial Delay	The time delay, in seconds, before the averaging sequence commences.
Averaging Time	The time duration, in seconds, of the averaging sequence.
Trigger Force	The minimum force required to start the averaging sequence. Toggle between compression and tension directions by pressing the **DIRECTION** key. Initial delay follows the trigger force.

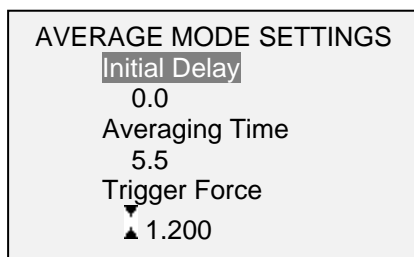After the parameters have been configured and the menu has been exited, press **MODE** until **AVG** is displayed. Then press **ZERO**. Average mode is now armed, and the averaging sequence will commence when the trigger force has occurred. The current status of the average sequence is displayed below the primary reading, as follows:

Step	Status Abbreviation	Description
1	TRIG WAIT	The trigger force has not yet occurred.
2	INIT DLY	The initial delay is currently taking place.
3	AVERAGING	The gauge is collecting readings. The status will be flashing until averaging has been completed.
4	AVRG DONE	Averaging has been completed. The average force is displayed in the primary reading.

At the completion of the averaging sequence, the peak values are retained until **ZERO** is pressed. Another averaging sequence may be started after **ZERO** has been pressed. To exit Average mode, press **MODE** and select the desired measuring mode.

5.5 External Trigger (ET)
This mode of operation is useful for measuring electrical contact activation force as well as synchronization of multiple instruments for a "snapshot" view of applied forces. It is possible to capture the reading with a normally open contact (high to low transition of the trigger signal) or a normally closed contact (low to high transition).

Before the parameters of External Trigger Mode can be configured, it must be enabled. To do so, enter the main menu, select **External Trigger**, scroll to one of the four available options and press **ENTER**. The options are as follows:

```
   EXTERNAL TRIGGER

 *  Disabled
    Momentary Hi->Lo
    Momentary Lo->Hi
    Maintained High
    Maintained Low
```

Option	Description
Momentary High → Low	The display will freeze the captured reading until **ZERO** is pressed. Applies to a high to low transition of the trigger signal.
Momentary Low → High	The display will freeze the captured reading until **ZERO** is pressed. Applies to a low to high transition of the trigger signal.
Maintained High	The display will show the captured reading only for as long as a high signal is maintained.
Maintained Low	The display will show the captured reading only for as long as a low signal is maintained.

After the selection has been made and the menu has been exited, press **MODE** until **ET** is displayed. External Trigger mode is now armed. Refer to the pin diagram in the **Communications** section for connection information.

To exit External Trigger mode, press **MODE** and select the desired measuring mode.

6   DIGITAL FILTERS

Digital filters are provided to help smooth out the readings in situations where there is mechanical interference in the work area or test sample. These filters utilize the moving average technique in which consecutive readings are pushed through a buffer and the displayed reading is the average of the buffer contents. By varying the length of the buffer, a variable smoothing effect can be achieved. The selection of 1 will disable the filter since the average of a single value is the value itself.

To access digital filter settings, select **Filters** from the menu. The display will appear as follows:

```
   DIGITAL FILTERS
     (1 = Fastest)

   Current Reading
         1
   Displayed Reading
         1
```
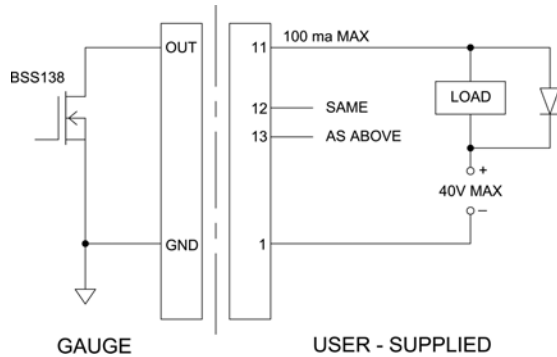
Two filters are available:

> **Current Reading** – Applies to the peak capture rate of the instrument.

> **Displayed Reading** – Applies to the primary reading on the display.

Available settings: *1,2,4,8,16,32,64,128,256,512,1024.* It is recommended to keep these filters at their minimum settings for best performance.
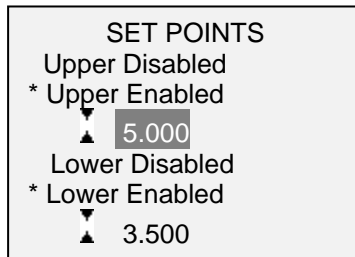
7   SET POINTS

7.1 General Information

Set points are useful for tolerance checking (pass/fail), triggering an external device such as a motorized test stand, or alarm indication in process control applications. Two limits, high and low, are specified and stored in the non-volatile memory of the instrument and the primary reading is compared to these limits. The results of the comparisons are indicated through the three outputs provided on the 15-pin connector, thus providing "under", "in range", and "over" signaling. These outputs can be connected to indicators, buzzers, or relays as required for the application.

7.2 Configuration

To configure set points, select **Set Points** from the menu. The screen will appear as follows:

Either one, two, or none of the set points may be enabled. To toggle between the tension and compression directions, press the **DIRECTION** key.

If two set points have been enabled, they are displayed in the upper left corner of the display. If only one set point has been enabled, the word "OFF" will appear in place of the value. If no set points have been enabled, the upper left corner of the display will be blank.

