Bolt Engineer®

Hydraulic Bolt Technology

Ultrasonic Bolt Load Measurement **Echometer ECM-1**

echometer

The echometer ultrasonically measures the elongation, stress and load in fasteners, quickly and accurately, and displays the result on an easy to read screen.

The measurement is achieved by determining the change in the transit time, of an ultrasonic shock wave along the length of the fastener as the fastener is tightened. The unit works with all bolt tightening systems and is used to monitor the fastener during the tightening process to ensure accurate initial loading. The Retained load in the fastener can then be monitored at any time .

Echometer minimises the requirement for extensive operator training. With built in data recording and reporting through an RS232 interface, the echometer is quick and easy to use and offers a reliable solution to the most difficult bolting problem.

KEY FEATURES:

- Quick and simple to operate.
- Compact and durable for proven reliability.
- Minimal operator training required.
- Provides elongation, load, stress and strain measurements.
- Accurate and reliable.
- Designed to complement Boltight bolt tensioning.
- Easy measure during tightening and monitoring during plant operation.
- Cost effective.
- Simple data recording and reporting.

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Ultrasonic Bolt Load Measurement — Echometer ECM-1

Physical

Size:

Width(2.5in/63.5mm)
Height (6.5in/165mm)
Depth(1.24in/31.5mm)

Weight:
320g (with no batteries).

Keyboard:
Membrane switch pad with twelve tactile keys.

Operating Temperature:
14°F to 140°F (-10°C to 60°C)

Case:
Extruded aluminum body with nickel-plated aluminum end caps(gasket sealed).

Data Output:
Bi-directional RS232 serial port.
Windows® PC interface software.

Display:
1/8in VGA grayscale display (240 x 160 pixels). Viewable area 2.4 x 1.8in (62 x 45.7mm). EL backlit (on/off/auto).

Ultrasonic Specifications Measurement

Modes:
Pulse-Echo (standard)
Pulse-Echo w/Gate (fine adjust)

Receiver:
Manual or Auto Set gain control with 40dB range.

Power Source

Three 1.5V alkaline or 1.2V NiCad AA cells.
Typically operates for 150 hours on alkaline and 100 hours on NiCad.

Auto power off if idle 5 min.
Battery status icon.

Measuring

Range: From 1" to 96" (25.4mm to 2435mm) length bolts.

Time: Nanoseconds.

Elongation: Change in length (inches/millimeters).

Load: Force load applied (pounds kip or kilo newtons kN).

Stress: Force per unit area stress (pounds kpsi or mega pascals Mpa).

Strain: Percentage strain applied (inches per inch or millimeters per millimeter)

Resolution: +/- 0.00001 inches (0.0001 mm)

Velocity Range:
0.0492 to 0.3936 in/ms
1250 to 9999 meters/sec

Fixed, Single and Two point zero calibration options.
Select bolt meterial types from a preset or custom list.

Units:
Imperial & Metric.

Display:
A-Scan: Rectified +/- (half wave view), or
RF (full waveform view).

Limits Bar (alarm limits)

Set Hi & Lo alarm limits for displaying an acceptable tolerance range.

Repeatability Bar Graph- Bar Graph indicates stability of measurement.

Data Logger (Internal)

Total of 8,000 readings, multiple bolt groups. Stores both waveform views, nanoseconds, elongation, load, stress and strain for each reading.

Memory:
16 megabit non-volatile ram.

Transducer

Transducer Types:

Single Element (1 to 10 MHz & 1/8" to 1" diameters).

Locking quick disconnect "00" LEMO connectors.

Standard 10 foot cable.

Custom transducers and cable lengths available on request.

Alam Limits:
Set Hi and Lo tolerances with audible beeper, viewable scan bar, and visual LEDs.

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6.2 Transducer contact requirements

The goal is to transmit as much sonic energy as possible from the transducer into the bolt, and to send that energy, to the greatest extent possible, down and back the center of the bolt, as shown in Figure 1.

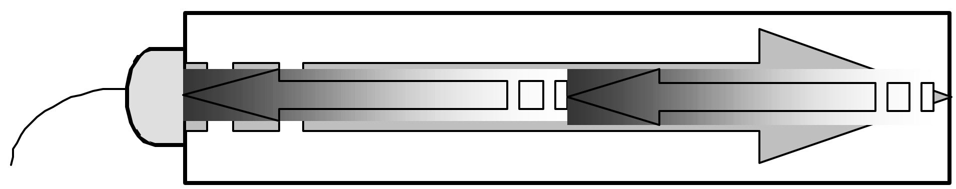

Figure 1 Sound path in a good bolt

Smooth, even surfaced bolt ends that seat the entire active surface of the transducer with minimum gap are required for accurate signal transmission. Bolt ends may need to be cleaned, ground, etc. to achieve the required surface.

