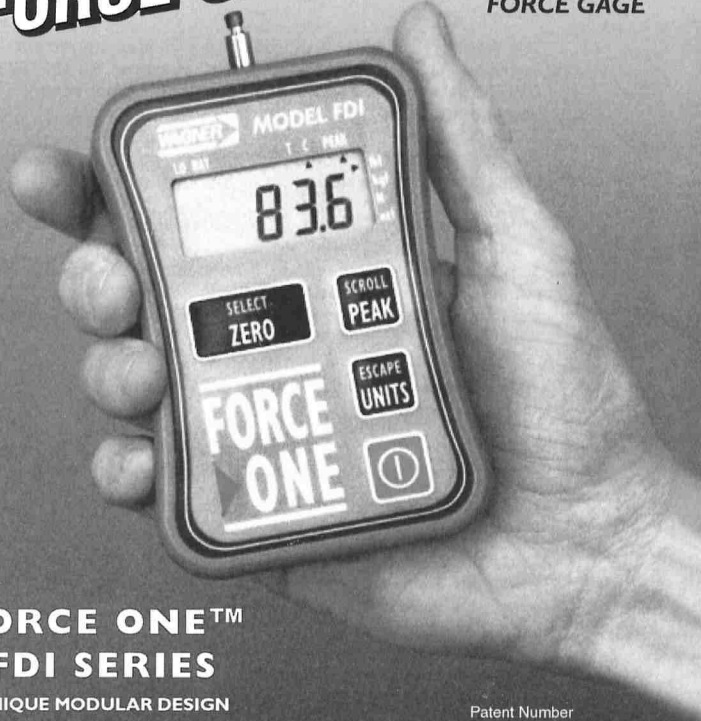




OPERATION MANUAL

FORCE ONE™

MULTI-CAPACITY
FORCE GAGE



FORCE ONE™ FDI SERIES

UNIQUE MODULAR DESIGN

INTERCHANGEABLE
FORCE CELL MODULES

2 TO 200 LBF

Patent Number
5,471,885

WAGNER INSTRUMENTS
GREENWICH, CT 06836
(203) 698-9681

IMPORTANT

READ THIS BEFORE USING THE FORCE ONE

1. The Wagner Force One™ Force Gage provides significant overload protection of its load cells. However, EXCESSIVE OVERLOADS or IMPACT LOADING may cause permanent damage to the load cell.

Prior to reaching the overload limit of its load cell, the gage will indicate an overload condition by displaying "StoP".

Refer to page 4 of this manual for overload protection by model.
2. To prevent accidental overload, the capacity of the Force Cell Module is immediately displayed when the gage is switched on. This indication of capacity is also a reminder of the Force Cell Module's limitations.
3. When "HELP" is displayed, it may indicate either:
 - Force Cell Module is not securely connected, or
 - Force Cell Module has been overloaded and is damaged.
4. The FDI is intended for axial loads only. Application of force to the load shaft at an angle (side loading) or twisting the load shaft (torque) will cause erroneous readings. If the non-axial or torque force is excessive, permanent damage may occur.
5. Attach all implements "finger-tight" only. Use of tools to attach any implement or adapter to the load shaft may cause permanent damage to the Force Cell sensor.
6. Use only the AC adapter/charger supplied with the FDI. Using other adapter/charger units may overcharge and damage the battery.

WAGNER FORCE ONE™ DIGITAL FORCE GAGE FDI SERIES

OPERATION MANUAL

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CONSTRUCTION

- Patented Plug 'n Play Design.
- Display Module adapts to seven Force Cell Modules.
- Full 5 digit, 0.5" LCD and simple 4 button keypad.
- Tension and Compression with lbf, ozf, kgf and N units.
- Displays "Peak", "T", "C" and "Lo Batt".
- Split housing for upright display with shaft up or down.
- Compact firm grip aluminum housing.
- Made in the USA - Patented Design.

