

Elcometer 205
Elcometer 206 • 206DL

Ultrasonic Thickness Gauge

Operating Instructions



The Elcometer 205, 206 and 206DL Ultrasonic Thickness Gauges have been tested in accordance with EU regulations governing Electro-magnetic compliance and they meet the required directives.

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Material Safety Data Sheets for the ultrasonic couplant supplied with the Elcometer 205, 206 & 206DL available as an accessory is available to download via our website :

Elcometer Ultrasonic Couplant Material Safety Data Sheet:

www.elcometer.com/images/MSDS/elcometer_ultrasonic_couplant.pdf

Elcometer Ultrasonic Couplant (High Temperature) Material Safety Data Sheet:

www.elcometer.com/images/MSDS/elcometer_ultrasonic_couplant_hi_temp.pdf

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A copy of this Instruction Manual is available for download on our Website via www.elcometer.com.

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Thank you for purchasing this Elcometer 205/206/206DL Ultrasonic Thickness Gauge. Welcome to Elcometer.

Elcometer are world leaders in the design, manufacture and supply of coatings inspection equipment. Our products cover all aspects of coating inspection, from development through application to post application inspection.

The Elcometer 205, 206 and 206DL Ultrasonic Thickness Gauges are world beating products. With the purchase of this gauge you now have access to the worldwide service and support network of Elcometer. For more information visit our website at www.elcometer.com.

1 ABOUT YOUR GAUGE

The Elcometer 205, 206 and 206DL Ultrasonic Thickness Gauges are handheld gauges for fast and accurate measurement of material thickness.

Your gauge is capable of measuring the thickness of various materials with accuracy as high as ± 0.1 mm (± 0.004 ""). The principal advantage of ultrasonic measurement over traditional methods is that ultrasonic measurements can be performed with access to only one side of the material being measured.

There are three versions of the gauge:

- The Elcometer 205 is the basic model.
- The Elcometer 206 includes all features of the 205 plus differential mode, an alarm and data output.
- The Elcometer 206DL model includes all the features of the Elcometer 206 model plus a data-logging (memory) facility which allows readings to be stored in batches before being downloaded to a computer.

This manual describes the operation of all three models - Elcometer 205, 206 and 206DL.

1.1 STANDARDS

The Elcometer 205, 206 & 206DL can be used in accordance with the following International Standards ASTM E 797, EN 14127 & EN 15317.

1.2 WHAT THIS BOX CONTAINS

- Elcometer 205, 206 or 206DL Gauge
- Bottle of couplant
- Battery, 2 x
- Carrying case
- Operating instructions
- CD with data transfer and data collection software - 206DL only
- Data transfer cable - 206DL only

Note: *The box does **not** include a transducer; these must be ordered separately. To order a transducer, contact Elcometer or your local Elcometer supplier.*

Your gauge is packed in a cardboard and foam package. Please ensure that this packaging is disposed of in an environmentally sensitive manner. Please consult your Local Environmental Authority for further guidance.

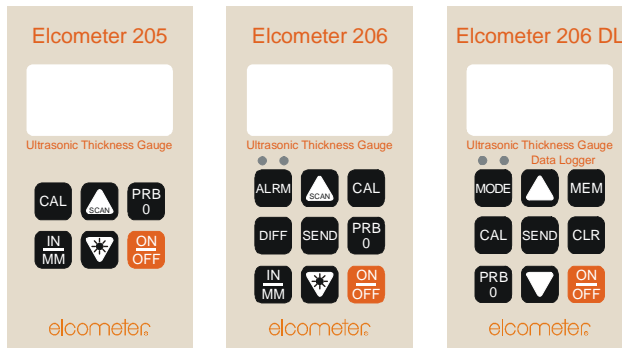


Figure 1. Elcometer 205 - 206 - 206DL

1.3 FEATURES OF THE GAUGE

SCAN MODE: Identifies the minimum thickness over a large area while moving the transducer over the surface. While the transducer is in contact with the material being measured the smallest value is held in memory and displayed when scanning is complete.

ALARM: Allows the user to set a target so that an audible and visual alarm operates when taking measurements. If the measurement falls below a pre-set nominal (target) value a red LED will light and the beeper sounds. A green LED will light to indicate an acceptable thickness.

DATA OUTPUT: Allows the user to send data direct to a printer or PC (data transfer cable required).

