



FORCE TEN™ FDX/FPX

OPERATION MANUAL

**FDX FORCE GAGE
FPX ALGOMETER**

FORCE TEN™

**COMPACT SIMPLICITY
HAND-HELD UTILITY
DIGITAL CLARITY**

**FORCE TESTER
FDX FORCE GAGE**



**PAIN TESTER
FPX ALGOMETER**



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CAUTION**MOST IMPORTANT - READ BEFORE USING THE FDX FORCE GAGE**

- OVERLOADS:**
- ▶ FDX provides overload protection of its load cell. However, **EXCESSIVE OVERLOADS** or **IMPACT LOADING** will cause permanent damage.
 - ▶ Prior to reaching an overload condition, the FDX sounds the tone for five seconds, then displays “HELP”. Continuing to apply force to the FDX will damage the load cell. For overload protection by capacity, see **SPECIFICATIONS TABLE 3**.
 - ▶ When **HELP** is displayed, it indicates:
 - FDX is overloaded. Increasing the load will damage the load cell.

CORRECT LOADING: FDX is intended for axial loads only. Application of force to the load shaft at an angle or twisting the load shaft will cause erroneous readings. If these forces are excessive, damage will occur.

ATTACHING IMPLEMENTS: Attach implements “finger-tight” only. Use of tools to attach implements to the load shaft will cause damage to the FDX.

AC ADAPTER/CHARGER: Use only the AC adapter/charger, supplied with FDX. Using other adapter/charger units may damage the gage.

CABLE CONNECTION: Turn FDX off before connecting or disconnecting a cable.

- NiMH BATTERIES:**
- ▶ Use of NiMH replacement batteries is recommended.
 -  ▶ Do not use charger or USB cable if alkaline or lithium batteries are used.
 -  ▶ Never install the batteries backwards.
 - ▶ Do not use batteries with different brand names or mix old batteries with new.
 -  ▶ Never crush, short-circuit, or incinerate batteries.
 - ▶ Do not use damaged batteries.
 -  ▶ Recommend recycling batteries using a local collection program.



FORCE TEN™ DIGITAL FORCE GAGE FDX

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**CONSTRUCTION**

- Fiberglass reinforced plastic pistol grip handle.
- Large 4-digit 0.7" display.
- Displays: **TENS, COMP, Peak**, 5-bar battery status, **USB/SGL** or **USB/CNT** data transmission and units.
- Tension and Compression with lbf, kgf, N and ozf selectable units.
- American standard threads – Metric adapters available.

OPERATION

- Simple 4-button control and menu access.
- Selectable units: lbf, kgf, N and ozf.
- Selectable auto-off, backlight & audible signal.
- Peak force sampling: 1200 / second.
- USB data output and charging.
- Single value output with SEND key.
- Single or continuous data output with Windows-compatible data logging software, included with gage.

POWER

- 2 x AAA 1.2V 1000 mAh rechargeable NiMH batteries.
- Charge battery from AC or USB.
- Selectable auto-off conserves battery charge.

ACCESSORIES

- 2 x AAA NiMH batteries, AC adapter/charger, hook, flat tip, carrying case, 6-ft long USB cable & driver, Mark-10 MESUR™ Lite data logging software, NIST calibration certificate.
- **FDX** implements - hook, flat tip
- **FPX** implements - 1 cm² rubber tip, verification hook

ACCURACY

- $\pm 0.3\%$ of full scale ± 1 least significant digit.

WEIGHT & DIMENSIONS

- 0.5 lb (225 g), shipping weight: 4 lb (2 kg).
- 5 3/8" (136 mm) H x 2 3/4" (70 mm) W x 1 1/4" (32 mm) D.



COMPACT SIMPLICITY
HAND-HELD UTILITY
DIGITAL CLARITY

FORCE TEN FDX
Compact Digital Force Gage

**USB Data Logging
Software**

**Large 4-digit 0.7" Display
with On / Off Backlight**

**NIST Calibration
Certificate**

0.3 % Accuracy

Overload Protection

**Selectable Units
lbf / kgf / N / ozf**

Pistol Grip Handle

**USB or AC Charger
20 Hour NiMH Battery**

Auto Calibration

**1200 Peak
Sampling Rate**



The newly updated **Force Ten™ FDX** is a low cost digital force gage, rich in useful features, for **routine force testing**. The USB data output, backlit display and audible signals are a few of the features, added to enhance the versatility of compact simplicity.

The **FDX** housing is made of impact resistant plastic and is intended for **hand-held testing** with a comfortable pistol grip handle. It is powered by 2 x AAA rechargeable NiMH batteries for portable use up to 20 hours with an overnight charge, or continuous AC power through the USB cable for stationary use.

The newly added USB data output pairs with Mark-10's MESUR™ Lite Windows-compatible data logging software, included with the **FDX**. Single data points are sent to MESUR™ Lite, using the gage **SEND** key, or MESUR™ Lite can collect single or continuous data points from the PC, which can then be exported to Microsoft Excel™.



