



FORCE ONE™ FDIX DIGITAL FORCE GAGE

OPERATION MANUAL

FORCE ONE™

FORCE ONE™ FDIX

Patented

PLUG 'N PLAY
DIGITAL FORCE GAGE



**MADE IN
USA**
CE

Patent Number 5,471,885

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

- FORCE CELL INTERCHANGE:** *FDIX uses a “Smart Load Cell” making it unnecessary to change capacity setting. FDIX recognizes the capacity of the Force Cell Module attached to it.*
- OVERLOADS:**
- ▶ *FDIX provides overload protection of its load cells. However, EXCESSIVE OVERLOADS or IMPACT LOADING will cause permanent damage.*
 - ▶ *Prior to reaching an overload condition, the FDIX displays “StoP”. Continuing to apply force to the FDIX will damage the Force Cell Module. For overload protection by model, see SPECIFICATIONS.*
 - ▶ *When HELP is displayed, it indicates:*
 - *Force Cell Module is not securely connected, or,*
 - *Force Cell Module is overloaded and damaged.*
- CORRECT LOADING:** *FDIX 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 Force Cell Module.*
- AC ADAPTER/CHARGER:** *Use only the AC adapter/charger supplied with FDIX. Using other adapter/charger units will damage the battery.*
- CABLE CONNECTION:** *Turn FDIX off before connecting or disconnecting a cable.*



FDX

OPERATION MANUAL

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**CONSTRUCTION**

- Patented Plug'n Play Design.
- FDMIX Force Display Module adapts to 7 FCMI Force Cell Modules.
- Tension and Compression with lbf, kgf, N and ozf units.
- Large 5 digit, 0.5" LCD.
- Displays: LO BAT, T, C, and PEAK.
- Split housing for upright display with shaft up or down.
- Compact firm grip aluminum housing.
- Made in the USA - Patented Design.
- Standard American threads.

OPERATION

- Change FCMI Force Cell Module to change gage capacity.
- Peaks captured at selectable 100 or 1000 samples/sec.
- Filtering of non-peak and peak readings.
- Bi-Directional USB/RS232 Interface.
- Four selectable baud rates: 4800, 9600, 19,200 or 38,400
- Single data point or continuous data output.
- Control of USB/RS232 data output from FDIX or computer.
- 500 data point memory storage.
- Remote firmware updates by user via e-mail.

POWER REQUIREMENTS

- Continuous AC operation with 110 or 220 VAC adapter/charger.
- Re-chargeable NiMH battery for up to 40 hours of operation.
- Auto-Off power conservation.

ACCESSORIES

- Re-chargeable NiMH battery, AC adapter/charger, two implements, USB cable and driver, case, manual and NIST Calibration Certificate.
- Optional accessories: Seven FCMI Force Cell Modules, RS232 cable, implements, grips, and test stand mounting kits.

ACCURACY

- Dedicated FCMI Force Cell Module: $\pm 0.2\%$ of full scale ± 1 L.S.D.
- Interchangeable FCMI Force Cell Modules: $\pm 0.3\%$ of full scale ± 1 L.S.D.

WEIGHT & DIMENSIONS

- 0.8 lb (.4 kg), shipping weight: 2 lb (.9 kg).
- 2 3/4" (70mm) w x 4" (100 mm) h x 1 1/4" (30mm) d.



FORCE ONE™ FDX FORCE GAGE

FEATURES

FORCE DISPLAY MODULE - FDMIX

Front Half
Electronics & Digital Display.

FORCE CELL MODULE - FCM1

Rear Half
Interchangeable Load Cell and Battery



Large 0.5"
5 Digit Display

Bi-Directional USB/RS232

500 Data Point
Memory

Re-chargeable 40 Hour
NiMH Battery & AC Power

Interchangeable
Force Cell Modules

Selectable 100 or 1000
Peak Sampling Rate

Firm Grip Design

Selectable
lbf/kgf/N/ozf

Overload Protection

Auto Calibration

Aluminum Housing



Patent Number 5,471,885

The **FDIX Digital Force Gage** provides the unique **patented ability to interchange various capacity Force Cell Modules** with a single force gage providing $\pm 0.3\%$ accuracy. If used with one Force Cell Module - one capacity - the accuracy is $\pm 0.2\%$.

The **FDIX** is a **general purpose force gage** intended for **hand-held or test stand use**. It can be used on motorized test stands, but is not intended for test stand control.

Several features add to **FDIX** usefulness and data quality. It provides **bi-directional USB/RS232 output** for logging data or plotting curves and **Auto-Calibration** permits calibration with only one test weight.

Expanded firmware includes **single data point** or **continuous data flow** to a computer, **500 data point memory storage** and **remote firmware updates** via download.

**TABLE 1 FDX DIGITAL FORCE GAGE & FORCE CELL MODULES**

FDIX MODEL	FCMI MODULE*	CAPACITY / GRADUATION				OVERLOAD PROTECTION TO	LOADSHAFT MOVEMENT AT CAPACITY
FDIX 2	FCMI 2	2 x 0.002 lbf	32 x 0.04 ozf	1 x 0.001 kgf	10 x 0.01 N	250 lbf	0.015"
FDIX 5	FCMI 5	5 x 0.005 lbf	80 x 0.1 ozf	2.5 x 0.002 kgf	25 x 0.02 N	250 lbf	0.011"
FDIX10	FCMI 10	10 x 0.01 lbf	160 x 0.2 ozf	5 x 0.005 kgf	50 x 0.05 N	250 lbf	0.007"
FDIX 25	FCMI 25	25 x 0.02 lbf	400 x 0.5 ozf	10 x 0.01 kgf	100 x 0.1 N	250 lbf	0.007"
FDIX 50	FCMI 50	50 x 0.05 lbf	800 x 1 ozf	25 x 0.02 kgf	250 x 0.2 N	250 lbf	0.007"
FDIX100	FCMI 100	100 x 0.1 lbf	1600 x 2 ozf	50 x 0.05 kgf	500 x 0.5 N	250 lbf	0.007"
FDIX 200	FCMI 200	200 x 0.2 lbf	3200 x 4 ozf	100 x 0.1 kgf	1000 x 1 N	400 lbf	0.005"

* Optional FCMI Force Cell Modules can be purchased separately and interchanged with all FDX Series Force Gages.

