Fastener Systems

All bolts... All tools...
All industries... ONE SOLUTION.
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 ±15% up to ±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 ±3% (3σ) independent of the operator. i-Bolt® Fastener Systems also provide the capability to inspect load in the actual joint with zero disturbance and ±5% (3σ) accuracy through the life cycle of the bolt.

The i-Bolt® Fastener System includes:

CUSTOMER BOLTS, LOADMASTER® CONTROL ELECTRONICS, ASSEMBLY TOOLS
i-Bolt® technology provides precise measurement of Load in fasteners during assembly and inspection.

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

**A system consists of:**

**LoadMaster® 3600**
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 Load Control Technologies 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.LoadCT.com.

**Load-Controlled Tools**
Impact Wrenches, Ratchet wrenches and Torque-Load In-line Spindle Adaptors. Fast, cost effective, and accurate to a specified load (3σ within ± 3%).
Load control also applicable to all existing production, development and service tools. Other tools available. Contact us for more information.

For more information please visit [www.LoadCT.com](http://www.LoadCT.com) or contact us at: **Tel: +1 610 272 2600**
i-Bolt® Ultrasonic Fastener

- i-Bolt® Technology equips each fastener with a permanent, proprietary low-cost ultrasonic transducer at the top or at the bottom of the bolt
- Load measurements are made via ultrasonics to 3σ accuracy better than ±3%
- Each instrumented bolt is also equipped with the i-Bolt® patented transducer-embedded 2D-barcode
- Every fastener is fully traceable and includes a database and automatic data logging

Pulse-Echo Load Measurement

During Tightening:
- Fastener elongates with load
- Speed of ultrasonic wave reduces with load

CHANGE IN TIME IS DIRECTLY PROPORTIONAL TO LOAD

Inspection

- Fastener identification through 2-D bar code
- Multiple inspection device configurations to address applications with limited access
- Retrieves zero-load acoustic signature and previous assembly/inspection data
- Zero disturbance of the joint
- Typical inspection load accuracy ~ ±5% (3σ)
- Automatic data logging

All in less than two seconds!
Assembly

1. Tools are equipped with a single, inexpensive, spring loaded “Contact Pin” embodied into their drive

2. The LoadMaster® 3600 is connected to the tool or incorporated in the housing of the tool itself

3. The LoadMaster® 3600 generates 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 ±3% (3σ) accuracy

All existing hand and powered production assembly tools (including low-cost impulse and impact tools) are easily adapted for precise load control with i-Bolt® ultrasonic fasteners

- 100% detection of joint and assembly defects
- Accurate load control (±3%)
- Elimination of Torque-tool calibration costs
- Reduction in total assembly cost

i-Bolt Database and Data Manager

- Every assembly and inspection measurement is automatically data logged by the LoadMaster® 3600
- Bolt load measurements at a rate of 500 points per second. Complete capability for storing tightening curve data for Load, Torque-Tension and Friction. PC software provides full data display and analysis
- Data is Hot sync to a PC via Bluetooth®, USB cable, Wireless LAN or GPRS (cell phone)
- LoadMaster® Data Manager then converts the files into Excel spreadsheets
- Internet-accessible database for all Load Control Technologies ultrasonic fasteners
- Data storage for approximately a million bolts in measurement instrument, unlimited when downloaded on local PC or server

For more information
www.LoadCT.com
Tel: +1 610 272 2600
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 ±3% (3σ) 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). 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 ±5% (3σ) 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

<table>
<thead>
<tr>
<th></th>
<th>Torque</th>
<th>Torque-Angle</th>
<th>Yield</th>
<th>Load Control Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Load Measurement</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Load Control Accuracy</td>
<td>±30%</td>
<td>±15%</td>
<td>±15%</td>
<td>±3%</td>
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<tr>
<td>High Speed Impact Tools</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Assembly Tool Cost</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>In-Place Inspection</td>
<td>±50%</td>
<td>No</td>
<td>No</td>
<td>±5%</td>
</tr>
</tbody>
</table>

### Conventional Ultrasonics vs. i-Bolt® Technology

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

A study was conducted by an automotive OEM on the installed cost of threaded fasteners in a mid-sized vehicle platform. The results show that the cost of the fastener is only 4% of the total.

www.archetypejoint.com 9/05
**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 or contact your local representative.
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.

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

For more information please visit www.LoadCT.com or contact us at: Tel: +1 610 272 2600