When set points are enabled, the following indicators are shown to the left of the primary reading:
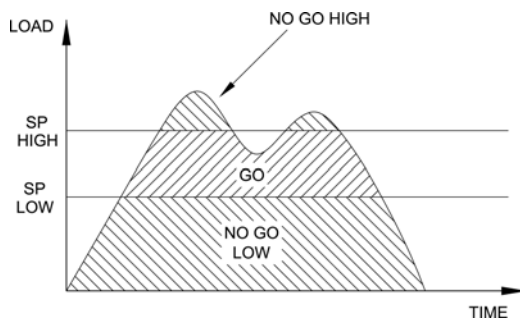
▲ – the displayed value is greater than the upper force   limit (NO GO HIGH)

■ – the displayed value is between the limits (GO)

▼ – the displayed value is less than the lower force limit (NO GO LOW)

Note: Set point indicators and outputs reference the displayed reading, not necessarily the current live load.

8   DATA MEMORY AND STATISTICS

Series 5 gauges have storage capacity of 1,000 data points. Readings may be stored, viewed, and output to an external device. Individual, or all, data points may be deleted. Statistics are calculated for the data presently in memory.

To enable memory storage, select **DATA Key** from the menu, then scroll to **Memory Storage** and press **ENTER**. Then exit the menu. In the home screen, the data record number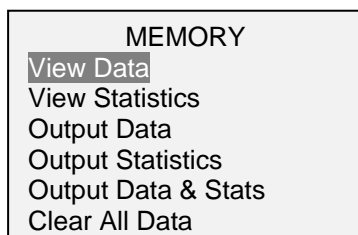 **0000** will appear below the primary reading. Press **DATA** at any time to save the displayed reading. The record number will increment each time **DATA** is pressed.

To view, edit, and output stored readings and statistics, select **Memory** from the menu. The screen appears as follows:

```
            MEMORY
View Data
View Statistics
Output Data
Output Statistics
Output Data & Stats
Clear All Data
```

8.1 View Data
All the saved data points may be viewed. The record number is displayed, along with the corresponding value and presently set unit of measurement. Any readings may be deleted individually. To do so, scroll to the desired reading and press **DELETE**. The letter "D" will appear to the left of the record number, indicating that the gauge is in **Delete** mode, as follows:

```
0001        2.458 lbF
0002        2.224 lbF
0003        2.446 lbF
0004        1.890 lbF
D 0005         2.098 lbF
0006        1.998 lbF
0007        2.042 lbF
```

Press **ENTER** to delete the value. To exit **Delete** mode, press **DELETE** again. Any number of readings may be individually deleted, however, all readings may also be cleared simultaneously. Refer to the **Clear All Data** section for details.

8.2 Statistics
Statistical calculations are performed for the saved values. Calculations include number of readings, minimum, maximum, mean, and standard deviation.

8.3 Output Data
Press **ENTER** to output data to an external device. The display will show, "SENDING DATA…", then "DATA SENT". If there was a problem with communication, the display will show, "DATA NOT SENT".

8.4 Output Statistics
Press **ENTER** to output statistics to an external device. The display will show, "SENDING STATS…", then "STATS SENT". If there was a problem with communication, the display will show, "STATS NOT SENT".

8.5 Output Data & Stats
Press **ENTER** to output data and statistics to an external device. The display will show, "SENDING

DATA", then "SENDING STATS…", then "DATA SENT", then "STATS SENT". If there was a problem with communication, the display will show, "DATA NOT SENT" and/or "STATS NOT SENT".

8.6 Clear All Data
Press **ENTER** to clear all data from the memory. A prompt will be shown, "CLEAR ALL DATA?". Select **Yes** to clear all the data, or **No** to return to the sub-menu.

For output of data and/or statistics, RS-232 or USB output must be enabled. Data formatting is <CR><LF> following each value. Units can be included or excluded (see **Communications** section for details). Output of data via the Mitutoyo output is possible, however, output of statistics is not. Refer to the **Communications** section for details.

Note: Data is not retained while the gauge is powered off.

9   COMMUNICATIONS

Communication with Series 5 force gauges is achieved through the micro USB and 15-pin serial ports located at the bottom of the instrument, as shown in the illustration in the **Power** section.

9.1 Installing the USB driver

It is recommended that the USB driver be installed before physically connecting the gauge to the PC with a USB cable.

1. Insert the Resource CD supplied with the gauge into the CD/DVD drive in the computer. Then, navigate in *Windows Explorer* or *My Computer* to one of the following folders on the CD:

      Windows 2000 through Vista - "Win_2K_XP_S2K3_Vista"

      Windows 7 - "Windows_7"

2. Execute the installer application "Mark-10USBInstaller.exe" by double-clicking it. When the program launches, one of the following windows will appear, depending on the operating system:
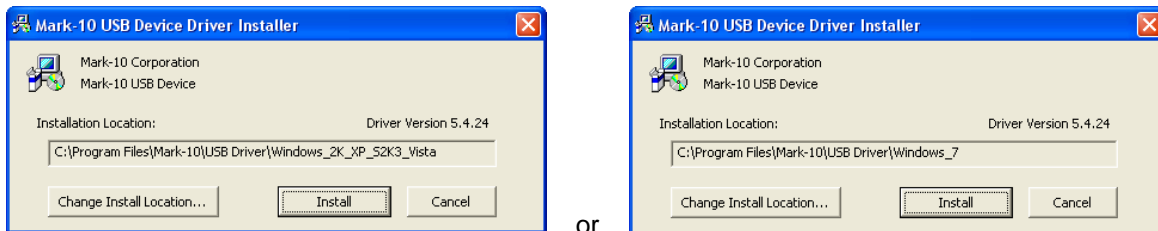
 or

Click "Install".