COMPACT ALGOMETER

HAND-HELD UTILITY
DIGITAL CLARITY

TEST
PAIN THRESHOLD
PAIN TOLERANCE
TRIGGER & TENDER POINTS

FORCE TEN FPX

Compact Digital Algometer
Pain Diagnostic Gage

**USB Data Logging
Software**

**Large 4-digit 0.7" Display
with On / Off Backlight**

**NIST Calibration
Certificate**

0.3 % Accuracy

Overload Protection

**Selectable Units
lbf / kgf / N / ozf**

Pistol Grip Handle

**USB or AC Charger
20 Hour NiMH Battery**

Auto Calibration

**1200 Peak
Sampling Rate**



The **FPX PainTest™** Algometer uses the **FDX Force Gage** as its force sensor, so FPX Algometer operation is the same as the **FDX Force Gage**.

When using the 1 cm² round rubber tip, the **FPX Algometer** display provides direct pressure readings matching the world-wide pain testing standard:

- lbf / cm²
- kgf / cm²
- N / cm²

Example:

If the force gage reading is 6 lbf,
the pressure reading is 6 lbf / cm².

It is assumed the FPX Algometer user is a medical or therapeutic professional, familiar with the broad field of pain testing.

Contact Wagner Instruments for assistance: sales@wagnerinstruments.com.

The updated Force Ten™ **FPX** Algometer performs pain diagnostic testing with the advantages of a digital force gage. Newly added features include backlit display, audible signals and USB output with data logging software for collection of patient test results.

Pressure algometry is a reliable measure of pain in muscle, joint, tendons, and ligaments. The FPX proves the benefits of applied medication, physiotherapy or manipulation.

As treatment progresses, the **FPX** quantifies improvements or setbacks. Pain threshold measurements provide unique information not obtainable by any other method. The objective measurements give reassurance to patients by confirming improvement.

> **Pain Threshold** -- the minimum pressure that induces pain in tender and trigger points of tissue. The FPX quantitatively assesses the tenderness of hypersensitive areas. The **FPX 25**, used for pain threshold testing, is appropriate for determining the minimum pressure that triggers pain at the point of interest.

> **Pain Tolerance** -- the point where a painful pressure stimulus can no longer be tolerated. The **FPX**, assesses pain-pressure sensitivity for maximum tolerated pressure. The **FPX 50** is used for pain threshold and tolerance testing; with a wider range for comparative tests between a normal sensitivity control point and the area of interest.

Algometers are used as a reliable method of quantifying tissue tenderness.

Before taking a measurement, you may wish to demonstrate the process to the patient by pressing the algometer into the palm of the hand.

Using the Algometer:

1. Localize any sensitive areas you wish to measure by gentle but firm palpation.
2. Holding the gage by the handle, place the rubber-tipped load shaft over the predetermined trigger point or area of palpable tenderness you wish to measure.
 - Make sure the gage shaft is perpendicular to the skin surface.
 - Stabilize any nodular muscular regions between the middle and index finger of your indifferent hand.
3. Apply steady, gentle pressure at a rate of 1kg/cm²/sec. until the patient first feels pain and responds by saying "now."
4. Remove Algometer and record the value.

**TABLE 1 FDX - CAPACITIES and RESOLUTION**

MODEL	CAPACITY * / GRADUATION			
FDX 10	10 x 0.01 lbf	160 x 0.2 ozf	5 x 0.005 kgf	50 x 0.05 N
FDX 25	25 x 0.02 lbf	400 x 0.5 ozf	10 x 0.01 kgf	100 x 0.1 N
FDX 50	50 x 0.05 lbf	800 x 1 ozf	25 x 0.02 kgf	250 x 0.2 N
FDX 100	100 x 0.1 lbf	1600 x 2 ozf	50 x 0.05 kgf	500 x 0.5 N

* Overload protection to 150% of capacity for FDX 10, FDX 25, FDX 50 and 130% capacity for FDX 100.

FPX Application Guide:

FPX 10 – For tissue over bone and more sensitive areas.

FPX 25 – Most popular for pain threshold trigger points.

FPX 50 – Popular with dual use for pain threshold and pain tolerance.

FPX 100 – For veterinary use on large animals, e.g., horses.

TABLE 2 FDX - OPTIONAL ACCESSORIES

MODEL	DESCRIPTION	MODEL	DESCRIPTION
FD/S-1 *	Steel Hook - Large (100 lbf)	FDX/NIST	NIST Calibration Certificate
FD/S-2 *	Flat Head (5/8" diameter)	FDX/CA210 *	Cable, USB, FDX to PC, Male A
FD/S-3	Cone Point	FDX/BATT-AAA	NiMH Battery – 1.2V 1000mAh AAA Size
FD/S-4	Chisel Head	FDX/AC-USB	AC Adapter with USB Cable – 110/220 VAC
FD/S-5	Vee Tip	* Replacement USB cable, driver and MESUR™ Lite software on a CD.	
FD/S-6	Extension Rod		
FD/A-7	Hinged Hook - Small (20 lbf)		
FD/S-7	Hinged Hook - Large (100 lbf)		
FD/RT	1 cm ² Flat Rubber Tip		
FD/CP2	2" Compression Plate		

* Steel hook and flat head included with FDX.