TABLE 2 FDX - OPTIONAL ACCESSORIES

MODEL	DESCRIPTION	MODEL	DESCRIPTION
FD/S-1	Steel Hook - Large (100 lbf)	FDIX/ CA110	RS232 Serial Cable
FD/B-1	Steel Hook - XL (200 lbf)	FDIX/ CA120	USB Cable & Driver
FD/S-2	Flat Head (5/8" diameter)	FD/ HDL	Aluminum Handles
FD/S-3	Cone Point	FD/ RT	Rubber Tip
FD/S-4	Chisel Head	FD/ CP2	2" Compression Plate
FD/S-5	Vee Tip	FD/NMH	NiMH Battery - 9V Size
FD/S-6	Extension Rod	FDI/AC110	AC Adapter - 110 Vac
FD/A-7	Hinged Hook - Small (20 lbf)	FDI/AC220	AC Adapter - 220 Vac
FD/S-7	Hinged Hook - Large (100 lbf)	FDIX/NIST	NIST Calibration Certificate
FD/A-8	Hinged Cradle - Small (20 lbf)		
FD/S-8	Hinged Cradle - Large (100 lbf)		





TABLE 3 FORCE ONE™ - TECHNICAL SPECIFICATIONS	
Item	Specification
Accuracy	Dedicated FCMI: $\pm 0.2\%$ F.S. ± 1 L.S.D.* Interchangeable FCMI: $\pm 0.3\%$ F.S. ± 1 L.S.D.**
Display	5 Digit, 0.5" Liquid Crystal Display (LCD)
Display Update	8 per second
Resolution	1000 graduations (1250 for 25 lbf capacity)
Tare	$\pm 10\%$ of Full Scale (FS)
Load Shaft Deflection	Varies by capacity - see page 6
Load Cell	Overload protected "Smart Load Cell"
Load Cell Interchangeability	Plug'n Play "Smart Load Cell"
Overload Protection	Varies by capacity - see page 6
Power	<ul style="list-style-type: none"> • 110 or 220 VAC Adapter/Charger • Rechargeable 7.2V NiMH battery (9V form)
Battery Endurance	Up to 40 hours at 100 Samples per second*** Up to 30 hours at 1000 Samples per second***
Battery Charge	10 hours for full charge
Calibration	Auto-Calibration - One full capacity weight
Peak Force Sampling Rate	Selectable: 100 Samples per second 1000 Samples per second
Digital Filter	<p>Non-Peak Mode: 100 Samples per second</p> <ul style="list-style-type: none"> • Routine Testing: Peak Off: 9 HZ Input Band Width • Rapid Event Testing: Peak On: 33 HZ Input Band Width <p>Peak Mode: 1000 Samples per second</p> <ul style="list-style-type: none"> • Routine Testing: Peak Off: 90 HZ Input Band Width • Rapid Event Testing: Peak On: 330 HZ Input Band Width
Menu Selection	<p>Menu selection of:</p> <ul style="list-style-type: none"> • AoFF - Automatic Off • PSS - Peak Sampling Rate • US-rS - USB / RS232 Output • StorE - Data Memory • L CAL - Auto-Calibration

* Dedicated and NIST certified for use with one FCMI.

** Fully interchangeable and NIST certified with multiple FCMI.

*** With 250 mAh NiMH battery installed.

A. KEYPAD**A.1 Keypad Description**

FDIX is operated with a five button keypad that controls all functions.

- ON/OFF**
- Turns FDIX on and off.
 - Self-tests display if held down when turning gage on.
 - At turn-on, display flashes Force Cell capacity and firmware 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 tare force or weight applied to the load shaft.

- SEND**
- Sends displayed data to memory storage or to FDX output port via USB/RS232.

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

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

Push/Hold UNITS until arrow moves to preferred force unit, quickly release. Unit selected will remain until changed.

Each of the above buttons, except ON/OFF and SEND also have set-up functions.

A.2 Keypad Control

Three black keypad buttons have the following additional functions:

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

- SELECT**
- Select displayed item.
 - Save selection.

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

Prior to actual test use, gain keypad and menu familiarity with practice.

B. Menu Operations
B.1 Menu Instructions

- Turn FDIx off.
- Push / Hold **ZERO**, push **On/OFF**.
- Release **On/OFF**, then **ZERO**, **AoFF** is displayed.
- **SCROLL** to review options: **AoFF**, **PSS**, **US -rS**, **StorE** and **LCAL**.
- **SELECT** to choose and move thru selections.

*Current setting is displayed. Push **SELECT** to retain that setting.*

- **SCROLL** to review selections - see Table 4, below.
- **SELECT** to choose, **donE** appears, current option is displayed again.
- Push **ESCAPE** to exit after options are selected or at anytime to exit menu.

*If factory default settings are preferred, move quickly thru the options and selections by repeatedly pushing **SELECT**.*

B.1.2 Menu Description

TABLE 4 MENU OPTIONS AND SELECTIONS		
Display	Option - Level One	Selections - Level Two
AoFF	Automatic Off	No* or 30 minutes
PSS	Peak Sampling Rate	<ul style="list-style-type: none"> • Sampling rate: 100 samples per second.* Input bandwidth: 9Hz in non-peak 33Hz in peak. • Sampling rate: 1000 samples per second. Input bandwidth: 90Hz in non-peak 330Hz in peak.
US -rS	USB/RS232 Set-Up	See D. Computer Interface - USB/RS232
StorE	Memory Set-Up	See E. Memory - Data Storage
L CAL	Auto - Calibration	See J.3 Auto-Calibration

* Factory default settings.

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.

