



**LOAD CONTROL**  
TECHNOLOGIES  
an Innovation Plus LLC Company



**i-Bolt**<sup>®</sup>  
*integrity*

Fastener Systems

**All bolts... All tools...  
All industries... ONE SOLUTION.**



# Load Control Technologies (LCT) i-Bolt® Fastener Systems

## Bolted Joints... the problem

A low level of confidence exists in bolted joint operations for the automotive, aerospace, construction, rail, nuclear and petrochemical industries. Even though these are among the most common and most critical assembly procedures, they rely on indirect estimates of clamp load such as torque, torque-angle or yield. These methods produce fastener installed load variations from  $\pm 15\%$  up to  $\pm 50\%$  regularly, resulting in joint failure.

Most joint failures are the result of insufficient or inconsistent clamp load at assembly. Problems such as bolt fatigue and vibration loosening, which account for over 75% of all bolted joint failures, can usually be prevented by achieving and maintaining a correct level of clamp load in the joint. In addition, torque based techniques do not allow for post-assembly direct load inspections.

## the solution...

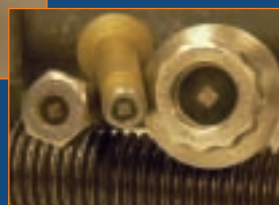
The Load Control Technologies (LCT) i-Bolt® Fastener Systems platform has taken proven ultrasonics and made them reliable, user friendly, 100% repeatable and ready for tightening with any type of tool. Tools are now controlled by measuring clamp load directly in the fastener with typical tightening accuracy of  $\pm 3\%$  ( $3\sigma$ ) independent of the operator. i-Bolt® Fastener Systems also provide the capability to inspect load in the actual joint with zero disturbance and  $\pm 5\%$  ( $3\sigma$ ) accuracy through the life cycle of the bolt.

The i-Bolt® Fastener System includes:

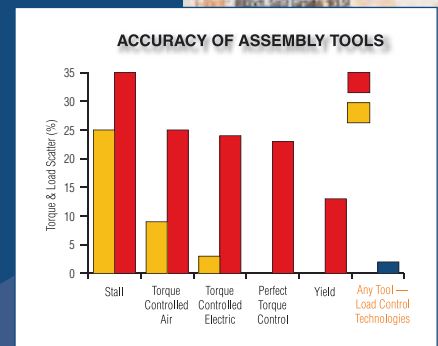
**CUSTOMER BOLTS, LOADMASTER® CONTROL ELECTRONICS, ASSEMBLY TOOLS**



- Inspect load in the actual joint with zero disturbance and  $\pm 5\%$  ( $3\sigma$ ) accuracy through the life cycle of the bolt.



- Tighten to desired load with any type of tool and achieve  $\pm 3\%$  ( $3\sigma$ ) accuracy.



- Track and produce a database of each fastener using its unique ID. Record automatically every tightening or inspection.





# Direct Measurement of **LOAD** in Fasteners during Assembly, Inspection and Maintenance of Wind Turbines



## i-Bolt® Ultrasonic Fastener Systems

The i-Bolt® Ultrasonic Fastener Systems aim to increase the availability of Land and Offshore Wind Turbines by significantly reducing the costs of installation, maintenance and operation. The systems are stand-alone or integrated with existing Condition Monitoring Systems enabling continuous load monitoring and condition based maintenance.

Tightening of fasteners (and bolts) is now controlled directly to Load instead of any Torque-Tension method achieving 3% installed load accuracy. In addition, post-installation non-destructive Load inspection is performed in less than two seconds with zero disturbance of the actual joint.

**LOAD**  
Tighten and Inspect to **LOAD**  
...others just **TORQUE** about it.



i-Bolt® technology provides precise measurement of Load in fasteners during assembly and inspection.

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For more information please visit [www.innovationplus.com](http://www.innovationplus.com)  
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Tighten and Inspect to **LOAD**  
...others just **TORQUE** about it.



i-Bolt® technology provides precise measurement of Load in fasteners during assembly and inspection.