**TABLE 3 FORCE TEN™ - TECHNICAL SPECIFICATIONS**

Item	Specification
Accuracy	±0.3 % Full Scale (FS) ± 1 Least Significant Digit (LSD)
Display	4-digit, 0.7" Liquid Crystal Display (LCD)
Display Update	8 per second
Resolution	1000 graduations (1250 for 25 lbf capacity)
Tare	20% of Full Scale (FS)
Overload Protection	15 / 37.5 / 75 / 130 lbf
Power	<ul style="list-style-type: none">• 110 or 220 VAC Adapter/Charger• USB connection• Rechargeable AAA NIMH battery
Battery Endurance	Up to 20 hours with backlight on Up to 30 hours with backlight off
Battery Charge	Overnight for full charge
Calibration	Auto-Calibration – One full capacity weight
Peak Force Sampling Rate	1200 Samples per second
Menu Selection	Menu selection of: <ul style="list-style-type: none">• Unit – set lbf, kgf, N, ozf• AOFF – set power off time• PSS – display sample rate• bLit – set backlight off time• tonE – set audible button press tone• USB – Display baud rate, stop bit, parity• LCAL – start auto-calibration

A. KEYPAD AND DISPLAY

A.1 Keypad Description

FDX is operated with four buttons that control all functions. Practice using the buttons to gain familiarity with gage operation prior to actual use.

For simplicity, each control button has two context sensitive functions. The function of each button depends on how the gage is powered on.

- See Section B. Menu Control of gage setup and configuration details
- See Section C. Gage Operation for all operating modes

If there is no display or if low battery is indicated, the battery may be low or not securely connected. Connecting the AC Power Adapter or USB Cable confirms dead battery.



ON/OFF BUTTON

- Turns FDX on and off

MENU ACCESS

- See Section B

ZERO / SELECT

- Selectable units, auto-off backlight & audible signal
- Zeros gage display
- Select items from menu

DISPLAY

- Force reading & units
- Tension / Compression
- Battery charge status

SEND / EXIT

Send Data

- Single value output with **SEND** key
- Data logging software
See MESUR™ Lite manual

Exit Menu

- Leave menu at any time

PEAK / SCROLL

Display Force

- Real Time Non-Peak
- Compression Peak
- Tension Peak

Control Menu

- See Section B
- Scroll through items
- Wrap-around scroll

B. MENU CONTROL

Three black buttons have the following additional functions:

- SELECT**
- Select displayed item.
 - Review selections within each option.

- SCROLL**
- Review menu options.
 - Review selections within each option.

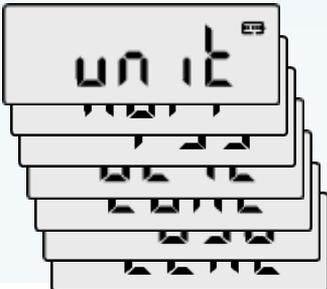
- EXIT**
- Cancel and return to previous menu option.
 - Exit set-up menu.

Prior to testing, practice using buttons and menu navigation.



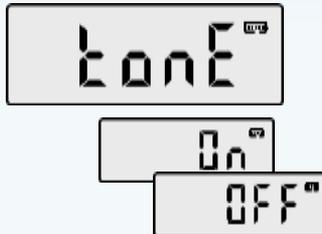
Set-up Menu

- Select a category
- View & choose: units, auto-off, filtering, backlight, audible signal, USB, calibration
- Change value
- Confirm change



Scroll Menu

- Scroll to view menu selection
- Wrap-around scroll



Exit & Save Menu

- Save new menu selections
- Leave menu at any time

B.1 Menu Description

There is no menu option for capacity selection - simply “Plug and Play”. The gage capacity is fixed by the built in load cell. The capacity is displayed during the power-on sequence (see section C. Gage Operation).

FDX features are configured using the set-up menu. First the category of features is selected, then the configuration value is reviewed or changed if needed.

Display	Menu Category	Configuration Value
unit	Select units	lbf * / kgf / N / ozf
AoFF	Power auto-off time	no * / 30 minutes
PSS	data Points Per Sec	1200 *
blit	Backlight auto-off time	1min / 5min * / 10min / 20min / 30min / OFF / On
tonE	Button press tone	OFF or On *
USb	Serial port configuration	bAud * / Lnth * / StoP * / Part * / trAn *
L CAL	Auto - Calibration	See H.3 Auto-Calibration

* Factory default settings.

B.2 Menu Operations

B.2.1 Menu Access

- Power off the gage.
- Press & hold **ZERO/SELECT**
- Then press & release **ON/OFF**
- Hold **ZERO/SELECT** until **SELC** is displayed
- Then release **ZERO/SELECT**



The display will automatically step through several screens before the menu can be used.

Display 1 – LCD test.

All segments of the display are momentarily highlighted providing a self-test for each LCD segment.