DATA-LOGGING: Memory capacity of up to 1000 readings. Readings are stored in up to 10 batches each containing up to 100 readings. Batches may be transferred to a PC using supplied software.

To maximise the benefits of your new Elcometer Ultrasonic Thickness Gauge, please take some time to read these Operating Instructions. Do not hesitate to contact Elcometer or your Elcometer supplier if you have any questions.

2 QUICK-START

To quickly configure the gauge and start taking readings:

1. Fit batteries: see page 7
2. Fit transducer: see page 8
3. Switch on: see page 9/11
4. Try taking a reading: see page 14
5. Set zero point: see page 16
6. Adjust calibration: see page 18

The gauge is now configured and ready to use.

3 GETTING STARTED

3.1 FITTING BATTERIES

Your gauge may be used with dry cell batteries or rechargeable batteries. 2 x LR6 (AA) alkaline batteries are supplied in the kit.

To fit or replace batteries:

7. Locate battery compartment cover (Figure 2) at top of gauge.
8. Unscrew battery compartment cover.
9. Referring to battery polarity instructions on rear of gauge, insert batteries into gauge ensuring correct polarity.
10. Replace battery compartment cover.

Remove the batteries from the gauge if it is to remain unused for a long period of time. This will prevent damage to the gauge in the event of malfunction of the batteries.

When the battery voltage is low the entire display will start to flash. When this occurs the batteries should be replaced.

Note: Alkaline batteries must be disposed of carefully to avoid environmental contamination. Please consult your local environmental authority for information on disposal in your region.

Do not dispose of any batteries in fire.

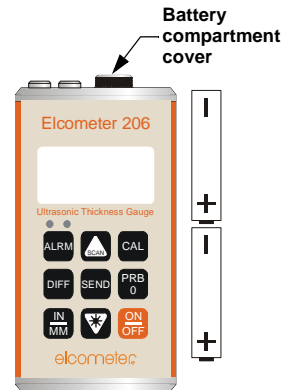


Figure 2. Fitting batteries

3.2 THE TRANSDUCER

The transducer (Figure 3) transmits and receives ultrasonic sound waves that the gauge uses to calculate the thickness of the material being measured.

The transducer connects to the gauge via the attached cable, and two coaxial connectors. When using transducers manufactured by Elcometer, the orientation of the dual coaxial connectors is not critical; either plug may be fitted to either socket.

The transducer must be used correctly in order for the gauge to produce accurate, reliable measurements.

Figure 4 shows the two semicircles of the wearface and the barrier separating them. One of the semicircles transmits ultrasonic sound into the material being measured, and the other semicircle receives the sound echoes back into the transducer. When the transducer is placed against the material being measured, it is the area directly beneath the centre of the wearface that is being measured.

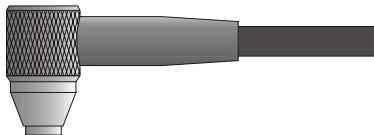








Figure 3. Typical transducer






Figure 4. Transducer - bottom view








3.3 THE KEYPAD

ELCOMETER 205 (6 BUTTONS) AND 206 (9 BUTTONS)

	<p>Press to switch the gauge on or off. When switching off, the gauge retains all of its settings. If the gauge is idle for 5 minutes, it will switch itself off.</p>	<p>205 206</p>
	<p>Press to zero the gauge. See "Setting the zero point (probe-zero)" on page 16.</p>	<p>205 206</p>
	<p>Press to adjust calibration. See "Calibration" on page 18.</p>	<p>205 206</p>
	<p>Press to change units (metric/imperial)</p>	<p>205 206</p>
	<p>a) Increases values on the display (press and hold to change values quickly).</p>	<p>205</p>
	<p>b) Switches SCAN measurement on and off. See "Scan mode" on page 22.</p>	<p>206</p>
	<p>a) Decreases values on the display (press and hold to change values quickly).</p>	<p>205</p>
	<p>b) Switches the display backlight between three settings; on, off and auto. See "Backlight" on page 27.</p>	<p>206</p>

	a) Press and hold when switching the gauge on to switch the audible beeper on or off.	206
	b) Press to toggle the alarm on or off, and to adjust the nominal thickness value. See "Alarm" on page 25.	
	Press to toggle the DIFFERENTIAL mode on or off, and to adjust the nominal thickness value. See "Differential Mode" on page 23.	206
	Press to send the displayed thickness measurement to an external storage device via the RS232 port. See "Transferring data" on page 29.	206