B.1.3 Menu Options

Force Cell Capacity - *There is no menu option for capacity selection - simply “plug and play”. The “Smart Load Cell” capacity is immediately recognized by FDIX and displayed when the power is turned on.*

- 1) **AoFF** Automatic-Off - Useful for battery power conservation.
FDIX automatically shuts off after a period if no buttons are pressed:
No Operates continuously, no automatic-off, consumes more battery power.
30 Shuts off after 30 minutes of inactivity, conserves battery power.
- 2) **PSS** Peak Sampling Rate and Filter.
FDIX provides selectable peak sampling rates and corresponding filtering.

▶ **Routine Testing**

Peak sampling rate of 100/sec is preferable for slowly occurring events and significantly reduces battery power consumption.

▶ **Rapid Event Testing**

Peak sampling rate of 1000/sec is required to capture peaks of rapidly occurring events and break tests. The FDIX takes 1000 “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 electromagnetic interference.

▶ **Filter Settings**

Filtering is simultaneously set with peak sampling rate as follows:

100 Samples/Second

- Routine Testing - Peak Off: 9 Hz Input Band Width
- Rapid Event Testing - Peak On: 33 Hz Input Band Width

1000 Samples Per Second

- Routine Testing - Peak Off: 90 Hz Input Band Width
- Rapid Event Testing - Peak On: 330 Hz Input Band Width

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.

**3) US -rS** USB/RS232 Communication Set-Up

FDIX is a bi-directional USB/RS232 force gage. The FDIX menu permits setup of the following parameters:

Table 5 USB/RS232 Communication Set-Up		
Display	Description	Selection Options
US-rS	Activation:	On or OFF*
bAud	Baud Rate:	4800, 9600* , 19200 or 38400
LEnth	Word Length:	7 or 8* bits
StoPb	Stop Bits:	1* or 2 bits
PArit	Parity:	nonE* , odd or EuEn
Func	Function**:	1* , 2, 3, 4, 5, 6, 7, or 8
trAnS	Transmission:	SGLPt* (Single Point) or Cont (Continuous)
SEnd	Send	On* or OFF

* Factory default settings are indicated in bold with asterisk.

** Function provides selection of computer keyboard command protocol - See D.4.3, Page 16.

4) StorE Memory Set-up

FDIX memory providing 500 data point storage. See E.

5) L CAL Auto - Calibration

FDIX features "Smart Load Cell" calibration for verification and adjustment without returning it to the factory. See J.

**C. GAGE OPERATIONS****C.1 Force Measuring - Non-Peak and Peak Modes**

- **Non-Peak Mode** FDIX displays **instantaneous force** being applied.
- **Peak Mode** FDIX displays highest peak tension or compression force applied since peak memory was last cleared.

FDIX continuously measures instantaneous tension and compression forces and continuously captures peak tension and compression forces. Thus, peak values are always available in both non-peak and peak modes.

C.1.1 Non-Peak Mode

Force values displayed vary with the instantaneous force applied. Use FDIX in this mode for monitoring applied force as it varies.

At any time tension or compression peaks are needed, they may be recalled - see below.

- **Enter Non-Peak Mode** Push **PEAK** repeatedly until arrow pointing at **PEAK** disappears, push **ZERO** to clear the gage.
- **Run Test** Apply push or pull force, the gage tracks and displays applied force.
- **Recall Peaks** Push **PEAK** to display compression and tension peaks.
- **Clear Peak Memory** Push **ZERO** while arrow points at **PEAK**.
- **Return to Non-Peak** Push **PEAK**.

It is important to note that the peak value retrieved is not necessarily the peak from the last test excursion, it is the highest peak since peak memory was last cleared.

C.1.2 Peak Mode

Force values displayed by FDIX 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 from the series of tests.

- **Enter Peak Mode** Push **PEAK** then push **ZERO** to clear peak memory. Display defaults to **C** and **PEAK**.
- **Run Compression Test** With arrows pointing at **C** and **PEAK**. Begin compression test by applying push force. Peak force is displayed. If a higher force is applied, that peak force is displayed.
- **Run Tension Test** Push **PEAK** until arrows point at **T** and **PEAK**. Begin tension test by applying pull force. Peak force is displayed. If a higher force is applied, that peak force is displayed.
- **Recall Peaks** Push **PEAK** repeatedly to display compression and tension peaks.
- **Return to Non-Peak** Push **PEAK**.

Prior to actual test use, practice FDIX non-peak and peak modes to gain familiarity.

FDIX in non-peak or peak mode, is continuously measuring instantaneous force applied and continuously capturing peaks.

Peaks can be recalled in non-peak as well as peak modes.

D. USB/RS232 COMPUTER INTERFACE

FDIX provides control of USB/RS232 output at the gage keypad or computer keyboard.

D.1 USB/RS232 Bi-directional FDIX Operation

USB/RS232 bi-directional operation permits operator to change settings, zero the gage and transmit filtered displayed data points from the gage keypad or the computer keyboard.

- **Single Data Point Transmission** - one data point at a time - is configured and initiated at FDIX keypad or configured and initiated at computer keyboard.
- **Continuous Data Transmission** - constant data flow - is configured and initiated at FDIX keypad or configured and initiated at computer keyboard.

D.2 Single Data Point Transmission - USB/RS232

Single data point transmission to computer is provided with all FDIX Version 3.3.3 or above and is controlled at the FDIX keypad or at a computer keyboard.

D.2.1 Gage Initiated - Configured and Initiated at FDIX keypad.

D.2.2 Menu Instructions

- Turn FDIX off.
- Push / Hold **ZERO**, push **On/OFF**.
- Release **On/OFF**, then **ZERO**, **AoFF** is displayed.
- **SCROLL** to review options: **AoFF**, **PSS**, **US-rS**, **StorE** and **LCAL**.
- **SELECT US-rS**, **On** or **OFF** appears. **SCROLL** to and **SELECT On**.
- Selecting **On** puts FDIX into USB/RS232 mode with the parameters and settings displayed by repeatedly pushing **SELECT**: **bAud** (Baud Rate), **LEnth** (Word Length), **StoPb** (Stop Bits), **PArit** (Parity), **Funct** (Function), **trAnS** (Transmission) and **SEnd** (Send).