3. The next screen appears as follows:
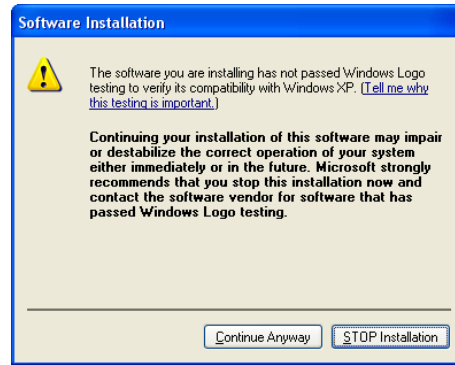
Click "Continue Anyway".

4. After installation completes the following screen may appear in non-Windows 7 operating systems.
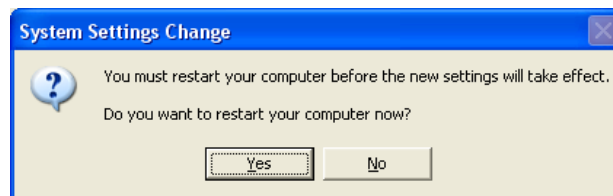
Restart the computer before connecting a Mark-10 USB device.

5. After Windows as restarted, plug in the device. The following will occur:

Windows 7 Operating Systems – When the Mark-10 USB device has been plugged into a USB port, the driver will automatically be found. When the driver installation is complete, a message will appear as follows: "The MARK-10 USB DEVICE driver is now installed and ready to use".

Non-Windows 7 Operating Systems – When the Mark-10 USB device has been plugged into a USB port, the following screen appears:

Select "No, not this time", then click "Next".

6. The next screen appears as follows:
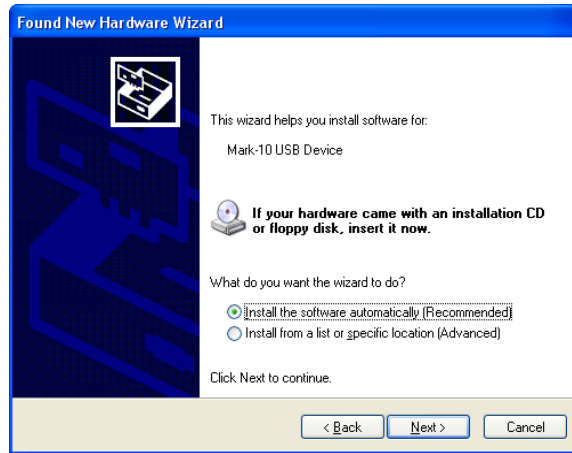
Select "Install the software automatically (Recommended)", then click "Next".

7. The next screen appears as follows:

Click "Continue Anyway".

8. The next, and final, screen appears as follows:

Click "Finish". The Mark-10 USB device is now installed and ready to use. The COM port number assigned by Windows may be identified in Device Manager, or in the communication application being used, such as MESURgauge or HyperTerminal.

9.2 Serial / USB

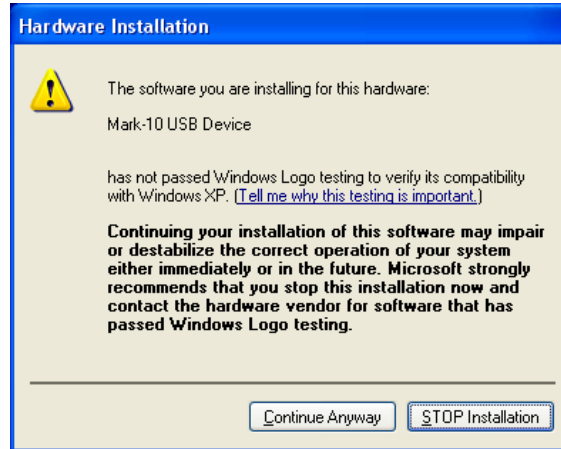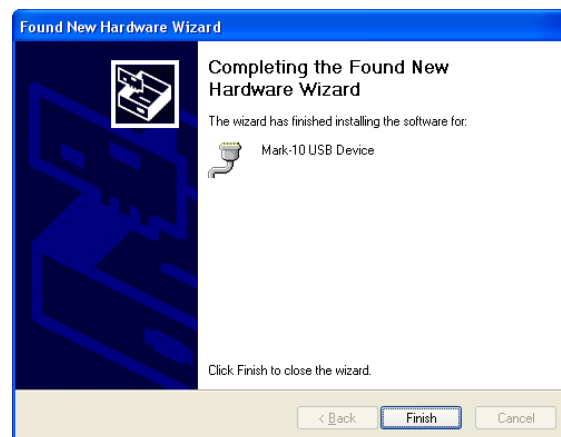To set up RS-232 and USB communication, select **Serial/USB Settings** from the menu. The screen appears as follows:

```
 SERIAL/USB SETTINGS
 *   RS232 Selected
     USB Selected
   + Baud Rate
   + Data Format
   + Auto Output
```
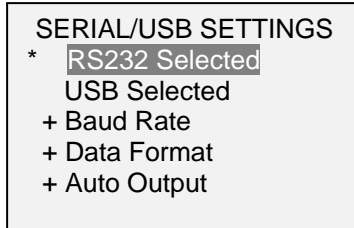
Select either RS-232 or USB input (output is always simultaneous through both the USB and RS-232 ports). Then configure the baud rate, data format, and automatic output as required for the application. Default values are as follows:

> **Baud Rate:** **115,200**
> **Data Format:** **Numeric + units**
> **Auto Output:** **Disabled**

Other communication settings are permanently set to the following:

> **Data Bits:** **8**
> **Stop Bits:** **1**
> **Parity:** **None**

Individual data points may be transmitted by pressing **DATA** or by requesting the appropriate ASCII command from an external device (see **Command Set** sub-section for details).