## i-Bolt® Ultrasonic Fastener Systems

-  Load controlled tightening with shorter assembly time and reduced manufacturing cost
-  Applicable to all fasteners and all tools achieving  $\pm 3\%$  ( $3\sigma$ ) installed load accuracy independent of who the operator is
-  Precise non-destructive, post-assembly load inspection in less than 2 seconds
-  Unique traceability of each fastener with automatic data logging and database for each individual bolt

**All bolts... All tools... All industries... One solution**

### A system consists of:



#### LoadMaster® 3300

Portable bolt load unit for inspecting fastener load or for measuring and controlling load during assembly with Load-Controlled Tools. Automatic data logging and hot sync via Bluetooth®, USB cable, Wireless LAN or GPRS (Cell phone).

Load control also applicable to all existing production, development and service tools.



#### i-Bolts®

Instrumentation of each fastener with the Innovation Plus permanent transducer for load measurements. Unique traceability of each fastener via 2-D transducer-embedded bar code with automatic data logging and database.

Submit Application Information Form (AIF) for qualification and approval. Available through local representative or at [www.innovationplus.com](http://www.innovationplus.com).



#### Load-Controlled Tools

Impact Wrenches, Ratchet wrenches and Torque-Load In-line Spindle Adaptors. Fast, cost effective, and accurate to a specified load ( $3\sigma$  within  $\pm 3\%$ ).

Load control also applicable to all exiting production, development and service tools. Other tools available. Contact us for more information.



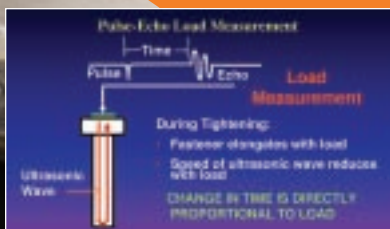
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## How it works... Assembly Tools

1. Tools are equipped with a single, inexpensive, spring-loaded "Contact Pin" in their respective drives.
2. The LoadMaster® Ultrasonic Control Electronics are connected to the tool or incorporated inside the housing of the tool itself.
3. The LoadMaster® Ultrasonic Control Electronics generate the transducer excitation pulse, makes the precision ultrasonic pulse-echo time-of-flight measurements and translate them into precise load readings.
4. Load readings are then read by the assembly tool controller as the fastener is being tightened.
5. The tool controller now monitors and stops on the required load (instead of torque) with  $\pm 3\%$  ( $3\sigma$ ) accuracy.



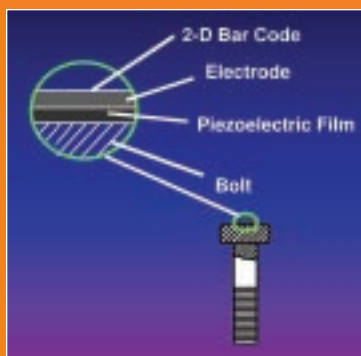
## How it works... Bolts

1. i-Bolt® Technology equips the end users' fasteners with a low-cost permanent ultrasonic transducer (only 50 microns thick) at the top or the bottom of each bolt. Form, fit or function of the fastener is not affected or changed.
2. The end user completes an Application Information Form for each joint/bolt type (please go to [www.LoadCT.com](http://www.LoadCT.com)). LCT replicates the end users' joint, generates the ultrasonic parameters and stores the ultrasonic signatures (including the zero load reading) of each individual bolt against their respective unique identifications in the transducer-embedded 2-D barcode.

3. Once a joint/bolt type is qualified, bolts can be ordered indefinitely. When the end user receives the i-Bolts, they are ready to be used.
4. The transducer is permanent and enables load controlled tightening, tightening load monitoring and load inspections throughout the life of the joint (30+ years) with near perfect repeatability and  $\pm 5\%$  ( $3\sigma$ ) inspection accuracy.

## How it works... Inspection

1. The fastener is identified through the 2-D bar code.
2. LoadMaster® Electronics retrieve the zero-load acoustic signature and zero-load reading.
3. Load measurement is displayed on the screen and automatically data logged.