Display 2 – Select.

SELC is displayed as long as the **ZERO/SELECT** button is held, indicating that menu selections may begin.



Display 3 – Menu category.

The first menu category is **unit**.



B.2.2 Menu Navigation

The FDX uses three intuitive buttons to view, scroll, select, and save all configuration and calibration items. **SCROLL**, **SELECT**, and **EXIT** labels under the buttons are used to control menu functions:

- **SCROLL** – moves through the list of available items. When **SCROLL** is pressed at the end of a list, the displayed item automatically returns to the top of the list.
- **SELECT** – moves into the selected category to display the available values. If a value is displayed and then saved, the display moves back to the previous category. The display momentarily shows **donE** to confirm that the value was saved.
- **EXIT** – exits the current selected value without saving, and moves back to the selected category; or exits a category without saving and moves back to the previous category; or exits the setup menu.

Sample Item Configuration

This example steps through button presses and display information to setup the **AoFF** (automatic power off) feature.

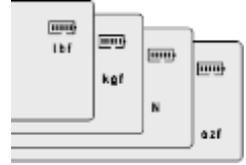
- Enter menu setup mode (see **Section B.2.1**).
The first menu selection is **unit**.
- Press **SCROLL** to view the available setup categories. Stop when the desired category is displayed (see **TABLE 4** for complete list). In this case – **AoFF**.
- Press **SELECT** to display the current setting.
- Press **SCROLL** to view the available options. The number of selections varies by category. In this case there are only two.
- Press **SELECT** when the desired option is displayed. In this case the selection is automatic power off after 30 minutes.
- The display will show **donE**, confirming that the new setting has been saved. The gage returns to the menu category when complete.



B.2.2.1 unit – How to change units.

This feature allows the user to select the units of measurement. The current setting is always shown on the display.

- ▶ **lbf** * displays all values in pounds force.
- ▶ **N** displays all values in Newtons.
- ▶ **kgf** displays all values in kilograms force.
- ▶ **ozf** displays all values in ounces force.


B.2.2.2 AoFF – How to change power auto-off time.

This feature conserves battery power by automatically shutting off the gage after a period of time if no buttons are pressed. Press the **ON/OFF** button to restart the gage.

NOTE: The gage automatically zeros at power on.

- ▶ **no** * - keeps the gage on all the time reducing battery duration, but the gage is always ready for use.
- ▶ **30** - gage turns off after 30 minutes if no activity is detected.


B.2.2.3 PSS – How to review data points per second.

This feature displays the internal sample rate of the gage. The sample rate is the number of electronic force measurements processed per second.

- ▶ **1200** * – provides 1,200 measurements per second. Peak sampling rate of 1200/sec is required to capture peaks of rapidly occurring events and break tests. The FDX takes 1200 “looks” per second to accurately capture a break point and display it.


Digital Filtering

Filtering of displayed data provides accurate force readings by eliminating vibrations and electro-magnetic inference.

Input bandwidth: The band of frequencies that filtering passes thru from the load cell to the display. All other background noise or interference frequencies are excluded.

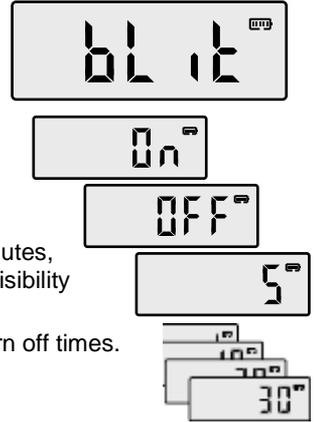
* Factory default setting

B.2.2.4 bLit – How to change backlight auto off time.

This feature saves power by automatically turning the display backlight off after a period of time.

- ▶ **On** - keeps the backlight on all the time for best visibility -- reduces battery duration.
- ▶ **OFF** - keeps the backlight off all the time maximizing battery duration -- reduces visibility.
- ▶ **5*** - keeps the backlight on for selected number of minutes, then turns off if no activity is detected. Provides best visibility with good battery duration when not in use.

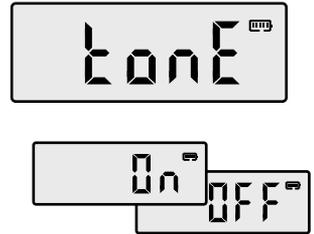
1 Min, 10 Min, 20 Min, 30 Min – optional automatic turn off times.


B.2.2.5 tonE – How to change power on / off tone.

This feature controls the audible tone during power on and off.

- ▶ **On** – momentary beep when power button is pressed.
- ▶ **OFF** – no beep when power button is pressed.

NOTE: Gage always signals audible overload alert whether **tonE** is on or off.


B.2.2.6 USb – How to review serial port configuration.

The various communication parameters of the FDX are grouped for convenience under the USB menu category. The FDX is a USB enabled force gage. The menu items in the USB category indicate the pre-set configuration used for digital communication. USB settings are not adjustable.

See **Section D - USB Data Output** for communication settings and use detail.