9.3 Automatic Output

The gauge has the ability to output data continuously via RS-232 or USB. To enable automatic output, select **Auto Output** from the **Serial/USB Settings** sub-menu. The screen appears as follows:

```
      AUTO OUTPUT

 *   Disabled
     Enabled
     Outputs per Sec.
         10
```
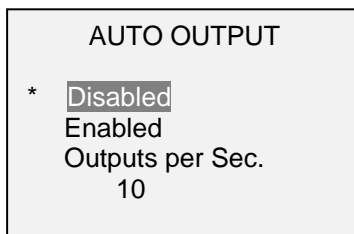
Select **Enabled** to activate automatic output. The number of outputs per second can be set to 1, 2, 5, 10, 25, 50, 125, or 250. The capabilities of the receiving device should be considered when selecting the data output rate.

After the settings have been saved, revert to the home screen. An icon will appear in the lower left corner of the display, as follows: ▶▶▶▶ This indicates that automatic data output has been armed. Automatic output of data may be initiated by pressing **DATA** or by sending the appropriate ASCII command from an

external device (see **Command Set** sub-section for details). The icon will become animated, signaling that automatic output is occurring. Press **DATA** again to end the data transmission.

9.4 Mitutoyo BCD settings
This output is useful for connection to data collectors, printers, multiplexers, or any other device capable of accepting Mitutoyo BCD data. Individual data points may be transmitted by pressing **DATA** or by requesting it from the Mitutoyo communication device (if available). To enable Mitutoyo output, select the desired format – either with polarity or without polarity. The screen appears as follows:

```
      MITUTOYO BCD

 *    Disabled
      Ena w/o Polarity
      Ena w/Polarity
```

9.5 Analog Output
This output can be used for chart recorders, oscilloscopes, data acquisition systems, or any other compatible devices with analog inputs. The output produces ±1 volt at full scale of the instrument. The polarity of the signal is positive for compression and negative for tension.

9.6 DATA Key Functions
The **DATA** key can be configured to perform several functions. To configure the **DATA** key, select **DATA Key** from the menu. The display will appear as follows:

```
      DATA KEY

 *    RS232/USB Output
      Mitutoyo Output
      Memory Storage
```
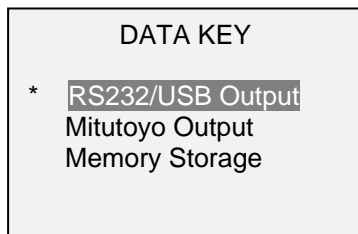
Three options are available:

Selection	Function when pressing DATA
RS232/USB Output	Outputs data via the serial and USB ports
Mitutoyo Output	Outputs data via Mitutoyo (Digimatic) through the serial port
Memory Storage	Stores a reading to memory (refer to the **Memory** section for details)

Any combination of the above functions may be selected.

9.7 I/O Connector Pin Diagram (female)
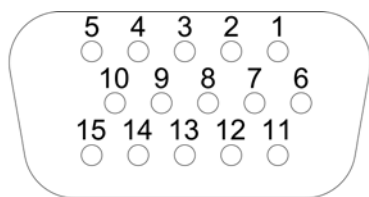
DB-9HD-15

Pin No.	Description	Input / Output
1	Signal Ground	---
2	Tension Overload	Output
3	RS-232 Receive	Input
4	RS-232 Transmit	Output
5	+12V DC	Output
6	Analog Output	Output
7	Compression Overload	Output
8	Mitutoyo Clock Output Bit 2	Output
9	Mitutoyo Data Output Bit 0	Output
10	Mitutoyo Request Input Bit 3	Input
11	"Under" Set Point	Output
12	"Over" Set Point	Output
13	"Within" Set Point	Output
14	External Trigger	Input
15	Mitutoyo Ready Output Bit 1	Output

9.8 Command Set / Gauge Control Language 2 (GCL2)

Series 5 force gauges may be controlled by an external device through the RS-232 or USB channel. The following is a list of supported commands and their explanations. All commands must be terminated with a Carriage Return character or with a Carriage Return/Line Feed combination. The gauge responses are always terminated with a Carriage Return/Line Feed.

Request Readings

?	Request the displayed reading (dependant on operating mode)
?C	Request the current (real time) reading
?PT	Request the peak tension reading
?PC	Request the peak compression reading
?ET	Request the reading obtained during the External trigger mode
?A	Request the average reading obtained during the Average mode

Units

LB	Switch units to pound-force
OZ	Switch units to ounce-force
KG	Switch units to kilogram-force
G	Switch units to gram-force
N	Switch units to Newtons
MN	Switch units to Milli-Newtons
KN	Switch units to Kilo-Newtons

Basic Functions
CUR   Current mode (real time mode) for primary reading
PT   Peak Tension mode for primary reading
PC   Peak Compression mode for primary reading
CLR   Clear peaks
Z   Zero display and perform the CLR function

Filters
FLTCn   Digital filter for displayed readings
            n=1,2,4,8,16,32,64,128,256,512,1024
FLTPn   Digital filter for peak readings
            n=1,2,4,8,16,32,64,128,256,512,1024

Memory & Statistics
MEM   Transmit all stored readings
STA   Transmit statistics

Set Points
SPHD   Disable high set point
SPLD   Disable low set point
SPHn   High set point. n=value (+ for compression, - for tension)
SPLn   Low set point. n=value (+ for compression, - for tension)
            Note: High set point value must be greater than low set point value if both values
            are set to the same polarity.