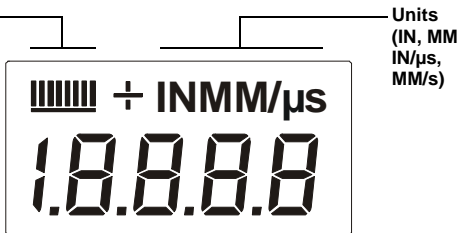
ELCOMETER 206DL

	Press to switch the gauge on or off. When switching off, the gauge retains all of its settings. If the gauge is idle for 5 minutes, it will switch itself off.
	Press to zero the gauge. See "Setting the zero point (probe-zero)" on page 16.
	Press to adjust calibration. See "Calibration" on page 18.
	Press to adjust the features and settings of the gauge (alarm, scan, units, backlight, and beeper).
	a) Increases values on the display (press and hold to change values quickly).
	b) Scrolls up through features and settings of the gauge and through files, memory locations, and functions of the data logger.
	a) Decreases values on the display (press and hold to change values quickly).
	b) Scrolls down through features and settings of the gauge and through files, memory locations, and functions of the data logger.
	Press to switch on/off data logging (memory). See "Using the data logger" on page 29.

CLR	<p>Press when data logger is switched on to clear the contents of an entire batch, or an individual memory location.</p> <p>The CLR key is also used to send an obstruct message (ObSt) to an individual memory location. The ObSt symbol would indicate that the user was unable to take a reading at a particular location. See "Using the data logger" on page 29.</p>
SEND	<p>Press to send the displayed thickness measurement to an internal memory location or an external storage device via the RS232 port. See "Transferring data" on page 29.</p> <p>The SEND key is also used to select data logging functions in the Elcometer 206DL.</p>

3.4 THE DISPLAY




Stability indicator
(see below)



Units
(IN, MM
IN/μs,
MM/s)

Thickness value/
Menu items

Stability indicator

	One bar - no readings are being taken
	Less than 5 bars - reading is unstable and may be inaccurate
	More than 5 bars - reading is stable

Refer to “Read display” on page 15 and “Transducers” on page 39 for information on how to achieve a stable measurement.

3.5 FRONT PANEL LIGHTS

Green light illuminates when:

- The alarm mode is active, and
- the measured thickness is greater than the alarm value.

Red light illuminates when:

- The alarm mode is active, and
- the measured thickness is less than the alarm value.

4 TAKING A READING

Disclaimer: Inherent in ultrasonic thickness measurement is the possibility that the instrument will use the second echo rather than the first echo from the back surface of the material being measured while in standard pulse-echo mode. This may result in a thickness reading which is TWICE what it should be.

The responsibility for proper use of the instrument and recognition of these types of phenomenon rests solely with the user of the instrument.

4.1 Before you start

- *Set the zero point of the gauge.*
See “Setting the zero point (probe-zero)” on page 16.
- *Calibrate the gauge.*
See “Calibration” on page 18.

- *Prepare the surface.*
See “Condition and preparation of surfaces” on page 42.

1. **Apply couplant**

For the gauge to work correctly there must be no air gaps between the transducer and the surface of the material to be measured. This is achieved using a material called a couplant.

Before the transducer is placed on the surface, put a small amount of the couplant supplied with the gauge on the surface of the material. Typically a single drop is sufficient.

2. **Place transducer onto surface of material to be measured**

Press the transducer wearface into the couplant. Moderate pressure on the top of the transducer using the thumb or index finger is sufficient; it is only necessary to keep the transducer stationary and the wearface seated flat against the surface of the material.

3. **Read display**

If six or seven bars of the stability indicator are showing, the display will be reading the correct thickness of the material directly beneath the transducer.

If the stability indicator has fewer than five bars showing, or the numbers on the display seem erratic, check to make sure that there is an adequate film of couplant beneath the transducer, and that the transducer is seated flat against the material. If the condition persists, it may be necessary to select a different transducer (size or frequency) for the material being measured.

The gauge will perform four measurements every second when the transducer is in contact with the surface of the material. The display is updated as each reading is taken.