B.2.2.7 L CAL – Calibrate the load cell.

See **Section H - Calibration** for calibration and verification procedures.



* Factory default setting

C. GAGE OPERATION

The FDX uses three intuitive buttons to zero (tare) the measurement, control the display mode, and send USB digital data to a computer. **ZERO**, **PEAK**, and **SEND** labels above the buttons are used to operate the gage:

- ON/OFF**
- Turns FDX on and off.
 - Self-test display if held down when turning gage on.
 - At turn-on, display flashes capacity and software version.

If there is no display or if low battery is indicated, the battery may be low or not securely connected. Connecting the AC Power Adapter will confirm this.

- ZERO**
- Returns display to zero in non-peak and peak mode.
 - Returns display to zero with or without applied tare force or weight.

- PEAK**
- Activates peak mode and recalls peak readings.

- SEND**
- Transmits a single data point
 - Current display value sent via the USB port.

Each of the buttons, except ON/OFF, also has set-up functions.



C.2 Set Zero

- Tare force reading
- Same zero all modes



C.3 Display Force

- Tension Peak
- Compression Peak
- Real Time Non-Peak



D.1 Send Data

- Transmit single data point with **SEND** key
- Single or continuous output with data logging software



C.1 Power On

Press the red **ON/OFF** button to power on the gage.

The display will automatically step through several screens before the gage can be used.



Power On Sequence

Display 1 – LCD test.

All segments of the display are momentarily highlighted providing a self-test for each LCD segment.



Display 2 – Firmware version number.

The software version number is momentarily displayed. The version number changes when new firmware is uploaded.



Display 3 – Gage capacity.

The gage capacity, current selection for operating mode, and measurement units are momentarily displayed.



Display 4 – Automatic zero.

The power on sequence automatically zeros the reading before the first value is displayed.



Display 5 – First value.

The first displayed value will always be zero (0, 0.0, 0.00, or 0.000) depending on gage capacity and units selection.



The gage is now ready for use with the same operating mode, units selection, and configuration settings currently in use when the gage was last turned off.

C.2 Zero the Display

For maximum accuracy and repeatability, the load cell should be “conditioned” before the gage is zeroed. Apply two conditioning cycles in the same push / pull direction as the planned test. The applied conditioning force should be more than the expected test result. Conditioning reduces internal load cell stresses and tightens grips or fixtures.

Conditioning is recommended for first time setup and when the applied force changes direction.

Press **ZERO** before each test for best accuracy and repeatability.

C.3 Display Force

The FDX uses three intuitive ways to display force values:

- **Non-Peak Mode** FDX displays normal (i.e. - instantaneous) force applied.
- **Tension Peak Mode** FDX displays highest peak tension force applied since the gage was last cleared by pressing **ZERO**.
- **Compression Peak Mode** FDX displays highest peak compression force applied since the gage was last cleared by pressing **ZERO**.

Peak values are always available in all modes. The FDX measures instantaneous real time forces and continuously updates peak forces in tension and compression.

C.3.1 Non-Peak Mode

Displayed force values vary with the instantaneous force applied. Use FDX in this mode for monitoring the applied force in real time as it varies.



At any time tension or compression peaks are needed, they may be viewed by pressing the **PEAK** button.

- **Enter Non-Peak Mode** Press **PEAK** repeatedly to cycle through the display modes until the **PEAK** icon is not displayed.
- **Clear Measurement** Press **ZERO** to tare the gage and clear peak values before each test for best accuracy and repeatability.
- **Run Test** Apply push or pull force. The gage tracks and displays the applied force.



FORCE TEN™ FORCE GAGE

C.3.2 Peak Mode

Peak force values displayed by FDX are the highest peak(s) of tension or compression since peak memory was cleared. If peak memory is cleared, the next peak value displayed will be that of the next test. If additional tests are run after the first test, without clearing the peak memory, the peak value displayed will always be the highest peak of the series.



- **Enter Peak Mode** Press **PEAK** repeatedly to cycle through the display modes until the desired **PEAK** icon is displayed.
- **Clear Measurement** Press **ZERO** to tare the gage and clear peak values before each test for best accuracy and repeatability. **See note below.**
- **Run Compression Test** When the **COMP PEAK** icon is visible, begin compression test by applying push force. Peak force is displayed. When a higher compression force is applied, the new peak is displayed.
- **Run Tension Test** When the **TENS PEAK** icon is visible, begin tension test by applying pull force. Peak force is displayed. When a higher tension force is applied, the new peak is displayed.
- **Recall Peaks** Press **PEAK** to cycle through display modes.
- **Clear Peak Memory** Press **ZERO** to tare the gage and clear peak values.
- **Return to Non-Peak** Press **PEAK** until the **PEAK** icon is not displayed.

NOTE: It is important to know that the displayed peak value is the highest peak since peak memory was last cleared. If ZERO is not pressed, while in COMP PEAK or TENS PEAK mode, the peak values from previous tests will be held in memory. New peak values will be not be detected.