**Unlike conventional ultrasonics, i-Bolt® does not require parallel surfaces and is not dependent on common transducer attachment procedures.**

**i-Bolt® is licensable to the OEM's bolt manufacturers for high volume production.**

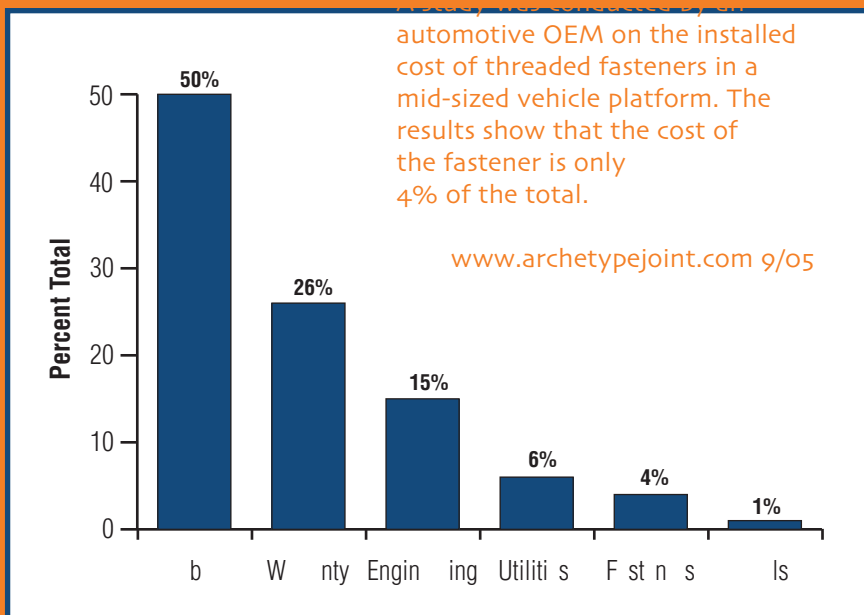
## Conventional Tightening Methods vs. i-Bolt® Technology

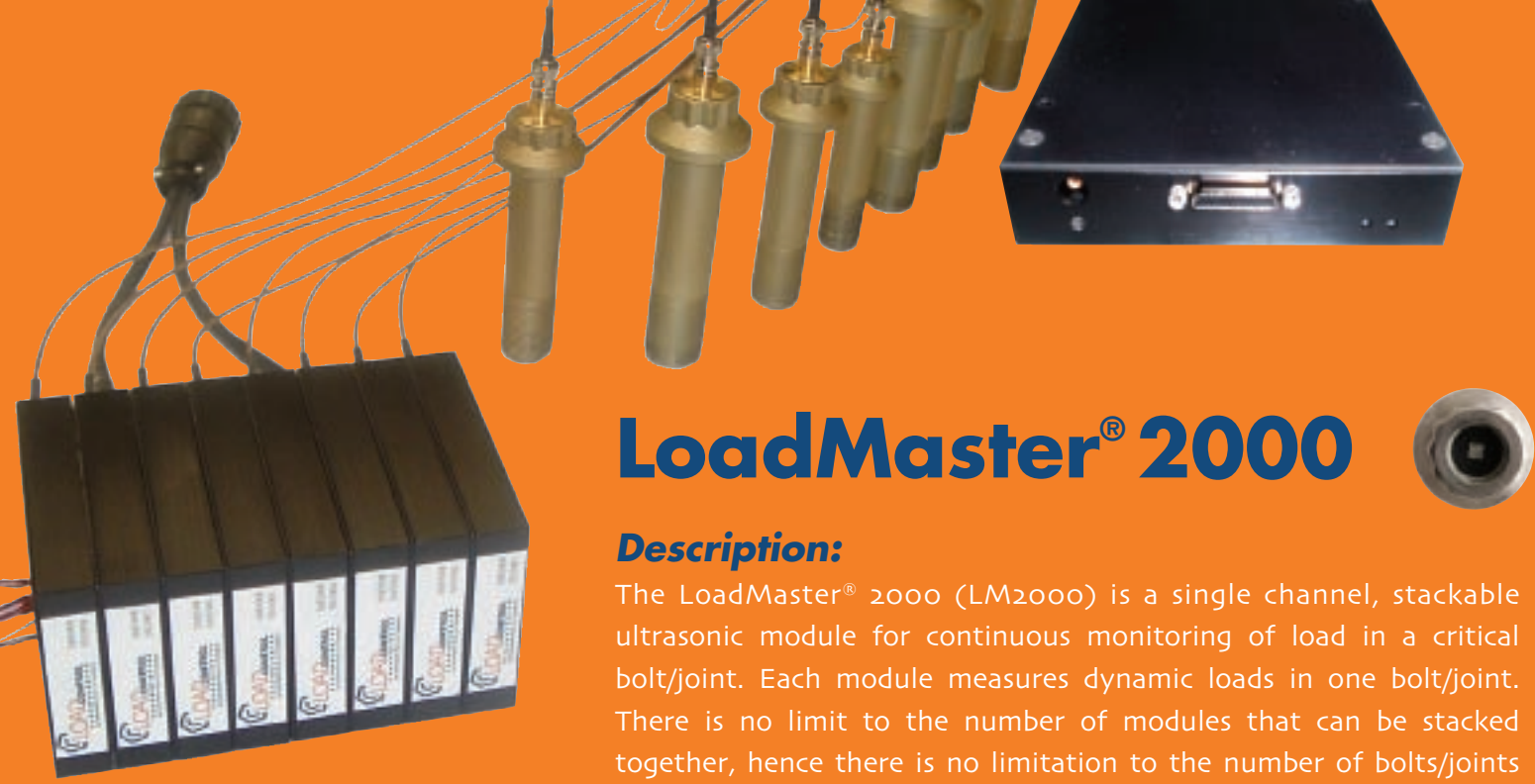
	Torque	Torque-Angle	Yield	Load Control Technologies
Direct Load Measurement	No	No	No	Yes
Load Control Accuracy	±30%	±15%	±15%	±3%
High Speed Impact Tools	No	No	No	Yes
Assembly Tool Cost	High	High	High	Low
In-Place Inspection	±50%	No	No	±5%