4. **Remove transducer from surface**

The display will show the last measurement made.

Note: Occasionally, a small film of couplant will be drawn out between the transducer and the surface as the transducer is removed. When this happens, the gauge may perform a measurement through this couplant film, resulting in a measurement that is larger or smaller than it should be. This phenomenon is obvious when one thickness value is observed while the transducer is in place, and another value is observed after the transducer is removed. If this happens, take the reading again using less couplant.

5 SETTING THE ZERO POINT (PROBE-ZERO)

Setting the zero point of the gauge is important for the same reason that setting the zero on a mechanical micrometer is important. If the zero point of the gauge is not set correctly, all of the measurements the gauge makes will be in error by some fixed number. When the zero point of the gauge is set, this fixed error value is measured and automatically corrected for in all subsequent measurements.

To set the zero point:

1. Plug the transducer into the gauge ensuring that the connectors are fully engaged. Check that the wearface of the transducer is clean and free of any debris.
2. Switch on the gauge.
3. The battery compartment cover on the top end of the gauge acts as a metal 'probe-disc'. Apply a single droplet of ultrasonic couplant to the top of this disc.

4. Press the transducer against the probe-disc, making sure that the transducer is flat against the surface (Figure 5). The display should show some thickness value, and nearly all the bars of the stability indicator should be illuminated.

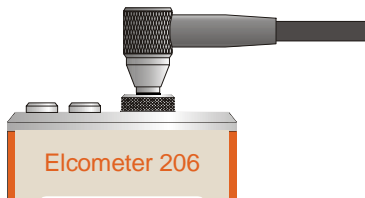


Figure 5. Transducer pressed against probe-disc

5. While the transducer is firmly coupled to the probe-disc, press the **PRB-0** key on the keypad. The gauge will display 'Prb0' while it is calculating the zero point.
6. Remove the transducer from the probe-disc.

When setting the zero point, the gauge will always use the sound-velocity value of the built-in probe-disc, even if some other velocity value has been entered for making measurements.

Although the gauge will remember the last zero point, it is generally a good idea to set the zero point whenever the gauge is switched on, as well as any time a different transducer is used. This will ensure that the zero point of the instrument is always correct.

6 CALIBRATION

In order for the gauge to make accurate measurements, it must be set to the correct sound-velocity for the material being measured.

Different types of material have different sound-velocities. For example, the velocity of sound through steel is 5918 m/s (about 0.233 in/ μ s) and the velocity of sound through aluminium is 6350 m/s (about 0.248 in/ μ s).

If the gauge is not set to the correct sound-velocity, all of the measurements the gauge makes will be erroneous by some fixed percentage.

There are three methods of calibrating your gauge:

One-point CALIBRATION: This is the simplest and most commonly used calibration procedure - optimising linearity over *large* ranges. One-point calibration is carried out using a known thickness.

Two-point CALIBRATION: This allows for greater accuracy over *small* ranges. Two-point calibration is carried out using two known thicknesses.

Known velocity CALIBRATION: The sound-velocity of the material being measured is entered directly into the gauge.

Note: *One-point and two-point calibrations must be performed on material with the paint or coating removed. Failure to remove the paint or coating prior to calibration will result in a multi-material velocity calculation that may be different from the actual material velocity intended to be measured.*

6.1 ONE-POINT CALIBRATION

This procedure requires a sample piece of the material to be measured, the exact thickness of which is known, e.g. from having been measured by some other means.

1. Switch on the gauge.
1. Set the zero point of the gauge - see “Setting the zero point (probe-zero)” on page 16.
2. Apply couplant to the sample piece.
3. Press the transducer against the sample piece, making sure that the transducer is flat against the surface of the sample. The display should show some (probably incorrect) thickness value, and nearly all the bars of the stability indicator should be illuminated.
4. Having achieved a stable reading, remove the transducer.
If the displayed thickness changes from the value shown while the transducer was coupled, repeat step 3 and 4.
5. Press the **CAL** key. The **MM** (or **IN**) symbol should begin flashing.
6. Use the **UP** and **DOWN** arrow keys to adjust the displayed thickness up or down, until it matches the known thickness of the sample piece.
7. Press the **CAL** key again. The **M/s** (or **IN/μs**) symbols should begin flashing. The gauge is now displaying the sound-velocity value it has calculated.
8. Press the **CAL** key once more to exit the calibration mode.