Data transmission factory default settings are listed at B.1.3(3), Page 11.

If factory default settings are preferred, move quickly thru the parameters and settings by repeatedly pushing SELECT.

- **bAud** appears first. Push **SELECT**, current setting appears, **SCROLL** to view settings, **SELECT** to choose, next parameter appears.
- At **trAnS**, push **SELECT**, **SCROLL** to and **SELECT SGLPt** for single data point transmission, **SEnd** appears.
- **SELECT SEnd**, **SCROLL** to and **SELECT On**, **donE** then **US-rS** appears. Push **ESCAPE** to return to operations for the first data point transmission.

D.3 Continuous Data Transmission - USB/RS232

Continuous data point transmission is provided with all FDIX Version 3.3.3 or above and is controlled at the FDIX keypad or at a computer keyboard.

D.3.1 Gage Initiated - Configured and initiated at FDIX keypad.

D.3.2 Menu Instructions

- Turn FDIX off.
- Push/Hold **ZERO**, push **On/OFF**.
- Release **On/OFF**, then **ZERO**, **AoFF** is displayed.
- **SCROLL** to review options: **AoFF**, **PSS**, **US-rS**, **StorE** and **LCAL**.
- **SELECT US-rS**, **On** or **OFF** appears. **SCROLL** to and **SELECT On**.
- Selecting **On** puts FDIX into USB/RS232 mode with the parameters and settings displayed by repeatedly pushing **SELECT**: **bAud** (Baud Rate), **LEnth** (Word Length), **StoPb** (Stop Bits), **PArit** (Parity), **Funct** (Function), **trAnS** (Transmission) and **SEnd** (Send).
- With all settings at factory default or previously selected, proceed thru the parameters and settings by repeatedly pushing **SELECT**.
- **bAud** appears first, **SELECT trAnS**, **SCROLL** and **SELECT Cont** (continuous data transmission).
- With selection of **Cont**, the following parameters appear and settings must be selected.

rAtE **SELECT**, **SCROLL** to and **SELECT** a sample rate:
Sr 0.5, Sr 1, Sr 2, Sr 5, Sr 10, Sr 20, Sr 50, Sr100/sec.

InCLO **SELECT** to include or exclude zero data, **SCROLL** to and
SELECT O On or **O OFF**, **SEnd** appears.

- **SELECT SEnd**, **SCROLL** to and **SELECT On**, **donE** then **US-rS** appears. Push **ESCAPE** to return to operations for the first data point transmission.

D.4 Computer Keyboard Control: Single Data Point - Continuous - Memory

FDIX single data point, continuous or memory transmission can be configured and initiated at computer keyboard. Any software package that receives data from a standard com port is compatible. Others that cannot, e.g., Excel, will need a keyboard wedge.

D.4.1 Computer Initiated - Configured at FDIX keypad and computer keyboard, initiated at computer keyboard.**D.4.2 USB/RS232 Keyboard Protocol Selection and Commands****D.4.3 Menu Instructions**

- Turn FDIX off.
- Push / Hold **ZERO**, push **On/OFF**.
- Release **On/OFF**, then **ZERO**, **AoFF** is displayed.
- **SCROLL** to review options: **AoFF**, **PSS**, **US-rS**, **StorE** and **LCAL**.
- **SELECT US-rS**, **On** or **OFF** appears. **SCROLL** to and **SELECT On**.
- Selecting **On** puts FDIX into USB/RS232 mode with the parameters and settings displayed by repeatedly pushing **SELECT**: **bAud** (Baud Rate), **LEnth** (Word Length), **StoPb** (Stop Bits), **PArit** (Parity), **Funct** (Function), **trAnS** (Transmission) and **SEnd** (Send).

Data transmission factory default settings are listed at B.1.3(3), Page 11.

If factory default settings are preferred, move quickly thru the parameters and settings by repeatedly pushing SELECT.

- **bAud** appears first. Push **SELECT**, current setting appears. **SCROLL** to view settings, **SELECT** to choose: next parameter appears.
- At **Funct**, push **SELECT**, **SCROLL** to and **SELECT** the preferred function from the following list which simultaneously selects protocol:

Function	Function	Characteristics	Example
1	5	Minus sign sent as -	- 0025.0 lb
2	6	Minus sign sent as “-”	“-” 0025.0 lb
3	7	Minus sign sent as -	- 0025.0
4	8	Minus sign sent as “-”	“-” 0025.0

Selection of Functions 1 - 4 also provides access to commands exclusive for remote FDIX control from the computer keyboard.

Selection of Functions 5 - 8 also provides access to another command structure used for interfacing with force gage software of another manufacturer - contact Wagner Instruments for details.



- At **trAnS**, push **SELECT**, **SCROLL** to and **SELECT SGLPt** (single data point) or **Cont** (continuous) transmission, **SEnd** appears.
- **SELECT SEnd**, **SCROLL** to and **SELECT On** or **OFF**, **donE** then **US-rS** appears. Push **ESCAPE** to return to operations for computer keyboard transmission control.