USB/RS-232 Communication
FULL   USB/RS-232 transmission with units
NUM   USB/RS-232 transmission without units (only numeric values)
AOUTn   Auto-transmit n times per second n=1,2,5,10,25,50,125,250. 0=disabled
            Note: n = 1 = yields 50 times per second. This is provided for backward
            compatibility with legacy gauges.

Mitutoyo Communication
MIT   Enable Mitutoyo output
MITD   Disable Mitutoyo output
POL   Mitutoyo output with polarity (+ for compression, - for tension)
NPOL   Mitutoyo output without polarity (absolute value)
PM   Print/send data to a Mitutoyo-compatible device

Averaging
A   Enable Average mode
AD   Disable Average mode
AM   Select Average mode (if enabled) for primary reading
ATn   Average time. n=0.1-300.0 seconds
DELn   Initial delay. n=0.1-300.0 seconds
TRFn   Trigger force. n=value (+ for compression, - for tension)

External Trigger
ETE   Enable edge-triggered External trigger mode
ETL   Enable level-triggered External trigger mode
HL   Enable reading captured on a high to low transition
LH   Enable reading captured on a low to high transition
ETD   Disable External trigger mode

Input / Output Bits

Sn	Set output bit (open drain, pull to ground). n=0,1,2
Cn	Clear output bit. n=0,1,2
Rn	Read current status of output bit or level of input pin. n=0,1,2,3

Personality

RN	Read product name
RM	Read model number
RV	Read firmware version number
RS	Read serial number

Other Commands

AOFFn	Auto-shutoff. n=0,5,10,15,20,25,30 minutes. 0=always on
SAVE	Save current settings in nonvolatile memory
LIST	List current settings and status

Following is an example LIST output: V1.00;LBF;CUR;FLTC8;FLTP1;AOUT00;AOFF5;FULL;MIT;POL;B0

All fields are separated by ";". The first field shows the firmware version, the last field shows the remaining battery power (B0=full charge, B3=minimum power). All other fields show the status of settings and features using the same abbreviations as the commands to set them.

Any detected errors are reported back by means of the following error codes:

*10	Illegal command
*11	Not applicable
*12	Invalid specifier
*22	Value too large

10   CALIBRATION

10.1 Initial Physical Setup

The gauge should be mounted vertically to a test stand or fixture rugged enough to withstand a load equal to the full capacity of the instrument. Certified deadweights or master load cells should be used, along with appropriate mounting brackets and fixtures. Caution should be taken while handling such equipment.

10.2 Calibration Procedure

1. Select **Calibration** from the menu. The display will appear as follows:

    ```
                CALIBRATION

        To invert the
        display, press the
        DIRECTION button.

         THEN PRESS ENTER
    ```
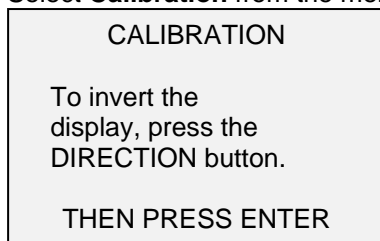
2. Press **DIRECTION** to invert the display, if desired. **ENTER** to continue. The display will appear as follows:

```
┌──────────────────────────────┐
│        CALIBRATION           │
│     ENTER # CAL POINTS       │
│         (1 TO 10)            │
│       COMPRESSION:           │
│            5                 │
│        TENSION :             │
│            5                 │
└──────────────────────────────┘
```

The gauge can be calibrated at up to 10 points in each direction. Enter the number of calibration points for each direction (compression and tension). At least one point must be selected for each direction.

Note: To achieve the accuracy specification of ±0.1%, it is recommended to calibrate the gauge at 5 or more even increments in both the tension and compression directions. For example, a gauge with capacity of 10 lbF should be calibrated at 2, 4, 6, 8, and 10 lb loads in each direction.

3. To escape the **Calibration** menu at any time, press **ESCAPE**. The display will appear as follows:

```
┌──────────────────────────────┐
│        CALIBRATION           │
│       NOT COMPLETE           │
│                              │
│   CANCEL                     │
│   EXIT W/O SAVING            │
│                              │
│                              │
└──────────────────────────────┘
```

Selecting "CANCEL" will revert back to the Calibration setup. Selecting "EXIT W/O SAVING" will return to the menu without saving changes.

4. After the number of calibration points has been entered, press **ENTER**. The display will appear as follows:

```
┌──────────────────────────────┐
│        CALIBRATION           │
│          OFFSET              │
│                              │
│   Place force gauge          │
│   horizontal                 │
│   THEN PRESS ZERO            │
│                              │
└──────────────────────────────┘
```

5. Place the force gauge horizontally on a level surface free from vibration, then press **ZERO**. The gauge will calculate offsets, and the display will appear as follows:

```
┌──────────────────────────────┐
│        CALIBRATION           │
│          OFFSET              │
│                              │
│                              │
│        Please wait…          │
│                              │
│                              │
└──────────────────────────────┘
```

```
        CALIBRATION                          CALIBRATION
         OFFSET                               OFFSET


    Sen.Offset Adj.Passed                 Sen.Offset Adj.Failed
    Ana.Offset Adj.Passed                 Ana.Offset Adj.Failed



```
                                    If failed:

6. The following screen appears after the offsets have been calculated:

```
        CALIBRATION
        COMPRESSION

      Attach necessary
      weight fixtures.

      THEN PRESS ENTER
```

Attach weight fixtures (brackets, hooks, etc), as required. Do not yet attach any weights or apply any calibration loads. Then press **ENTER**.

7. The display will appear as follows:

```
        CALIBRATION
        COMPRESSION

      Optionally exercise
      load cell a few times.

      THEN PRESS ENTER
```

Optionally exercise the load cell shaft several times (at full scale, if possible), then press **ENTER**.