The gauge is now ready to perform measurements.

6.2 TWO-POINT CALIBRATION

This procedure requires that the operator has two known thickness points on the test piece that are representative of the range to be measured.

1. Set the zero point of the gauge - see “Setting the zero point (probe-zero)” on page 16.
2. Apply couplant to the sample piece.
3. Press the transducer against the sample piece, at the first calibration point, making sure that the transducer is flat against the surface of the sample. The display should show some (probably incorrect) thickness value, and nearly all the bars of the stability indicator should be illuminated.
4. Having achieved a stable reading, remove the transducer.

If the displayed thickness changes from the value shown while the transducer was coupled, repeat steps 3 and 4.

5. Press the **CAL** key. The **IN** (or **MM**) symbol should begin flashing.
6. Use the **UP** and **DOWN** arrow keys to adjust the displayed thickness up or down, until it matches the thickness of the sample piece.
7. Press the **PRB-0** key. The display will flash **1OF2**.
8. Repeat steps 3 to 6 on the second calibration point.
9. Press the **CAL** key again. The **M/s** (or **IN/μs**) symbols should begin flashing. The gauge is now displaying the sound-velocity value it has calculated.
10. Press the **CAL** key once more to exit the calibration mode.

The gauge is now ready to perform measurements within this range.

6.3 KNOWN VELOCITY CALIBRATION

This procedure requires that the operator knows the sound-velocity of the material to be measured. A table of common materials and their sound-velocities can be found in “Sound velocities of common materials” on page 47.

1. Press **ON/OFF** key to switch on the gauge.
2. Press the **CAL** key to enter calibration mode. If the **MM** (or **IN**) symbol is flashing, press the **CAL** key again, so that the **M/s** (or **IN/ μ s**) symbols are flashing.
3. Use the **UP** and **DOWN** arrow keys to adjust the displayed velocity up or down, until it matches the sound-velocity of the material to be measured.
4. Press the **CAL** key once more to exit the calibration mode.

The gauge is now ready to perform measurements.

Note: *At any time during the gauge calibration procedure (IN, MM, IN/ μ s, or M/s flashing in the display), pressing the **PRB-0** key will restore the gauge to the factory default sound-velocity for steel, 5918 m/s (0.233 in/ μ s).*

To achieve the most accurate measurements possible, it is generally advisable to calibrate the gauge to a sample piece of known thickness. Material composition (and thus, its sound-velocity) sometimes varies from lot to lot and from manufacturer to manufacturer. Calibration to a sample of known thickness will ensure that the gauge is set as closely as possible to the sound-velocity of the material to be measured.

7 SET-UP OPTIONS

7.1 SCAN MODE

Your gauge includes **Scan Mode** which allows it to examine a large region, searching for the thinnest point. In normal operation, the gauge performs and displays four measurements every second, which is quite adequate for single measurements. In **Scan Mode**, however, the gauge performs eight measurements every second, but does not display them. While the transducer is in contact with the material being measured, the gauge memorises the lowest measurement it finds. The transducer may be 'scrubbed' across a surface, and any brief interruptions in the signal will be ignored. When the transducer loses contact with the surface for more than a second the gauge will display the lowest value it found.

To switch scan mode on/off:

Elcometer 205/206

1. Switch on the gauge.
2. Press **UP/SCAN** key to toggle the status of the Scan mode.
The gauge will display **SCAN OFF** or **SCAN On** depending on which mode the gauge is in.
3. Repeat step 2 to switch scan mode on or off.

Elcometer 206DL

1. Switch on the gauge.
2. Press **MODE** key to activate features and settings.
3. Press **UP** and **DOWN** arrow keys to scroll to **SCAN** symbol.
The gauge will display **SCAN OFF** or **SCAN On** depending on which mode the gauge is in.
4. Press **SEND** key to switch scan mode on or off.
5. Press **MODE** key when finished.

7.2 DIFFERENTIAL MODE

(Elcometer 206 and 206DL only)

Your gauge includes **Differential Mode** which allows it to display the positive or negative difference from an entered nominal value.