OPERATION

- Change Force Cell Module to change capacity.
- Simple set-up for Force Cell Module change.
- Simple "Smart Load Cell Calibration".
- Peaks captured at selectable 100 or 1000 samples/sec.
- All functions executed on 4 button keypad.
- Filtering of current and peak readings.
- Automatic shut-off preserves battery.

POWER REQUIREMENTS

- Rechargeable NiMH battery for 10 hours of operation.
- Extended operation with Auto-Off and 100/sec. peak sampling.
- Continuous AC operation with 110 or 220 VAC adapter/charger.

ACCESSORIES

- Includes: Re-chargeable NiMH battery, AC adapter/charger, five implements, hook of appropriate capacity, case, manual and NIST Certificate of Calibration.
- Optional accessories include: seven Force Cell Modules, handles, implements, grips, and test stand mounting kits.

ACCURACY

- Accurate to $\pm 0.3\%$ of Full Scale ± 1 L.S.D.

WEIGHT & DIMENSIONS

- Instrument: 13 oz, shipping weight: 2 lb.
- Dimensions: 2 3/4" w x 4" h x 1 1/4" d.

FORCE ONE™

Advanced Simplicity

FORCE DISPLAY MODULE
Contains Microprocessor,
Electronics & Digital Display

FORCE CELL MODULE
7 Interchangeable Modules Available
2, 5, 10, 25, 50, 100 & 200 lbf

Patented
Interchangeable
Capacity Modules

2, 5, 10, 25, 50, 100
& 200 lbf modules

Menu Selectable
Features

"Smart Load Cell"
Calibration

Firm Grip Design

Aluminum Housing

Re-chargeable NiMH
Battery & AC Power

Actual Size

Patent Number 5,471,885

Made in USA

Large 0.5"
5 Digit Display

Selectable 100 or
1000/sec. Peak
Sampling Rate

Keypad Selectable
Units lbf/ozf/kgf/N

SELECTING A FORCE ONE™ FDI FORCE GAGE SYSTEM

Customize a Force One™ Force Gage System to Suit Your Needs:

- Basic system consists of a Force Display Module and a Force Cell Module.
- Add other Force Cell Modules as needed to increase or decrease capacity.
- Changing Force Cell Modules changes capacity and resolution to suit your needs.
- Switching Force Cell Modules is quick and easy and provides the ultimate in economy.



TABLE 1 FORCE ONE™ DIGITAL FORCE GAGE - COMPLETE SYSTEM

MODEL	OVERLOAD PROTECTION TO	LOADSHAFT MOVEMENT AT CAPACITY	CAPACITY / GRADUATION			
FDI 2	25 lbf	0.015"	2 x 0.002 lbf	32 x 0.04 ozf	1 x 0.001 kgf	10 x 0.01 N
FDI 5	50 lbf	0.011"	5 x 0.005 lbf	80 x 0.1 ozf	2.5 x 0.002 kgf	25 x 0.02 N
FDI 10	100 lbf	0.007"	10 x 0.01 lbf	160 x 0.2 ozf	5 x 0.005 kgf	50 x 0.05 N
FDI 25	250 lbf	0.007"	25 x 0.02 lbf	400 x 0.5 ozf	10 x 0.01 kgf	100 x 0.1 N
FDI 50	250 lbf	0.007"	50 x 0.05 lbf	800 x 1 ozf	25 x 0.02 kgf	250 x 0.2 N
FDI 100	250 lbf	0.007"	100 x 0.1 lbf	1600 x 2 ozf	50 x 0.05 kgf	500 x 0.5 N
FDI 200	400 lbf	0.005"	200 x 0.2 lbf	3200 x 4 ozf	100 x 0.1 kgf	1000 x 1 N

ALL MODELS INCLUDE: One Force Display Module (FDMI), One Force Cell Module (FCMI), Battery, AC Adapter/Charger, Five Implements, One Hook of Appropriate Capacity, Case, Manual and NIST Calibration Certificate. Optional accessories are available.

Optional Interchangeable Force Cell Modules (FCMI), Table 2, may be added to the above FDI Series Force Gages and interchanged with the original Force Cell Module.