8. The display will appear as follows:

```
        CALIBRATION
        COMPRESSION
        GAIN ADJUST
    APPLY FULL SCALE LOAD
       10.000 LBF +/-20%
      THEN PRESS ENTER
```

Apply a weight equal to the full scale of the instrument, then press **ENTER**.

9. After displaying "PLEASE WAIT…" the display will appear as follows:

```
        CALIBRATION
        COMPRESSION

      ENSURE NO LOAD

      THEN PRESS ZERO
```

Remove the load applied in Step 8, leave the fixtures in place, then press **ZERO**.

10. The display will appear as follows:

```
        CALIBRATION
        COMPRESSION
        APPLY LOAD
          1 OF 5
        ENTER LOAD:
        2.000 LBF
      THEN PRESS ENTER
```

Use the **UP** and **DOWN** keys to adjust the load value as required. The load values default to even increments, as indicated by the previously entered number of data points (even increments are recommended for best results). For example, if a 50 lbF capacity gauge is calibrated, and 5 data points were selected, the load values will default to 10, 20, 30, 40, and 50 lb. Apply the calibration load. Then press **ENTER**.

Repeat the above step for the number of data points selected.

11. After all the compression calibration points have been completed, the display will appear as follows:

```
         CALIBRATION
    COMPRESSION COMPLETE
      REVERSE DIRECTION
        FOR TENSION
       Attach necessary
       weight fixtures.
      THEN PRESS ENTER
```

Press **ENTER**.

12. The display will appear as follows:

```
        CALIBRATION

     To invert the
     display, press the
     DIRECTION button.

       THEN PRESS ENTER
```

Reverse the orientation of the load cell shaft by rotating the gauge 180 degrees. Press **DIRECTION** to invert the display. Then attach weight fixtures. The following screens will step through the same procedure as with the compression direction. Proceed in the same manner.

13. At the completion of the tension calibration, the display will appear as follows:

```
        CALIBRATION
         COMPLETE

    SAVE & EXIT
    EXIT W/O SAVING
```
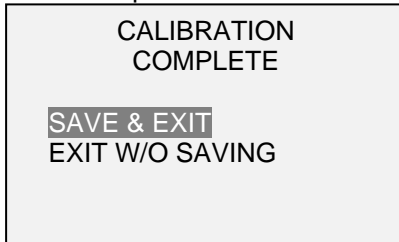
To save the calibration information, select "SAVE & EXIT". To exit without saving the data select "EXIT W/O SAVING".

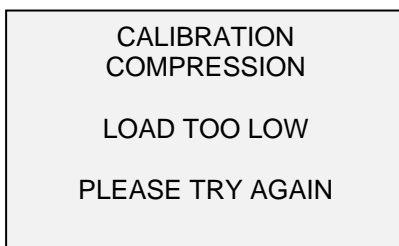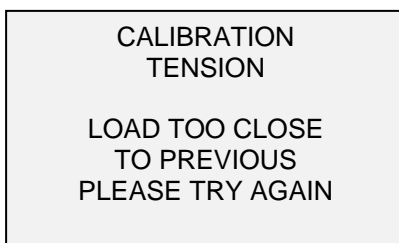14. Any errors are reported by the following screens:

```
        CALIBRATION

      Units must be gF.

     PLEASE TRY AGAIN
       PRESS ENTER
```
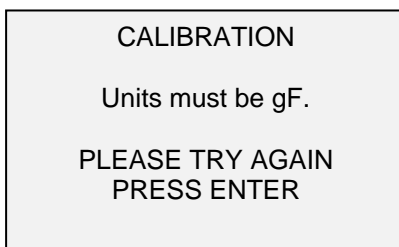
Displayed at the start of calibration if a disallowed unit is selected.

```


      LOAD NOT STABLE

     PLEASE TRY AGAIN

```

Ensure that the load is not swinging, oscillating, or vibrating in any manner. Then try again.

```
        CALIBRATION
        COMPRESSION

       LOAD TOO LOW

     PLEASE TRY AGAIN
```

The calibration weight does not match the set value.

```
        CALIBRATION
          TENSION

      LOAD TOO CLOSE
        TO PREVIOUS
     PLEASE TRY AGAIN
```
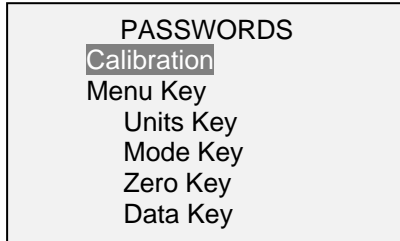
The entered calibration point is too close to the previous point.

11   PASSWORDS

Two separate passwords may be set to control access to the Calibration section and to the menu and other keys. To access the passwords setup screen, select **Passwords** from the menu. The display will appear as follows:

```
        PASSWORDS
Calibration
Menu Key
     Units Key
     Mode Key
     Zero Key
     Data Key
```

11.1 Calibration Password

Select **Calibration** from the sub-menu. The display will appear as follows:

```
CALIBRATION PASSWORD

 *  Disabled
    Enabled
    Set Password
    (0000 – 9999)
        5000
```
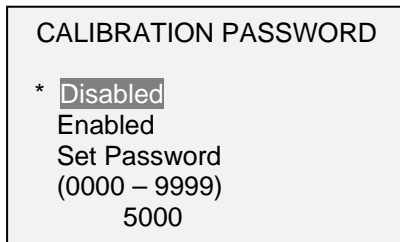
To set the password, select **Enabled** , then **Set Password**. Use the **UP** and **DOWN** keys to increment and decrement the value, from 0 to 9999. When the desired value has been selected, press **ENTER**, then **ESC** to exit the sub-menu.