To switch differential mode on/off and enter the value:**Elcometer 206**

1. Switch on the gauge.
2. Press the **DIFF** key.
The gauge will display **DIFF OFF** or **DIFF** followed by a thickness value and flashing **MM** (or **IN**), depending on which mode the gauge is in.
3. Repeat step 2 to switch differential mode on or off.
4. Assuming **DIFF** value flashing **MM** is displayed, use the **UP** and **DOWN** arrow keys to scroll to the desired nominal thickness value.
5. Press the **DIFF** key once again to select the nominal value entered.

Elcometer 206DL

1. Switch on the gauge.
2. Press **MODE** key to activate features and settings.
3. Press **UP** and **DOWN** arrow keys to scroll to **dIFF** symbol.
The gauge will display **DIFF OFF** or **DIFF** followed by a thickness value and flashing **MM** (or **IN**), depending on which mode the gauge is in.
4. Press **SEND** key to switch differential mode on or off.
5. Assuming **DIFF** value flashing **MM** is displayed, use the **UP** and **DOWN** arrow keys to scroll to the desired nominal thickness value.
6. Press **SEND** key to select the desired nominal value and return to mode menu.
7. Press **MODE** key when finished.

7.3 ALARM

(Elcometer 206 and 206DL only)

The **Alarm** feature of the Elcometer 206 and 206DL allows the user to set an audible and visual alarm when taking measurements.

If the alarm is switched on, the green light on the front panel of the gauge is illuminated. If the measurement falls below the value set by the user, a red light shows on the front panel of the gauge and the beeper is sounded (if it is switched on).

Use of the red light and beeper improves the speed and efficiency of the inspection process by eliminating constant viewing of the reading displayed.

To switch beeper on/off

Elcometer 206

1. While the gauge is off, press and hold down **ALRM** key.
2. Switch on the gauge.
3. Release **ALRM** key.
The gauge will display **bBEEP OFF** or **bBEEP On** depending on whether the beeper is on or off.
4. Repeat steps 1 to 3 to toggle between **bBEEP ON** and **bBEEP OFF**.

Elcometer 206DL

1. Switch on the gauge.
2. Press **MODE** key to activate features and settings.
3. Press **UP** or **DOWN** arrow keys to scroll to **bBEEP**.
The gauge will display **bBEEP OFF** or **bBEEP On** depending on whether the beeper is on or off.
4. Press **SEND** key to toggle the status of the beeper on/off.
5. Press **MODE** key when finished.

To set alarm value and switch alarm on

Elcometer 206

1. Switch on the gauge.
2. Press **ALRM** key to toggle the status of the alarm until the gauge displays:
ALAr followed by a thickness value and flashing **MM** (or **IN**) symbol.
3. Press **UP** and **DOWN** arrow keys to adjust thickness value.
4. Press **ALRM** key when correct value is displayed.

Elcometer 206DL

1. Switch on the gauge.
2. Press **MODE** key to activate features and settings.
3. Press **UP** or **DOWN** arrow keys to scroll to **ALAr**. The gauge will display:
ALAr OFF
4. Press **SEND** key. The gauge will display:
A thickness value and flashing **MM** (or **IN**) symbol.
5. Press **UP** and **DOWN** arrow keys to adjust thickness value.
6. Press **SEND** key when correct value is displayed.
7. Press **MODE** key.

The alarm value is now set and the alarm is switched on.

To switch alarm off

Repeat the steps above, but select **ALAr OFF**.

7.4 BACKLIGHT

The gauge display includes a backlight. The backlight can be set to one of three modes - on/off/auto.

- ON - backlight is on
- OFF - backlight is off
- AUTO - backlight automatically illuminates while the gauge is making a measurement and switches off after several seconds (to conserve battery life).

To set backlight mode

Elcometer 205/206

1. Switch on the gauge.
2. Press **DOWN** key to toggle the status of the backlight.
The gauge will display **OFF**, **On** or **Auto**, depending on backlight setting.
3. Repeat step 2 until the correct setting is displayed.

Elcometer 206DL

1. Press **ON/OFF** key to switch on the gauge.
2. Press **MODE key** to activate features and settings.
3. Press **UP** and **DOWN** arrow keys to scroll to the **LitE** symbol.
The gauge will display **LitE OFF**, **LitE On** or **LitE Auto**, depending on backlight setting.
4. Press **SEND** key until the correct setting is displayed.
5. Press **MODE** key.