TABLE 2 FORCE ONE™ FORCE CELL MODULES - OPTIONAL CAPACITIES

The optional FCMI Force Cell Modules below can be purchased separately and used with all Force One™ FDI Series Force Gages, see Table 1.

MODEL	OVERLOAD PROTECTION TO	LOADSHAFT MOVEMENT AT CAPACITY	CAPACITY / GRADUATION			
FCMI 2	25 lbf	0.015"	2 x 0.002 lbf	32 x 0.04 ozf	1 x 0.001 kgf	10 x 0.01 N
FCMI 5	50 lbf	0.011"	5 x 0.005 lbf	80 x 0.1 ozf	2.5 x 0.002 kgf	25 x 0.02 N
FCMI 10	100 lbf	0.007"	10 x 0.01 lbf	160 x 0.2 ozf	5 x 0.005 kgf	50 x 0.05 N
FCMI 25	250 lbf	0.007"	25 x 0.02 lbf	400 x 0.5 ozf	10 x 0.01 kgf	100 x 0.1 N
FCMI 50	250 lbf	0.007"	50 x 0.05 lbf	800 x 1 ozf	25 x 0.02 kgf	250 x 0.2 N
FCMI 100	250 lbf	0.007"	100 x 0.1 lbf	1600 x 2 ozf	50 x 0.05 kgf	500 x 0.5 N
FCMI 200	400 lbf	0.005"	200 x 0.2 lbf	3200 x 4 ozf	100 x 0.1 kgf	1000 x 1 N

TABLE 3 FORCE ONE™ - OPTIONAL ACCESSORIES

FDMI	Force Display Module	FD/S-5	Vee Tip
FDI/ HDL	Aluminum Handles	FD/S-6	Extension Rod
FD/RT	Flat Rubber Tip (7/16" Dia.)	FD/A-7	Hinged Hook - Small (20 lbf)
FD/ CP2	Compression Plate (2" Dia.)	FD/S-7	Hinged Hook - Large (100 lbf)
FD/A-1	Aluminum Hook - Small (10 lbf)	FD/A-8	Hinged Cradle - Small (20 lbf)
FD/S-1	Steel Hook - Large (100 lbf)	FD/S-8	Hinged Cradle - Large (100 lbf)
FD/B-1	Steel Hook - XL (200 lbf)	FT/FDI	Mounting Kit - FTS & FTC Stands
FD/S-2	Flat Head	FTK/FDI	Mounting Kit - FTK Stand
FD/S-3	Cone Point	FD/NMH	NiMH Battery - 9V size
FD/S-4	Chisel Head		

* One included with FDI Force Gage - see Table 1.
** No charge when FDI is ordered with test stand.



FORCE ONE™ - TECHNICAL SPECIFICATIONS

Item	Specification
Accuracy	± 0.3 % F.S. ± 1 Least Significant Digit
Display	5 Digit, 0.5" Liquid Crystal Display (LCD)
Display Update	8 per second
Resolution	1000 graduations (except 1250 for 25 lbf capacity)
Tare	± 10% of Full Scale (FS)
Load Shaft Deflection	Varies by capacity - see page 4
Load Cell	Overload protected "Smart Load Cell"
Load Cell Interchangeability	Plug and Play "Smart Load Cell"
Overload Protection	Varies by capacity - see page 4
Power	(1) 110 or 220 VAC Adapter / Charger (2) Rechargeable 7.2V NiMH battery (9V form)
Battery Endurance	Up to 24 hours at 100 Samples per Second Up to 18 hours at 1000 Samples per Second
Battery Charge	10 hours for full charge
Calibration	One full capacity weight (Auto-Cal)
Peak Force Sampling Rate	Selectable: 100 Samples per Second (SPS) 1000 Samples per Second (SPS)
Digital Filter	Non-Peak Mode: 100 Samples per Second (1) Routine Testing: 9 HZ Input Band Width (2) Rapid Event Testing: 90 HZ Input Band Width Peak Mode: 1000 Samples per Second (1) Routine Testing: 33 HZ Input Band Width (2) Rapid Event Testing: 330 HZ Input Band Width
Gage Control	Menu selection of: (1) Automatic Off (AoFF) (2) Peak sampling rate (PSS) (3) Auto calibration (L CAL)

A. KEYPAD

A.1 Keypad Description

The FDI Force Gage is operated with a four-button keypad to control all functions.