Prior to actual test use, practice with FDX “Non-peak” and “Peak” modes to gain familiarity. FDX in non-peak or peak mode is continuously measuring the instantaneous force applied and continuously capturing peaks.

Press the PEAK button to recall peak values in non-peak as well as peak modes.

C.3.3 Error Messages

The FDX continuously monitors the applied force and displays error messages when the force is outside the normal operating range. The FDX displays the following messages when operator error or maintenance issues are detected:

CAUTION



- 1) **TARE TOO HIGH** – verifies that the tare force is within the recommended operating range.

StoP is displayed when:

- ▶ Too much tare force is applied.
- ▶ Tare is more than 20% of rated load cell capacity.
- ▶ Recovery: reduce tare & press **ZERO**.



- 2) **OUT OF RANGE** – detects operator error or accidental use of the gage above the specified full scale. Monitors force on the load cell and sounds tone when force is over capacity.

The tone sounds as a reminder that the accuracy of values above full scale is not guaranteed.

A 5-second tone sounds when:

- ▶ Too much force is applied.
- ▶ More than 105% of full scale reading.
- ▶ Recovery: Reduce the applied force.



WARNING



- 3) **!!! OVERLOAD !!!** – detects operator error or accidental overload. Senses total force on the load cell (tare + load) and is not affected by tare.

- ▶ Too much force is applied.
- ▶ More than 120% of full scale load is applied.
- ▶ Gage may be damaged.
- ▶ Recovery: reduce force & check calibration.





D. USB DATA OUTPUT

USB communication enables the operator to transmit data points from the gage to a USB connected computer. Data transmission is triggered by pressing the **SEND** button, or from the computer with **MESUR™Lite** software. **MESUR™Lite** can be controlled to trigger a single data point or a continuous data stream from the gage.

D.1 USB Commands

FDX USB port is controlled by gage buttons or computer keyboard.

FDX is keyboard controlled from a computer using the **FDX** bi-directional USB port. This feature is useful for those with software programming skills and is not intended for use with commercially available software such as Microsoft Excel™.

To view the communication protocol configuration, proceed to **USB** menu category in **FDX** set-up menu. See **Table 5 Section E.1** for details.

After USB communication is established, proceed with the following:

COMMAND
(Not Case Sensitive)

DESCRIPTION

? or C?

Send single force data point

Data Format:

The gage responds by sending a sequence of ASCII characters reporting the current force value. Each value will have the following format:

- + / - indicates compression / tension
- 4 digits with decimal point
- units

Examples:

- 23.02 lbf
18.14 fgf

reads 23.02 pounds force in tension
reads 18.14 kilograms force in compression

Notes:

- All commands will return a message:
- Formatted digital value
- All commands must be followed by ENTER (Carriage Return / Line Feed)
- Unrecognized commands will yield no response.

E. DATA TRANSMISSION

The FDX transmits force data through the USB port only – no analog or other data output is available.

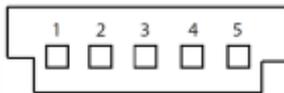
E.1 USB Configuration Settings

FDX force values transmitted are those displayed on the FDX. Serial data is transmitted via the USB port, with the following fixed parameters. Computer settings must match pre-set gage settings, which are not user selectable.

TABLE 5 DATA TRANSMISSION	
Baud Rate	9600 (fixed, not user adjustable)
Word Length	8 (fixed, not user adjustable)
Stop Bits	1 (fixed, not user adjustable)
Parity	None (fixed, not user adjustable)
Data Format	- 25.00 lbf

F. PIN ASSIGNMENTS

The 5-contact USB connector is located on the top side of the FDX. The contact assignments are:



CONTACT	SYMBOL	DESCRIPTION
1	VBUS+	USB +5V DC Power
2	D-	Data – for USB communication
3	D+	Data + for USB communication
4	No Connection	Reserved for future use
5	GND	USB 5V Return



G. GAGE CAPACITY

The FDX force gage capacity is determined by the ratings of the built in load cell and cannot be changed by the user.

G.1 Overload Protection

- Each FDX is protected against overload.
- Prior to reaching overload limits of the load cell, the gage will indicate an overload condition by displaying warning messages.
- Safe overload limits are a total of both tared weight and applied test weights.

TABLE 6 SAFE OVERLOAD LIMITS			
Units	Capacity	Limit	% of F.S.
lbf	10 / 25 / 50 / 100	15 / 37.5 / 75 / 130	150 / 150 / 150 / 130
kgf	5 / 10 / 25 / 50	7.5 / 15 / 37.7 / 65	150 / 150 / 150 / 130
N	50 / 100 / 250 / 500	75 / 150 / 375 / 650	150 / 150 / 150 / 130
ozf	160 / 400 / 800 / 1600	240 / 600 / 1200 / 2080	150 / 150 / 150 / 130

H. CALIBRATION

FDX features “Smart Load Cell” calibration for verification and adjustment without having to return the gage to the factory.

Certified lb or kg test weights are applied in tension and compression to measure the FDX accuracy before starting calibration. Review the measured data and compare to the accuracy specification to determine if the gage passes or fails to meet the specification.