D.4.4 USB/RS232 Keyboard Commands

- Proceed using the following commands:

COMMAND - Not Case Sensitive**DESCRIPTION****Single Force Data Point**

FZ	<u>Z</u> ero gage - Set gage to zero
FR	R <u>e</u> set gage - Turns gage off then on
F	S <u>e</u> nd single force data point (Force displayed, not instantaneous)
I	S <u>e</u> nd single force data point (Instantaneous force, independent of force data displayed)

Continuous Force Data Flow

C.5, C1, C2, C5, C10, C20, C50, C100	S <u>e</u> t samples per second
CA	I <u>n</u> clude zeros - Set <u>a</u> ll continuous data flow
CX	E <u>x</u> clude zeros - Set over 2% continuous data flow
CB	<u>B</u> egin continuous data - Start continuous data flow
CE	<u>E</u> nd continuous data - Stop continuous data flow

Data Point Memory

MA	S <u>e</u> nd <u>a</u> ll data points in memory
MZ	<u>Z</u> ero database - Go to beginning of database
MC	M <u>e</u> mo <u>r</u> y <u>c</u> ount - Send number of data points
MN	S <u>e</u> nd <u>n</u> ext data point
MK	S <u>k</u> ip next data point

Units

UL	S <u>e</u> t <u>L</u> B (lbf)
UK	S <u>e</u> t <u>K</u> G (kgf)
UN	S <u>e</u> t <u>N</u> EWTON (N)
UO	S <u>e</u> t <u>O</u> Z (ozf)

Peak Force Data

PN	S <u>e</u> t <u>N</u> on - Peak
PT	S <u>e</u> t <u>T</u> ension Peak
PC	S <u>e</u> t <u>C</u> ompression Peak

Notes:

- Unrecognized commands will be responded with "?".
- All commands must be followed by ENTER (Carriage Return).

E. Memory - Data Storage

FDIX Memory provides storage of 500 data points in memory for later retrieval. A data point can be saved or sent to computer by pushing **FDIX SEND**. Data points are retrieved and reviewed on the display or sent by USB/RS232 to a computer. Data points in memory can be retrieved from the computer keyboard - see E.6.

DEFINITIONS

Force Units	A system for quantifying force - lbf, ozf, kgf, N.
Data Point	Results of a test performed producing an instantaneous peak compression or peak tension data point expressed in force units.
Instantaneous Force	The force currently applied to force gage expressed in force units.
Peak Force	The maximum compression or tension force applied during one test expressed in force units.

E.1 Memory Display

Four flashing arrows indicate the currently displayed memory item:

- 1 - Data Point Number - 500 consecutively numbered data points
- 2 - Instantaneous force with unit of force.
- 3 - Compression Peak force with a unit of force.
- 4 - Tension Peak force with unit of force.

E.2 Menu Instructions

SEND is used to send data points to FDIX memory or to computer by USB/RS232.

To set up **SEND** mode:

- Turn **FDIX** off.
- Push/Hold **ZERO**, push **ON/OFF**
- Release **ON/OFF** then **ZERO**, **AOFF** is displayed.
- **SCROLL** to and **SELECT StorE**, **rdAtA** appears.
- **SCROLL** to and **SELECT SEnd**.
- **On** or **OFF** appears.
- **SCROLL** to and **SELECT On** to send to FDIX memory.
- **donE** is flashed, then **StorE**.
- Press **ESCAPE** to proceed with memory operations.

SEND is enabled in US-rS or StorE, but not at the same time. If SEND is On in US-rS, SEND is OFF in StorE and vice-versa. SEND can be set OFF for both US-rS and StorE.

E.3 Memory Save Operation

Data points are saved in memory at the FDIX keypad only, but retrieved at FDIX keypad or computer keyboard.

E.3.1 Gage Initiated - Configured and Initiated at FDIX Keypad

After memory set-up is complete (E.2), proceed with memory save operations, performing force tests and storing data points in memory.

- Push **PEAK**: to **SCROLL** to **T PEAK** or **C PEAK** (tension or compression).
- Push **ZERO** and begin force test #1.
- Upon completion of force test #1, the data point is displayed.
- Push **SEND** to store data point. **Save** is flashed, then data point number, 1.
- Continue to send data points: 2, 3, 4 etc. as required.

Data points remain in memory until cleared at FDIX keypad (See E.5).

E.4 Data Review

E.4.1 Menu Instructions

To enter data review:

- Turn FDIX off.
- Push/Hold **ZERO**, push **ON/OFF**.
- Release **ON/OFF** then **ZERO**, **AoFF** is displayed.
- **SCROLL** to **StorE**.
- Push **SELECT**, **rdAtA** is displayed.
- **SELECT**. **Data point number** is displayed, and **first arrow flashes**.
- **SCROLL**. **Instantaneous value** is displayed, and **second arrow flashes**.
- **SCROLL**. **Compression peak value** is displayed, and **third arrow flashes**.
- **SCROLL**. **Tension peak value** is displayed, and **fourth arrow flashes**.
- **SCROLL**. **Data point number** for next data point is displayed.
- **SCROLL**. **Review** additional saved data points.
- **End** appears when all values have been displayed.

SEND is also used for **REVERSE SCROLL**. Pressing **SEND** will display the previous data point or data point number. The flashing arrow will be updated to indicate the data point number being displayed.

E.5 Data Clear**E.5.1 Clear All Data (CL dt)**

To clear all data in memory:

- Turn FDIX off.
- Push/Hold **ZERO**, push **ON/OFF**.
- Release **ON/OFF** then **ZERO**, **AoFF** is displayed.
- **SCROLL** to and **SELECT StorE**, **rdAtA** is displayed.
- **SCROLL** to **CL dt** (Clear all data).
- Push and hold **SEND** (approximately 5 seconds) until **CLrd** is displayed.
- Push **ESCAPE** twice to return to operations.

E.5.2 Clear Last Data Point (CL Pt)

To clear last data point in memory:

- Turn FDIX off.
- Push/Hold **ZERO**, push **ON/OFF**.
- Release **ON/OFF** then **ZERO**, **AoFF** is displayed.
- **SCROLL** to and **SELECT StorE**, **rdAtA** is displayed.
- **SCROLL** to **CL Pt** (Clear last data point).
- Push and hold **SEND** (5 seconds) until **CLrd** is displayed.
- Push **ESCAPE** twice to return to operations.

E.6 Computer Keyboard Control - Data Point Memory**E.6.1 Commands - FDIX Protocol (Functions 1 - 4)****COMMAND DESCRIPTION**

MA	Send all data points in memory.
MZ	Go to beginning of memory. Gage returns "Pass" or "Empty".
MC	Send number of data points in memory.
MN	Send next data point record. Gage sends data points or "Empty", "End" or "Full".
MK	Skip next data point record. Gage sends data points or "Empty", "End" or "Full".