- ON/OFF**
- Turns the gage on and off.
 - Self-tests the display if held down when turning gage on.
 - At turn-on, the display flashes the Force Cell Module capacity and the software version number installed in the FDI.

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

- ZERO**
- Returns display to zero whether in Normal or Peak mode.
 - Returns display to zero with any tare force or weight applied to the load shaft up to the full capacity of the gage.

- UNITS**
- Selects the units of measurement: lbf, kgf, N, or ozf.

- PEAK**
- Activates the peak retention mode and recalls peak tension and compression readings.

Each of the above buttons, except ON/OFF, has additional functions for use in selecting options within the set-up menu - see Section A.2.

A.2 Keypad Control

The three black buttons of the FDI keypad have the following additional functions:

- SCROLL**
- Review menu options.
 - Review selections within each option.
- SELECT**
- Select the displayed item.
 - Save the selected item.
- ESCAPE**
- Cancel and return to previous menu option.
 - Exit the set-up menu.

B. MENU SET-UP

B.1 Menu Description

The FDI Force Gage features several options that are selected through a set-up menu. At the first level are the options; the second level provides selections within the first level options.

The following table is a summary:

MENU OPTIONS AND SELECTIONS		
Display	Option	Selections
AoFF	Auto Off	No* or 30 minutes
PSS	Peak Sampling Rate	100*: (1) Sampling rate is 100 samples per second. (2) Input bandwidth is 9Hz in normal and 33Hz in peak.**
		1000: (1) Sampling rate is 1000 samples per second. (2) Input bandwidth is 90Hz in normal and 330Hz in peak.**
L CAL	Calibration using one dead weight	See Section D.3

* Indicates factory setting; other values may be selected by user.

** Input bandwidth is the band of frequencies that filtering permits to be passed through from the load cell sensor to the display. All other frequencies – the background noise or interference – are excluded from the data display.

B.2 Menu Operations

B.2.1 Menu Access

- Turn off the FDI.
- Press / Hold ZERO, press ON/OFF.
- Release ON/OFF first, then release ZERO after "AoFF" is displayed.

B.2.2 Menu Instructions

- After entry into the set-up menu, the first option displayed is "AoFF".
- Press SCROLL to review the menu options.
- Press SELECT to choose an option and to move to the list of selections.

The current setting is displayed first.

- Press SCROLL to review the possible selections.
- Press SELECT to choose the selection: "donE" will momentarily appear on the display, and then the previous menu is displayed.
- Continuing to press SCROLL without pressing SELECT will move the display thru the available options with no changes made to settings.
- Press ESCAPE, at any time, to exit the current menu.

B.2.3 Menu Options

1) AoFF Automatic-Off

The FDI is designed to automatically turn off after a period during which no buttons are pressed. The selections are:

No FDI does not shut off automatically – consumes more battery power
30 FDI shuts off after 30 minutes of inactivity

2) PSS Peak Sampling Rate and Digital Filter

The FDI provides selectable peak sampling rates and corresponding digital filtering.

► Routine Testing

The peak sampling rate of 100/sec is preferable and significantly reduces power consumption for battery operation.

► Rapid Event Testing

The peak sampling rate of 1000/sec is necessary to capture the peak reading of rapidly occurring events and break tests. The FDI takes 1000 looks per second to accurately capture the failure point and display it.

► Digital Filtering

Filtering of the data to be displayed ensures more accurate force readings by eliminating erroneous readings caused by vibrations and electro-magnetic interference.