- Passes - there is no need to re-calibrate -- the gage can be re-certified.
- Fails - the gage should be re-calibrated, verified, and certified.

FDX should be periodically tested to verify it is within the specified tolerance.

H.1 Calibration Procedure Description

Step 1: Pre-calibration Verification -- check current calibration.

Certified lb, kg test weights are applied in tension and compression to measure the FDX accuracy. Review the measured data and compare to the accuracy specification to determine if the gage passes or fails to meet the specification.

- Passes - there is no need to re-calibrate -- the gage can be re-certified.
- Fails - the gage should be re-calibrated, verified, and certified.

Step 2: Calibrate the gage -- if needed.

Calibrate the gage - The FDX **Auto-Calibration** feature enables the gage to be calibrated by one full capacity lb, kg test weight.

Step 3: Verification – verify correct calibration.

The FDX **MUST** be verified after each calibration to confirm that the calibration is complete and correct.

H.2 Verification Test Procedure

Warm-up FDX for 2-3 minutes after power-on to stabilize the electronics.

A five-point tension and compression verification test is recommended with weights equal to 20%, 40%, 60%, 80%, and 100% of FDX capacity. If the displayed weight differs more than $\pm 0.3\%$ of full scale ± 1 L.S.D., at any point, the FDX is out of tolerance.

Accuracy verification requires the following testing fixtures:

- Test stand capable of supporting weights equal to the FDX capacity.
- Set of lb, or kg test weights.
- Fixtures for applying test weights in tension and compression.

To restore accuracy, proceed to H.3, Auto-Calibration.

H.3 Auto-Calibration (LCAL)

This procedure is used to return the FDX to its specified accuracy after verification indicates the FDX is out of tolerance, or if readings are incorrect.

It is recommended to calibrate the gage in tension, however, the gage can be calibrated using a single weight in tension or compression if desired.

Certified NIST traceable test weights are recommended, resulting in an NIST Calibration Certificate.

Unless the FDX is verified with the test procedure described in **Section H.2** and an NIST Calibration Certificate issued, FDX is not certified to NIST standards. If certification is not required, Auto-Calibration is adequate to return the FDX to specified accuracy.

After Auto-Calibration, FDX accuracy should be confirmed using H.2 Verification.

H.3.1 Start Auto-Calibration Procedure

Test weights must match the FDX capacity to be tested.

WARNING! – *significant measurement error will occur:*

- *if the selected units do not match that of the calibration weight*
- *if the calibration weight does not match the load cell capacity*

▶ Attach FDX to the calibration test stand, and stop all movement.

▶ Enter the calibration menu:

- Power off the gage.
- Press & hold **ZERO/SELECT**
- Then press & release **ON/OFF**
- Hold **ZERO/SELECT** until **SELCL** is displayed
- Then release **ZERO/SELECT**
- The display will show **unit** when the gage is ready.



- Press **SCROLL** until **LCAL** is displayed. Then press **SELECT** to enter the calibration procedure.



- Press **SCROLL** until the desired units are displayed. **CAL1** is for pound weights and **CAL2** is for kilogram weights.



- Press **SELECT** to start the calibration procedure.



- The gage will display **nuLL** and wait for the operator to complete all set-up procedures and stop all motion.



H.3.2 Step-by Step Auto-Calibration Procedure

Step 1: Set-up weight hanger fixture.

Install appropriate weight hanging fixture before starting calibration.

Step 2: Condition the load cell.

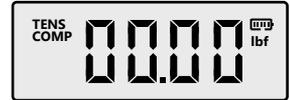
The load cell must be “conditioned” before the gage is zeroed. Apply two conditioning cycles in tension (or compression) by applying then removing full scale weights twice.

Conditioning reduces internal load cell stresses and tightens grips or fixtures for better accuracy and repeatability.



Step 3: Measure the zero value.

Make sure all motion has stopped.
Press **SELECT** to tare the fixture weight and capture the zero value.
The display will momentarily flash all zeros.

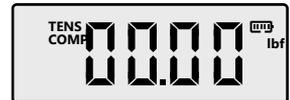


Step 4: Apply full scale weight.

The display shows how much weight to apply. This will always be equal to the full scale capacity of the gage: 10.00 lbf, 25.00 lbf, 50.00 lbf, 100.0 lbf or, 5.000 kgf, 10.00 kgf, 25.00 kgf, 50.00 kgf.

- Apply the appropriate pound or kilogram full scale weight.
- Make sure all motion has stopped.
- Press **SELECT**.

The display will momentarily flash all zeros.



Step 5: Verify as needed.

The display is showing the non-peak real time value.



If desired, verify the new calibration as described in **Section H.2 Verification**



FORCE TEN™ FORCE GAGE

Step 6: Calibration Complete.

The display still shows the non-peak real time value.



Fails Calibration:

If performance is not acceptable for any reason, press the **POWER** button to exit calibration mode without saving.

Call the factory if the gage does not meet performance requirements after several calibration attempts.