## Conventional Ultrasonics vs. i-Bolt® Technology

	Conventional Ultrasonic Technology	Load Control Technologies i-Bolt® Technology
Accurate Load Inspection (3σ)	No	±5%
Aerospace Materials	Limited	All
Lightening Holes/Internal Drives	No	Yes
Identification/Tracking	No	Yes
Fastener Database	No	Yes
Manufacturing Cost	High	Low
Licensed Fastener Manufacturer	No	Yes
Affects the Form, Fit or Function of the Fastener	Yes	No
In-Production	No	Yes
In-Service	No	Yes

## Installed Cost of Threaded Fasteners





# LoadMaster® 2000

## Description:

The LoadMaster® 2000 (LM2000) is a single channel, stackable ultrasonic module for continuous monitoring of load in a critical bolt/joint. Each module measures dynamic loads in one bolt/joint. There is no limit to the number of modules that can be stacked together, hence there is no limitation to the number of bolts/joints that can be monitored simultaneously. This unit is ideal for continuous dynamic load measurements either in the lab or in real world applications with remote monitoring capability. Each module includes a bolt load probe, cable and embedded high speed thermistor.

## Technical Specifications:

Measurement Update Rate:	Selectable 500ms to 2ms
Dimensions:	4.0 in (102 mm) x 5.0 in (127 mm) x .75 in (19 mm)
Weight:	1 lb (454 grams)
Housing:	Aluminum
Connections:	SMB Coax Connectors
Power Supply:	12 Volts
<b>Item Code:</b>	LM2000



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# LoadMaster® 5032



## Description:

The LoadMaster® 5032 is a Multiplexer that allows the LoadMaster® 3500 to continuously monitor up to 32 fasteners at the same time. The number of fasteners to be monitored is programmable as is the length of time between load readings. The Multiplexer sequentially selects each of the programmed channels and performs a one to two second inspection reading on each fastener. Data logging in Excel format is available via the standard Load Control Technologies Data Manager software (included). The LoadMaster® 5032 is ideal for long term load measurements either in the lab or in real world applications. It includes 32 bolt load probes with embedded high speed thermistors.



## Technical Specifications:

Weight:	1.0 pounds (454 grams)
Housing:	Plastic
Connections:	SMB
Power Supply:	Connect with LoadMaster® 3500
Changing time per Channel:	300 ms
Dimensions:	4.5 in (115mm) x 2 in (51mm) x 14 in (356mm)

**Item Code:** LM5032



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## **Benefits**

*Eliminate all torque and friction issues*

*Reduce engineering and manufacturing costs*

*100% confidence in achieving and maintaining the design load*

*Better utilization of fastener strength, reducing need to over-design*

*Size, weight and cost reductions from fewer, smaller, lighter fasteners*

*Achieve same tightening accuracy and quality in service and production*

*Decrease in recall, product liability, warranty and repair costs*

*Loss of reputation is avoided*

***Tighten and inspect to LOAD...  
others just torque about it.***



***Go to [www.LoadCT.com](http://www.LoadCT.com) or contact your local representative.***

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