► Filter Settings

The degree of filtering is simultaneously set with the peak sampling rate as follows:

Non-Peak Sampling Mode 100 Samples Per Second

- Routine Testing: 9 Hz Input Band Width
- Rapid Event Testing: 90 Hz Input Band Width

Peak Sampling Mode 1000 Samples Per Second

- Routine Testing: 33 Hz Input Band Width
- Rapid Event Testing: 330 Hz Input Band Width

Input bandwidth is the band of frequencies that filtering permits to pass thru from the load cell sensor to the display. All other frequencies – the background noise or interference – are excluded from the data display.

3) **Force Cell Capacity** Plug and Play

There is no menu option for capacity selection — simply “plug and play”. The capacity of the “Smart Load Cell” attached is immediately recognized by the FDI and displayed when the power is turned on.

4) **L CAL** Auto - Calibration

The FDI has “Smart Load Cell” calibration that permits verification and adjustments to the gage without returning it to the factory. See Section D.3 for this procedure.

C. INTERCHANGING FORCE CELL MODULES

The Wagner FDI Force Gage gives the user the unique patented ability to combine various capacity Force Cell Modules with a single force gage.

C.1 Module Description

The FDI Force Gage consists of two modules:

- **Force Display Module (FDMI)** contains the display electronics and keypad. All control functions are initiated by keypad entry; control information and data are displayed on the LCD screen.
- **Force Cell Module (FCMI)** contains the load cell and battery in a structure capable of loads to 200 lbs. The applied force data is sent from the FCMI to the FDMI through a center-mounted connector that also carries power to the FDMI. The center connector provides quick removal of the FCMI for replacement and easy rotation of the FCMI to change the load shaft direction from up to down.

C.2 Connecting a Force Cell Module (FCMI)

- Back out the two captive screws on the rear half (FCMI).
- Detach the FCMI carefully by easing the halves of the gage straight out.
- To re-attach the FCMI or replace it with another one, align the center connector by aligning the edges of the two halves so they coincide, and squeeze together.
- Drive in the screws, turn on the gage and proceed with use of the FDI.

Since the FDI utilizes a “smart load cell”, it is unnecessary to make any capacity setting. The FDI recognizes the capacity of the FCMI attached to it immediately.

C.3 Overload Protection

- Each Force Cell Module is protected against overload. See page 4 for the overload limit of each capacity.
- Prior to reaching overload limits of the load cell, the gage will indicate an overload condition by displaying “**StoP**”.

D. CALIBRATION

To ensure accuracy, the FDI should be periodically tested to confirm that it is within the specified tolerance.

D.1 Procedure Description

- **Testing Calibration** – Certified weights are applied to the FDI in tension and compression to determine if the FDI can be certified. This procedure is used for required periodic certification and determines if the calibration procedure is necessary.
- **Calibration** – The FDI is provided with an **Auto-Calibration** feature that enables the FDI to be calibrated by applying one weight, equal to the full capacity of the FDI.

D.2 Testing Calibration

Warm-up of the FDI is important. Allow 2-3 minutes for the electronics to stabilize after power-on.

The FDI is calibrated at the factory to an accuracy of $\pm 0.3\% \pm 1$ LSD. To test calibration, a five-point test is recommended, with weights equal to 20%, 40%, 60%, 80%, and 100% of the gage capacity. The weight test should be performed in both tension and compression modes. If the displayed weight should differ more than $\pm 0.3\% \pm 1$ LSD, the gage is out of tolerance.

To verify accuracy of the FDI, basic testing fixtures are required; namely, a test stand capable of accommodating test weights equal to the capacity of the gage being tested, and fixtures for applying the test weights in both tension and compression. Call Wagner Instruments if you require testing fixtures.

The accuracy of the FDI depends on the ability of both the Force Cell Module (FCMI) and Force Display Module (FDMI) to meet the specified tolerance. Therefore, each interchangeable FCMI in use must be tested with the FDMI to verify accuracy.

If any combination of FDMI and FCMI units are out-of-tolerance, then Auto-calibration of the FDI is necessary. Proceed to Section D.3, Auto-calibration, for the procedure to restore accuracy.

D.3 Auto-Calibration (L CAL)

Factory calibration with certified test weights, resulting in a certificate of calibration traceable to NIST, is recommended.