Avoid:

- Rough or irregular surface's which prevent adequate contact with the transducer. Irregular or rough surfaces can be filled with couplant, but energy transmission will still be reduced and dispersed causing mode conversions to occur from reflections off the side walls of the bolt, as shown at left of Figure 2.

- Bolt ends not perpendicular to the axis of the bolt, as shown at right of Figure 2. Energy will be transmitted toward the side wall and reflect along the bolt, yielding poor signal quality and possible measurement errors. Avoid alignment errors exceeding 2 degrees.

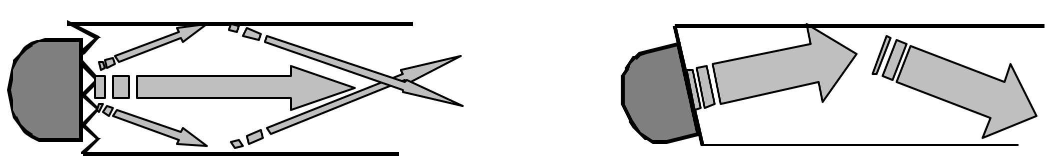

Figure 2 Rough and angled transducer contact

- Rusted, dirty, or thick paint-covered bolt ends. These coatings prevent sonic energy from traveling between the transducer and the bolt. Very thin coating or plating is acceptable.

- Bolt ends with recessed grademarks, as shown at left of Figure 3. Couplant can be used to fill recessed grademarks. Small indentations cause some loss of signal strength, but normal measurement is still possible. Large or numerous indentations cause the signal to be too weak for a reliable measurement.

- Bolt ends with raised grade marks, or indentations with a raised edge, which cause the transducer to be seated at an angle to the axis of the bolt, thus preventing adequate contact, as shown at right of Figure 3.

Figure 3 Effect of lowered and raised grade marks

6.3 Bolt end reflectors

Smooth, flat reflecting bolt ends that are perpendicular to the axis of the bolt are required for accurate echo reception. Bolt ends may need to be cleaned, ground, etc. to achieve the required surface.

Note: Misalignment exceeding 2 degrees can cause significant errors.

Avoid:

- Rough reflecting bolt ends. As shown in Figure 4, if the reflecting end of the bolt is rough or curved, most of the reflected energy will be dispersed and a weak or distorted echo will be received.

- Reflecting bolt ends not perpendicular to the axis of the bolt. Sonic energy will be reflected toward the sidewall of the bolt, as shown in Figure 5.

- Nonperpendicular reflecting bolt ends due to bending of the bolt as shown in Figure 6.

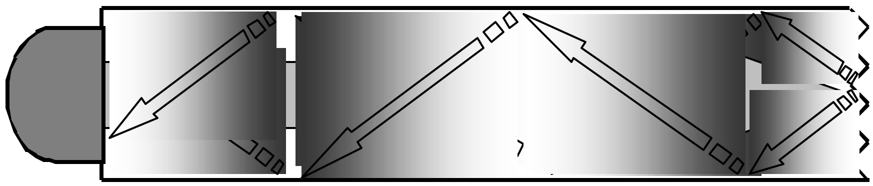

Figure 4 Rough reflective surface

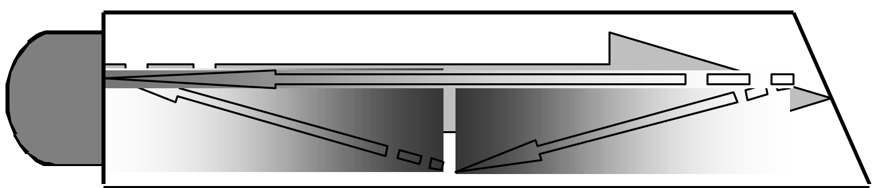

Figure 5 Non Parallel reflecting Surface

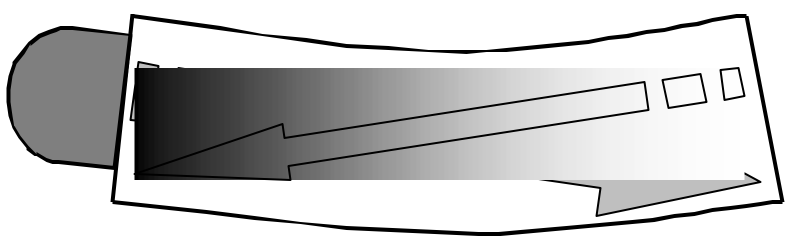

Figure 6 Reflection in a bending bolt