11.2 Menu Key Password

If enabled, every time the **MENU** key is selected, a password must be provided. Select **Menu Key** from the sub-menu. Follow the same procedure as described in section 10.1.

11.3 Locking Out Other Keys

Other keys may be locked out individually. Select any combination of keys (**UNITS**, **MODE**, **ZERO**, **DATA**) by pressing **ENTER** in the **Passwords** sub-menu. Pressing a locked key will prompt the message "KEY PROTECTED" and then revert to the previous screen.

11.4 Password Prompts
If passwords have been enabled, the following will be displayed when pressing the **MENU** key or accessing the **Calibration** section:

```
   ENTER PASSWORD
    (0000 – 9999)


        5000
```
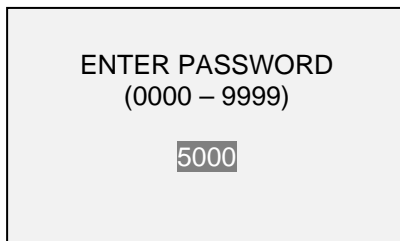
Use the **UP** and **DOWN** keys to select the correct password, then press **ENTER** to continue.

If the incorrect password has been entered, the display will appear as follows:

```
INCORRECT PASSWORD

    Reset password
    Request code:
        XXXX

  Press ENTER or ESC
```

To re-enter the password, press ESC to exit to the home screen. Then, access the desired function and enter the password again when prompted.

If the password has been misplaced, it can be reset. Press **ENTER** to generate a *request code*. The *request code* must be supplied to Mark-10 or a distributor, who will then provide a corresponding *authorization code*. Enter the *activation code* to disable the password.

12   OTHER SETTINGS

12.1 Automatic Shutoff
The gauge may be configured to automatically power off following a period of inactivity. Inactivity is defined as the absence of any key presses or load changes of 100 counts or less. To access these settings, select **Automatic Shutoff** from the menu. The display will appear as follows:

```
  AUTOMATIC SHUTOFF

 *  Disabled
    Enabled
    Set Minutes
        5
```

Select **Disabled** to disable automatic shutoff. Select **Enabled** to enable it. The length of time of inactivity is programmed in minutes via the **Set Minutes** parameter. Available settings: 5-30, in 5 minute increments.

12.2 Backlight
Although the backlight may be turned on and off at any time by pressing the **BACKLIGHT** key, there are several available initial settings (applicable upon powering on the gauge). To access these settings, select **Backlight** from the menu. The display will appear as follows:

```
      BACKLIGHT
     Off
     On
  *  Auto
     Set Minutes
         1
```

Select **Off** for the backlight to be off upon powering on the gauge.

Select **On** for the backlight to be on upon powering on the gauge.

Select **Auto** for the backlight to be on upon powering gauge, but will shut off after a period of inactivity (as defined in the **Automatic Shutoff** sub-section). The length of time of inactivity is programmed in minutes via the **Set Minutes** parameter. Available settings: *1-10*, in 1 minute increments.

12.3 LCD Contrast
The contrast of the display may be adjusted. Select **LCD Contrast** from the menu. The screen will appear as follows:

```
        LCD CONTRAST

         Set Contrast
             15
```

Press **ENTER** to modify the contrast. Select a value from 0 to 25, 25 producing the most contrast. Higher contrast ratios will deplete battery power more quickly.

12.4 Beeps
Audible tones can be enabled for all key presses and alerts, such as overload, set point value reached, etc. The Set Point alert can be configured to be either a momentary tone or a continuous tone (until the load is restored to a value between the set points). To configure the functions for which audible tones will apply, select **Beeps** from the menu. The screen will appear as follows:

```
              BEEPS

          Keys
        * Alerts
            Set Points
              * Momentary
                Continuous
```
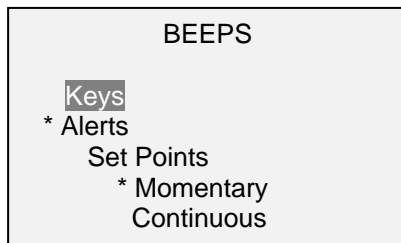
12.5 Initial settings
This section is used to configure the initial settings upon powering on the gauge. The initial units of measurement and the primary reading measurement mode may be configured. To access these settings, select **Initial Settings** from the menu. The screen will appear as follows:

```
         INITIAL SETTINGS

       Units
          LBF
       Mode
          Real Time
```
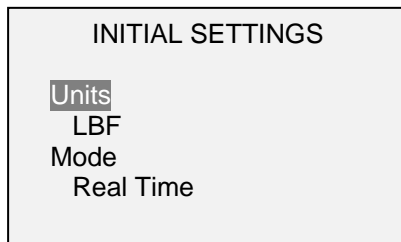
The default values are LBF and Real Time.

12.6 Information / Welcome Screen

The following screen is displayed at power up and can be accessed at any time by selecting **Information** from the menu:

```
        Digital Force Gauge

Model No: M5-50
Serial No: 1234567
Version: 1.0
(c) Mark-10 Corp.
```