Unless the FDI is tested according to the procedure of Section D.2, and verified to be within the specified accuracy with certified test weights, and a certificate of calibration issued, the FDI is not considered certified and traceable to NIST standards. However, if certification is not required, Auto-Calibration is adequate in returning the FDI to specified accuracy.

Auto-Calibration is a field calibration procedure that can be done whether the FDI is used with one or more Force Cell Modules (FCMI). This procedure is used to return the FDI to its specified accuracy after testing calibration (Section D.2) has indicated the FDI to be out of tolerance, or if it is obvious that the displayed readings are incorrect.

After Auto-Calibration, the FDI accuracy should be verified using the procedure in Section D.2.

D.3.1 Auto-Calibration Procedure

Verify that the test weights to be used match the capacity of the Force Cell Module to be tested — NIST certified weights are recommended.

- ▶ Set UNITS to lbf — all calibrations are executed in pounds (lbf).
- ▶ Securely mount the FDI on the test stand with all testing fixtures in place, and allow all movement to stop.
- ▶ Enter the set-up menu:
 - Turn off the FDI.
 - Press / Hold ZERO; press ON/OFF.
 - Release ON/OFF first, then release ZERO after “AoFF” is displayed.
- ▶ Gage set-up:
 - SCROLL to the L CAL menu option.
 - Press SELECT - the FDI displays “null”.
 - Press SELECT - the FDI displays a force cell capacity after “zero” is momentarily displayed.

If the capacity shown is not that of the attached Force Cell Module, SCROLL to the correct Force Cell Module capacity.

- ▶ Calibrate
 - Apply the full-scale weight that matches the display — only in pounds.
 - Press SELECT when the weight is applied and all motion has stopped.
 - The FDI displays the actual applied weight, which indicates a successful calibration.

The FDI will reject a calibration with weights that are significantly higher or lower than the full-scale capacity of the Force Cell Module. It is also possible for the FDI to accept a calibration with weights that are close to, but do not match, the full scale capacity of the Force Cell Module. This erroneous calibration will give inaccurate readings.

▶ Calibration Accepted

- The FDI displays the actual applied weight, which indicates a successful calibration. If “uuuuu” or “nnnnn” is displayed, the weight is not accepted, or other problems exist with the gage — see Calibration Rejected (below).

Further verification is recommended, and can be done at this point by applying weights to check accuracy at various points of the gage's range. A five-point test is recommended at 20%, 40%, 60%, 80%, and 100% of the full-scale capacity, if such weights are available.

- To exit the calibration mode, press SELECT when the full-scale capacity is displayed or at anytime during or after the five point weight test.
- The FDI will momentarily display “done”, and return to normal display. This completes the Auto-Calibration, and the FDI is ready for normal use.

▶ Calibration Rejected

- If the weight is not accepted, the display shows “uuuuu” for under, or “nnnnn” for over. Verify that the full-scale weight applied matches the Force Cell Module capacity.
- If the weight used does not match the Force Cell Module capacity, remove the weight and repeat the Auto-Calibration Procedure, Section D.3.1.
- If “uuuuu” or “nnnnn” is displayed again after repeating Auto-Calibration, the problem may be a defective or damaged Force Display Module or Force Cell Module. Call Wagner Instruments for instructions.

E. MOUNTING INFORMATION

The FDI Digital Force Gage may be mounted on most popular light capacity test stands using the threaded mounting holes on the back of the gage.

E.1 Mounting on Wagner Test Stands

The FDI may be mounted on all Wagner test stands using the appropriate mounting kits. Refer to the Wagner sales catalog.

E.2 Mounting on other Test Stands

The FDI may be mounted on other test stands, using the appropriate mounting kit. Refer to the Wagner sales catalog.

E.3 Reversible Load Shaft

The FDI load shaft may be reversed from pointing up in the hand-held configuration, to pointing down in the test stand configuration. After separating the two modules, reverse the Force Cell Module 180° and reassemble. Refer to Section C.2.