USB/RS232 data is returned in the following format:

[Data Point Number], [Instantaneous force value], [Compression peak value],
[Tension peak value] [CR] [LF]

F. USB/RS232 Communications

FDIX has force data transmission in USB/RS232 format only - no analog or other data output is available.

F.1 USB/RS232 Transmission

FDIX force values displayed are those transmitted or in memory. USB/RS232 data is transmitted as individual data points or continuously to 100 data points per second with the following parameters.

Table 5 USB/RS232 Communication Set-Up		
Display	Description	Selection Options
US-rS	Activation:	On or OFF*
bAud	Baud Rate:	4800, 9600* , 19200 or 38400
LEnth	Word Length:	7 or 8* bits
StoPb	Stop Bits:	1* or 2 bits
PArit	Parity:	nonE* , odd or EuEn
Funct	Function**:	1* , 2, 3, 4, 5, 6, 7, or 8
trAnS	Transmission:	SGLPt* (Single Point) or Cont (Continuous)
SEnd	Send	On* or OFF

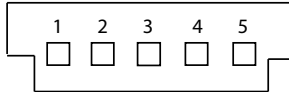
* Factory default settings are indicated in bold with asterisk.

** Function provides selection of computer keyboard command protocol - See D.4.3.

G. USB/RS232 Pin Assignments

The 5 contact USB type connector is located on the left side of the FDIX. USB or RS232 data is automatically transmitted depending upon the cable connected: USB via FDIX/CA120 or RS232 via FDIX/CA110

The contact assignments are:



PIN	SYMBOL	DESCRIPTION	COLOR
1	NOT USED	NOT USED	NONE
2	TX*	TRANSMIT DATA*	WHITE
3	RX**	RECEIVE DATA**	GREEN
4	NOT USED	NOT USED	NONE
5	GND	GROUND	BLACK

*Transmit data from FDIX to PC.

**Receive data from PC to FDIX.

H. Interchanging Force Cell Modules

The FDIX Force Gage provides the unique patented ability to interchange various capacity Force Cell Modules of a single force gage. One Force Display Module provides the electronic control and display for up to seven Force Cell Modules.

H.1 Module Description

The FDIX consists of two modules:

- **Force Display Module (FDMIX)** contains the display electronics and keypad. All control functions are initiated by keypad entry or by computer keyboard with control information and data displayed on the LCD screen.
- **Force Cell Module (FCMI)** contains the load cell and battery in a load bearing structure. Applied force data is sent from the FCMI to the FDMIX through an internal center connector that also carries power to the FDMIX. The center connector provides quick removal of the FCMI for replacement and easy FCMI rotation to change the load shaft direction from up to down.

H.2 Connecting a Force Cell Module (FCMI)

- Back out the two captive screws of the FCMI.
- Detach the FCMI by carefully easing the two halves apart.
- To re-attach the FCMI or replace it with another FCMI, align the center connector by aligning the edges of the two FDIX halves and gently squeeze together.
- Drive the screws in, turn the gage on to confirm that FDIX functions and proceed.

Since the FDIX uses a “Smart Load Cell”, it is unnecessary to change any capacity setting. The FDMIX recognizes the capacity of the FCMI attached to it.

H.3 Overload Protection

- Each FCMI is protected against overload.
- Prior to reaching overload limits of the load cell, the gage will indicate an overload condition by displaying **StoP**.
- See Table 1 on page 6 for the safe overload limit of each FDIX Force Gage.

J. Calibration

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

J.1 Procedure Description

- **Verification - Testing Calibration** - Certified lb or kg test weights are applied in tension and compression to determine if the FDX can be certified and if the calibration procedure is necessary.
- **Calibration** - The FDX has **Auto-Calibration** enabling the gage to be calibrated by one full capacity lb or kg test weight.

J.2 Verification - Testing Calibration

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

To verify, a five-point tension and compression test is recommended with weights equal to 20%, 40%, 60%, 80%, and 100% of FDX capacity. If the displayed weight differs more than $\pm 0.2\%$ of full scale ± 1 L.S.D. (Dedicated) or $\pm 0.3\%$ of full scale ± 1 L.S.D. (Interchangeable), the FDX is out of tolerance.

Accuracy verification requires testing fixtures: a test stand capable of supporting weights equal to the FDX capacity either - lb or kg test weights - and fixtures for applying test weights in tension and compression. Testing fixtures are available from Wagner Instruments.

FDX accuracy depends on the Force Cell Module (FCMI) and Force Display Module (FDMIX) meeting the specified tolerance. Therefore, each interchangeable FCMI in use must be tested with the FDMIX to verify accuracy.

If any combination of FDMIX and FCMI units are out-of-tolerance, Auto-Calibration of the FDX is necessary. To restore accuracy, proceed to J.3, Auto-Calibration.

J.3 Auto-Calibration (L CAL)

Auto-Calibration is applied if FDIX is used with one or more Force Cell Modules (FCMI). The procedure is used to return the FDIX to its specified accuracy after verification indicates the FDIX is out of tolerance, or if obvious that readings are incorrect.

Certified NIST traceable test weights are recommended, resulting in an NIST Calibration Certificate. Test weights are available from Wagner Instruments.

Unless FDIX is tested with J.2 Verification and an NIST Calibration Certificate issued, FDIX is not certified to NIST standards. Auto-Calibration is adequate for returning FDIX to specified accuracy for certified or non-certified use.

After Auto-Calibration, FDIX accuracy should be confirmed using J.2 Verification.

J.3.1 Auto-Calibration (LCAL) Procedure

Test weights must match the Force Cell Module capacity to be tested.

Set UNITS to lbf or kgf - calibrations are performed in pounds (lbf) or kilograms (kgf).

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

Attach hook and any fixtures, but no test weights.

Enter the set-up menu:

- Turn FDIX off.
- Push / Hold **ZERO**; push **ON/OFF**.
- Release **ON/OFF**, then **ZERO**, **AOFF** is displayed.