13   SPECIFICATIONS

13.1 General

Accuracy:	±0.1% of full scale ±1 digit
Sampling rate:	7,000 Hz
Power:	AC or rechargeable battery. Low battery indicator appears when battery level is low, and gauge powers off automatically when power reaches critical stage.
Battery life:	**Backlight on:** up to 7 hours of continuous use
	Backlight off: up to 24 hours of continuous use
Measurement units:	lbF, ozF, gF, kgF, N, kN, mN (depending on model)
Outputs:	**USB / RS-232:** Fully configurable up to 115,200 baud. Includes Gauge Control Language 2 for full computer control.
	Mitutoyo (Digimatic): Serial BCD suitable for all Mitutoyo SPC-compatible devices.
	Analog: ±1 VCD, ±0.25% of full scale at capacity,
	General purpose: Three open drain outputs, one input.
	Set points: Three open drain lines.
Configurable settings:	Digital filters, outputs, automatic output (via USB/RS-232), automatic shutoff, default settings, averaging mode, external trigger, passwords, key tones, audio alarms, backlight, calibration
Safe overload:	150% of full scale (display shows "OVER" at 110% and above)
Weight (gauge only):	**M5-012 - M5-100:** 1.0 lb [0.45 kg]
	M5-200 - M5-500: 1.2 lb [0.54 kg]
Included accessories:	Carrying case, chisel, cone, V-groove, hook, flat, extension rod, AC adapter, battery, USB cable, resource CD (USB driver, MESURgauge DEMO software, and user's guide), NIST-traceable certificate of calibration with data
Warranty:	3 years (see individual statement for further details)

13.2 Capacity, resolution & load cell deflection

MODEL	CAPACITY							RESOLUTION							LOAD CELL DEFLECTION
	LBF	OZF	KGF	GF	N	KN	MN	LBF	OZF	KGF	GF	N	KN	MN	
M5-012	0.12	2		50	0.5		500	0.00002	0.0005		0.01	0.0001		0.1	0.005 [0.13]
M5-025	0.25	4		100	1		1000	0.00005	0.001		0.02	0.0002		0.2	0.010 [0.25]
M5-05	0.5	8		250	2.5		2500	0.0001	0.002		0.05	0.0005		0.5	0.010 [0.25]
M5-2	2	32	1	1000	10			0.0005	0.01	0.0002	0.2	0.002			0.009 [0.23]
M5-5	5	80	2.5	2500	25			0.001	0.02	0.0005	0.5	0.005			0.005 [0.13]
M5-10	10	160	5	5000	50			0.002	0.05	0.001	1	0.01			0.010 [0.25]
M5-20	20	320	10	10000	100			0.005	0.1	0.002	2	0.02			0.004 [0.10]
M5-50	50	800	25	25000	250			0.01	0.2	0.005	5	0.05			0.010 [0.25]
M5-100	100	1600	50	50000	500			0.02	0.5	0.01	10	0.1			0.010 [0.25]
M5-200	200	3200	100		1000	1		0.05	1	0.02		0.2	0.0002		0.010 [0.25]
M5-500	500	8000	250		2500	2.5		0.1	2	0.05		0.5	0.0005		0.010 [0.25]

13.3 Dimensions
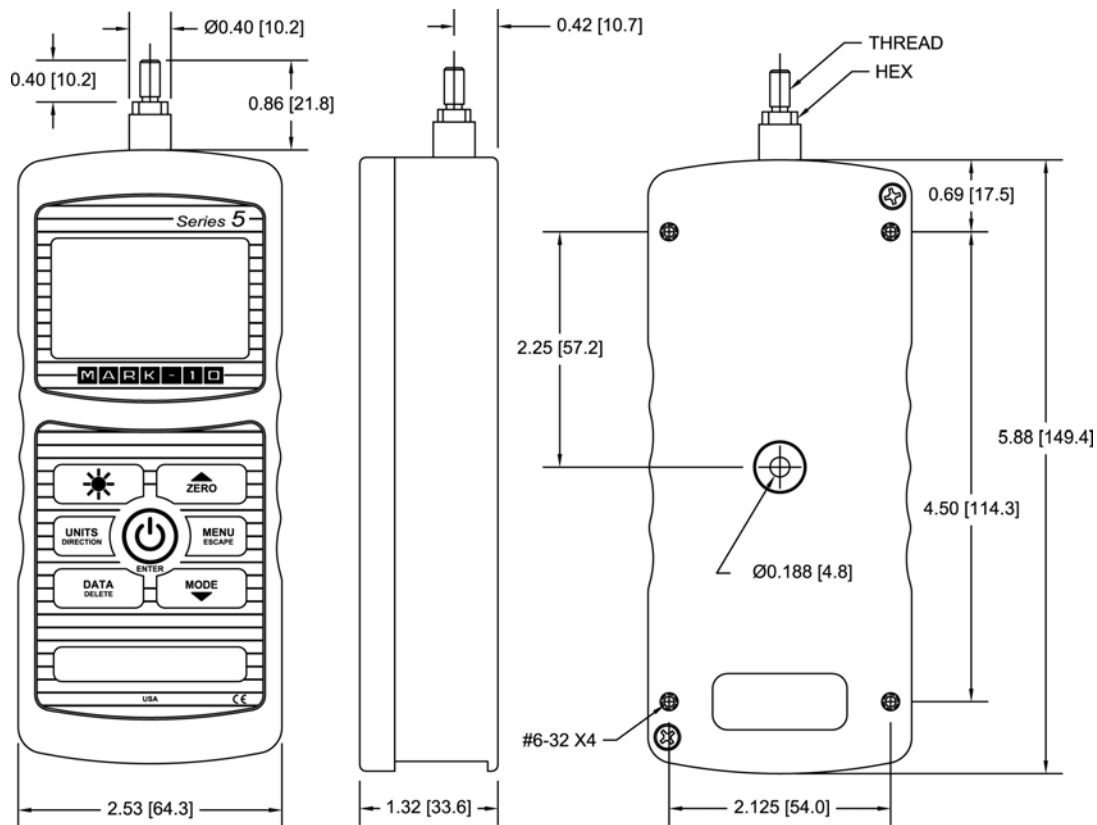
	Thread	Hex
M5-012 – M5-100	#10-32	5/16
M5-200 – M5-500	5/16-18	11/32