F. POWER SUPPLY

The preferred source of power is determined by gage use. For portable use, battery power is preferred. For stationary use, the AC adapter is recommended.

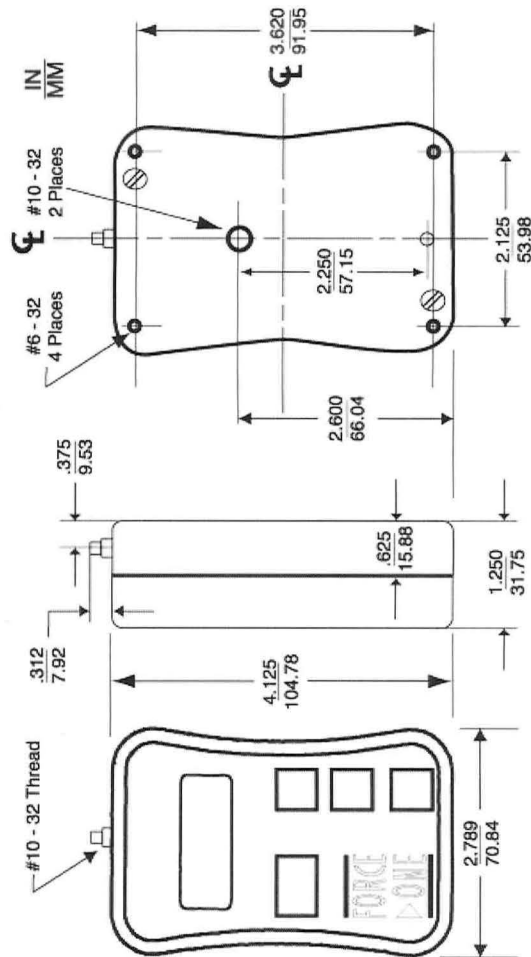
F.1 Battery

The FDI is powered by a rechargeable 7.2 Volt (9V form) Nickel Metal Hydride (NiMH) battery. With a full 10 hour charge, the NiMH battery will provide power up to 24 hours when used continuously on the 100 Hz setting. This can be extended by using the Auto-Off feature — see Section B.

When the display indicates low battery power — arrow points at LO BATT — the battery must be charged. With the AC adapter plugged in, the FDI is always charging whether turned on or off. The FDI will charge faster when turned off.

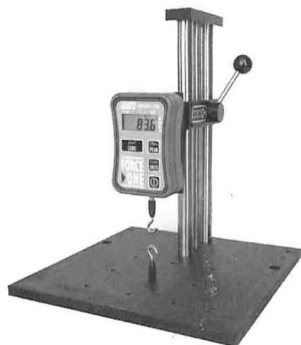
DIMENSIONS

FORCE ONE™ - MODEL FDI





Force One™ shown mounted on
Wagner FTC 100 Test Stand
(sold separately).



Force One™ shown mounted on
Wagner FTK 100 Test Stand
(sold separately).



FORCE ONE™ - MODEL FDI

WARRANTY

Wagner Instruments expressly warrants for one year from the date of purchase, that the goods sold shall be free from defects in workmanship and materials under normal conditions. Wagner Instruments will, at its option, replace, repair, or refund, in full, the purchase price of the instrument or any part thereof which, in our opinion, is defective, provided the instrument has not been subjected to tampering, abuse, or exposed to highly corrosive conditions. An instrument that has been improperly used cannot be considered under this warranty. We make no warranties, expressed or implied, including, without limitation, any warranties of fitness or merchantability, except as expressly set forth above. We shall not be liable for any anticipated lost profits, incidental damages, consequential damages, costs, time charges, or other losses in connection with the instrument or any replacement parts thereof. If a manufacturing defect is found, we will replace or repair the instrument, or replace any defective part thereof without charge; however, our obligation hereunder does not include the cost of transportation, which must be borne by the customer. We assume no responsibility for damage in transit, and the purchaser should present any claims for such damage to the carrier. In addition, instead of replacing or repairing the instrument, as aforesaid, we may, at our option, take back the defective instrument and refund, in full settlement, the purchase price thereof.

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