Passes Calibration / Save:

Make sure all motion has stopped.

Press **SELECT** to record that the calibration is acceptable.

The display will flash **done** when all data is saved.



The gage will automatically exit the menu / setup mode and go to normal operation.

Calibration can be checked any time by performing the verification procedure described in **Section H.2**

WARNING

It is possible for the FDX to accept calibration with weights that do not match the full scale capacity. This erroneous calibration will give inaccurate readings.

If this occurs, cycle power and re-start calibration by navigating to LCAL in the set-up menu and repeating the calibration procedure with correct weights.

Verification is recommended to check calibration accuracy.

*Verification **MUST** be performed for certified calibration.*

J. POWER SUPPLY

The preferred power source is determined by FDX use: the rechargeable battery for portable use and AC adapter/charger or USB port for stationary use.

J.1 Battery and AC Adapter

The FDX is powered by two rechargeable 1.2 Volt (AAA) Nickel Metal Hydride (NiMH) batteries. With a full charge, the NiMH batteries will provide power up to 20 hours of continuous use with backlight and up to 30 hours if used continuously with the backlight off. Battery life can be extended further by using Auto-Off (**described in Section B.2.2**).

Low battery power is indicated on the display with a battery icon that indicates when the charger is plugged in, when the battery has a strong charge, and when the battery is low.

The gage will automatically turn off when the battery is fully discharged.

With the AC adapter plugged in, FDX is charging when turned on or off and charges faster when off.

- ▶ **Battery OK**
 – 3 to 5 bars.
 – safe to use gage without charger.

 or
  or
 

- ▶ **Battery Low**
 – 2 or fewer bars.
 – plug in charger soon.
 – gage will power down soon and data loss may occur.

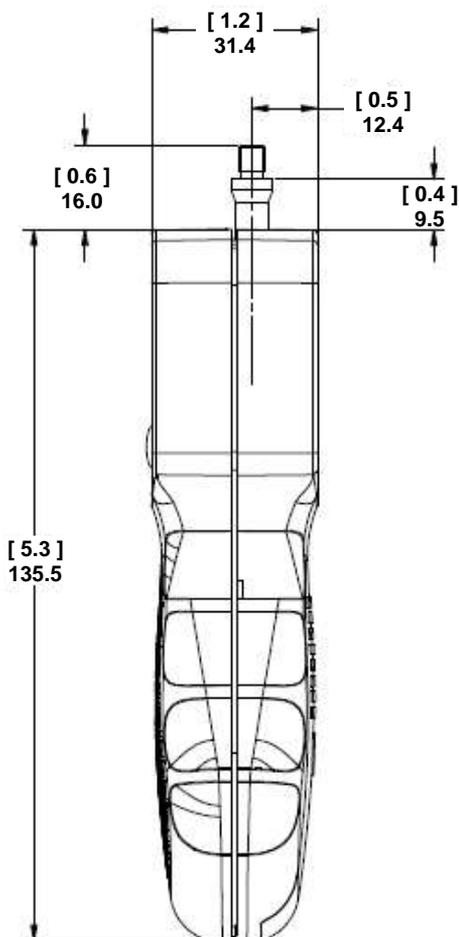
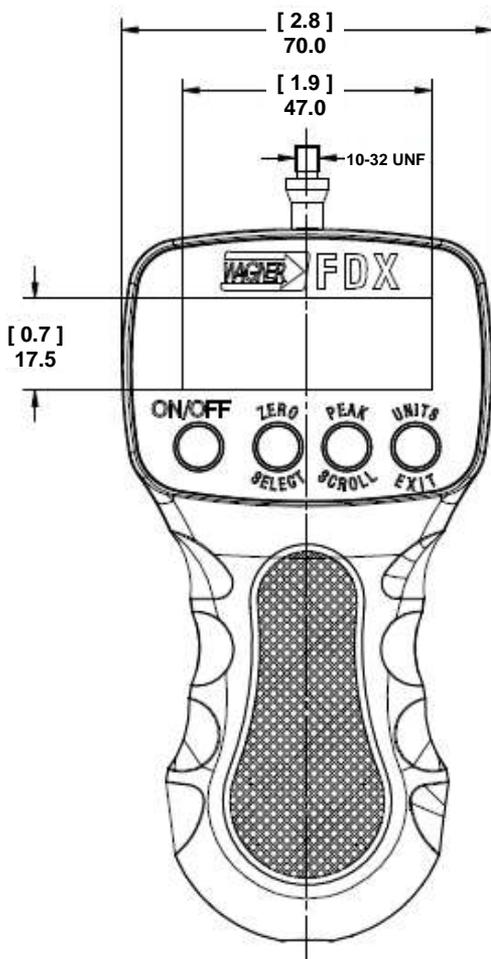
 or
  or
 

- ▶ – **NOTE: No warning** – the gage automatically turns off when the battery charge is too low.

- ▶ **Charging**
 – increasing bars indicates charging.
 – charger or USB port plugged in.
 – can use gage indefinitely.





Units: [inch]
 mm




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