Gage set-up:

- **SCROLL** to **L CAL** option.
- Push **SELECT** - FDIX displays **null**.
- Push **SELECT** - FDIX displays a force cell capacity after zero flashes.

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

Calibrate:

- Apply full-scale weight matching the display - in pounds (lb) or kilograms (kg).
- Push **SELECT** with weight applied and movement stopped.
- FDIX displays applied weight indicating successful calibration.

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

Calibration Accepted:

- FDIX displays the actual applied weight indicating successful calibration. If **uuuuu (under)** or **nnnnn (over)** is displayed the weight is not accepted, or other problems exist - see Calibration Rejected (below).

Verification is recommended by applying weights to check accuracy at various points of FDIX range.

- To exit calibration push **SELECT** when FDIX full-scale capacity is displayed or at anytime during or after the five point weight test.
- FDIX flashes **donE** and returns to normal operation.
- Auto-Calibration is complete and FDIX is ready for use.

Calibration Rejected:

- If the weight is not accepted, the display shows **uuuuu (under)** or **nnnnn (over)**. Verify weight applied matches the FDIX capacity.
- If the weight used does not match FDIX capacity, repeat J.3.1 Auto-Calibration with an accurate full scale weight.
- If **uuuuu** or **nnnnn** is displayed again after repeating Auto-Calibration, the Force Display Module or Force Cell Module may be defective or damaged. Call Wagner Instruments for instructions.

K. Mounting Information

FDIX is mounted on most popular light capacity test stands using the threaded mounting holes on the back side of FDIX - See Dimensions, page 31.

K.1 Mounting on Wagner Test Stands

FDIX is mounted on Wagner test stands using the included mounting kit.

K.2 Mounting on other Test Stands

FDIX is mounted on other test stands, using mounting kits available from Wagner.

K.3 Reversible Load Shaft

The FDIX load shaft may be reversed from pointing up for hand-held use, to pointing down for test stand use.

- Back out the two captive screws of the FCMI.
- Detach the FCMI by carefully easing the 2 halves apart.
- Rotate the FCMI 180° for the configuration you require.
- To re-attach the FCMI or replace it with another FCMI, align the center connector by aligning the edges of the two halves and gently squeeze together.
- Drive the screws in, turn the gage on to confirm FDIX functions and proceed.

L. Power Supply

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

L.1 Battery and AC Adapter

The FDIX is powered by a rechargeable 9 Volt form Nickel Metal Hydride (NiMH) battery. With a 10 hour charge, the NiMH battery provides power up to 40 hours used continuously on the 100 Hz setting. This is extended by using Auto-Off - see B.1.3, Page 10.

Low battery power is indicated on the display with an arrow pointing at LO BAT. With the AC adapter plugged in, FDIX is charging when turned on or off and charges faster when off.

**TABLE 1 FDX DIGITAL FORCE GAGE & FORCE CELL MODULES**

FDIX MODEL	FCMI MODULE*	CAPACITY / GRADUATION				OVERLOAD PROTECTION TO	LOADSHAFT MOVEMENT AT CAPACITY
FDIX 2	FCMI 2	2 x 0.002 lbf	32 x 0.04 ozf	1 x 0.001 kgf	10 x 0.01 N	250 lbf	0.015"
FDIX 5	FCMI 5	5 x 0.005 lbf	80 x 0.1 ozf	2.5 x 0.002 kgf	25 x 0.02 N	250 lbf	0.011"
FDIX10	FCMI 10	10 x 0.01 lbf	160 x 0.2 ozf	5 x 0.005 kgf	50 x 0.05 N	250 lbf	0.007"
FDIX 25	FCMI 25	25 x 0.02 lbf	400 x 0.5 ozf	10 x 0.01 kgf	100 x 0.1 N	250 lbf	0.007"
FDIX 50	FCMI 50	50 x 0.05 lbf	800 x 1 ozf	25 x 0.02 kgf	250 x 0.2 N	250 lbf	0.007"
FDIX100	FCMI 100	100 x 0.1 lbf	1600 x 2 ozf	50 x 0.05 kgf	500 x 0.5 N	250 lbf	0.007"
FDIX 200	FCMI 200	200 x 0.2 lbf	3200 x 4 ozf	100 x 0.1 kgf	1000 x 1 N	400 lbf	0.005"

* Optional FCMI Force Cell Modules can be purchased separately and interchanged with all FDX Series Force Gages.

TABLE 2 FDX - OPTIONAL ACCESSORIES

MODEL	DESCRIPTION	MODEL	DESCRIPTION
FD/S-1	Steel Hook - Large (100 lbf)	FDIX/ CA110	RS232 Serial Cable
FD/B-1	Steel Hook - XL (200 lbf)	FDIX/ CA120	USB Cable & Driver
FD/S-2	Flat Head (5/8" diameter)	FD/ HDL	Aluminum Handles
FD/S-3	Cone Point	FD/ RT	Rubber Tip
FD/S-4	Chisel Head	FD/ CP2	2" Compression Plate
FD/S-5	Vee Tip	FD/NMH	NiMH Battery - 9V Size
FD/S-6	Extension Rod	FDI/AC110	AC Adapter - 110 Vac
FD/A-7	Hinged Hook - Small (20 lbf)	FDI/AC220	AC Adapter - 220 Vac
FD/S-7	Hinged Hook - Large (100 lbf)	FDIX/NIST	NIST Calibration Certificate
FD/A-8	Hinged Cradle - Small (20 lbf)		
FD/S-8	Hinged Cradle - Large (100 lbf)		





TABLE 3 FORCE ONE™ - TECHNICAL SPECIFICATIONS	
Item	Specification
Accuracy	Dedicated FCMI: $\pm 0.2\%$ F.S. ± 1 L.S.D.* Interchangeable FCMI: $\pm 0.3\%$ F.S. ± 1 L.S.D.**
Display	5 Digit, 0.5" Liquid Crystal Display (LCD)
Display Update	8 per second
Resolution	1000 graduations (1250 for 25 lbf capacity)
Tare	$\pm 10\%$ of Full Scale (FS)
Load Shaft Deflection	Varies by capacity - see page 6
Load Cell	Overload protected "Smart Load Cell"
Load Cell Interchangeability	Plug'n Play "Smart Load Cell"
Overload Protection	Varies by capacity - see page 6
Power	<ul style="list-style-type: none"> • 110 or 220 VAC Adapter/Charger • Rechargeable 7.2V NiMH battery (9V form)
Battery Endurance	Up to 40 hours at 100 Samples per second*** Up to 30 hours at 1000 Samples per second***
Battery Charge	10 hours for full charge
Calibration	Auto-Calibration - One full capacity weight
Peak Force Sampling Rate	Selectable: 100 Samples per second 1000 Samples per second
Digital Filter	Non-Peak Mode: 100 Samples per second <ul style="list-style-type: none"> • Routine Testing: Peak Off: 9 HZ Input Band Width • Rapid Event Testing: Peak On: 33 HZ Input Band Width Peak Mode: 1000 Samples per second <ul style="list-style-type: none"> • Routine Testing: Peak Off: 90 HZ Input Band Width • Rapid Event Testing: Peak On: 330 HZ Input Band Width
Menu Selection	Menu selection of: <ul style="list-style-type: none"> • AoFF - Automatic Off • PSS - Peak Sampling Rate • US-rS - USB / RS232 Output • StorE - Data Memory • L CAL - Auto-Calibration

* Dedicated and NIST certified for use with one FCMI.

** Fully interchangeable and NIST certified with multiple FCMI.

*** With 250 mAh NiMH battery installed.

**CONSTRUCTION**

- Patented Plug'n Play Design.
- FDMIX Force Display Module adapts to 7 FCMI Force Cell Modules.
- Tension and Compression with lbf, kgf, N and ozf units.
- Large 5 digit, 0.5" LCD.
- Displays: LO BAT, T, C, and PEAK.
- Split housing for upright display with shaft up or down.
- Compact firm grip aluminum housing.
- Made in the USA - Patented Design.
- Standard American threads.

OPERATION

- Change FCMI Force Cell Module to change gage capacity.
- Peaks captured at selectable 100 or 1000 samples/sec.
- Filtering of non-peak and peak readings.
- Bi-Directional USB/RS232 Interface.
- Four selectable baud rates: 4800, 9600, 19,200 or 38,400
- Single data point or continuous data output.
- Control of USB/RS232 data output from FDIX or computer.
- 500 data point memory storage.
- Remote firmware updates by user via e-mail.

POWER REQUIREMENTS

- Continuous AC operation with 110 or 220 VAC adapter/charger.
- Re-chargeable NiMH battery for up to 40 hours of operation.
- Auto-Off power conservation.

ACCESSORIES

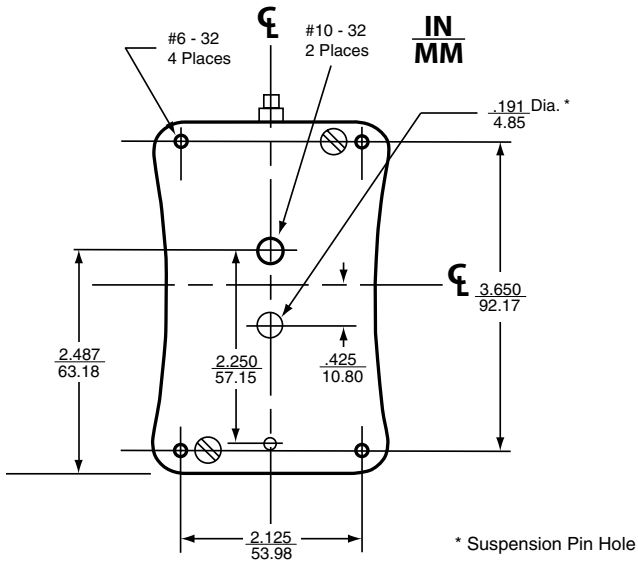
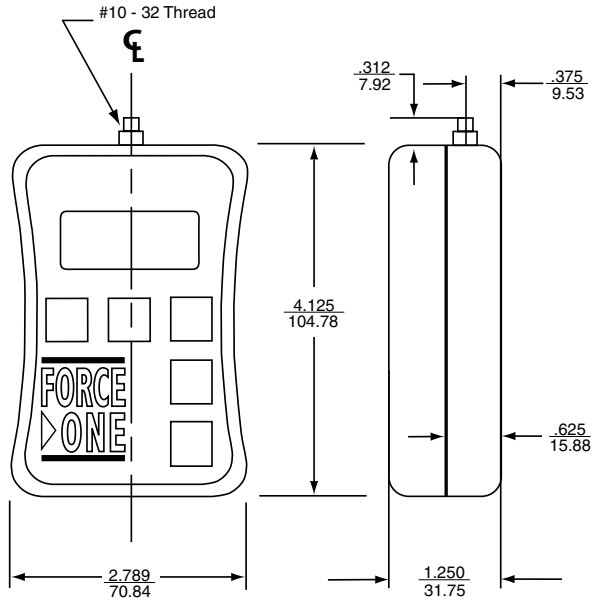
- Re-chargeable NiMH battery, AC adapter/charger, two implements, USB cable and driver, case, manual and NIST Calibration Certificate.
- Optional accessories: Seven FCMI Force Cell Modules, RS232 cable, implements, grips, and test stand mounting kits.

ACCURACY

- Dedicated FCMI Force Cell Module: $\pm 0.2\%$ of full scale ± 1 L.S.D.
- Interchangeable FCMI Force Cell Modules: $\pm 0.3\%$ of full scale ± 1 L.S.D.

WEIGHT & DIMENSIONS

- 0.8 lb (.4 kg), shipping weight: 2 lb (.9 kg).
- 2 3/4" (70mm) w x 4" (100 mm) h x 1 1/4" (30mm) d.





Force One™ FDX shown mounted on Wagner FTK 100 Test Stand

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.

**WAGNER INSTRUMENTS**

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