8 TRANSFERRING READINGS TO A COMPUTER

(Elcometer 206 and 206DL only)

Readings can be transferred from the Elcometer 206 and Elcometer 206DL to a computer. The Elcometer 206 will transfer readings as they are taken. The Elcometer 206DL will transfer readings as they are taken and also transfer the contents of its memory.

A data transfer cable is used to connect the gauge to the computer. This cable is supplied with the Elcometer 206DL and is available as an optional accessory for the Elcometer 206 (see “Spares” on page 36).

Elcometer recommends the use of ElcoMaster communications software to transfer the data - see “Data transfer software” on page 45. Other types of software may also be used.

8.1 CONNECTING THE DATA TRANSFER CABLE

1. Plug the 9-pin female D-type connector on one end of the data transfer cable into the COM port on the PC or USB to COM adapter.
2. Plug the jack connector on the other end of the data transfer cable into the RS232 data connection socket on the bottom of the gauge (Figure 6).
3. Start the communications software ElcoMaster.
4. Select gauge type Elcometer 206 or 206DL.



Figure 6. RS232 data connection socket

8.2 TRANSFERRING DATA

Elcometer 206

After taking a measurement, press the **SEND** key to send the measurement to the computer.

Elcometer 206DL

Follow the instructions in “Using the data logger” on page 29.

9 USING THE DATA LOGGER

(Elcometer 206DL only)

The Elcometer 206DL is equipped with a data logging feature. This is a valuable reporting gauge for inspection purposes. It increases efficiency by reducing the time it takes to manually record the measurements during the inspection process. The gauge can then be connected to a computer or serial printer to save and print the results of the inspection.

The gauge has a memory capacity of 1000 readings. Measurements are stored in up to 10 batches (files), each consisting of up to 100 readings (memory locations).

9.1 SETTING-UP THE DATA LOGGER

1. Switch on the gauge.
2. Press **MEM** key to activate the data logger.

The display will flash **FILE F-01** (or the last batch used). There are 10 batches, numbered **F-01 to F-10**.

3. Press the **SEND** key to enter batch setup. The current batch will be displayed (F-01, F-03, etc.)

4. Press the **UP / DOWN** arrow keys to scroll to the batch (1-10) that will be used.
5. Press the **SEND** key once again to select the batch.
The display will flash **FILE F-04** (or the selected batch).
6. Press the **MEM** key, to access the memory locations in the batch selected.
The display will flash the current memory location (L007, L039, etc.), followed by the status of the memory location. The memory location can contain one of three possible things:
 - a measurement that was previously stored
 - **CLr** in the display, indicating that the memory location is empty
 - **ObSt** (obstruct) in the display, indicating that a measurement could not be obtained
7. Press the **UP / DOWN** arrow keys to advance to the desired memory location.

9.2 STORING A MEASUREMENT

1. Take a measurement and press the **SEND** key to store a reading in the memory location.
The data logger will then **automatically advance** to the next memory location in sequential order.
2. Repeat **step 1** as required.

9.3 DELETING CONTENTS OF A MEMORY LOCATION

The user may require a memory location that is currently full to be over written. The procedure for deleting (clearing) the contents of the memory location is outlined in the following steps:

Note: This procedure assumes the steps in 9.1 and 9.2 have been completed, and 9.2 is being repeated.

1. Press the **UP / DOWN** arrow keys to move to the memory location to be cleared.

If the memory location is currently full, the display will flash the **FuLL** symbol.

2. Press the **CLR** key to delete the contents of the memory location. The display will flash the memory location (L011, L099, etc.) and the **CLr** symbol.
3. Take another measurement, and press the **SEND** key to write to the same memory location just cleared.

9.4 DELETING CONTENTS OF AN ENTIRE BATCH

The user may require the contents of an entire batch to be cleared of all measurements. This would allow the user to start a new list of measurements starting at memory location L001, for example. The procedure is outlined in the following steps:

1. Press **ON/OFF** key to switch on the gauge.
2. Press **MEM** key to activate the data logging functions and settings.
3. Press **SEND** key to enter batch setup.
4. Press **UP / DOWN** arrow keys to scroll to the batch that is to be cleared of all measurements.
5. Press **SEND** key once again to select the batch. The display will flash **FILE F-05** (or the batch selected).
6. Press **UP / DOWN** arrow keys to scroll to the flashing **CLr F-05** (or the batch selected).
7. Press **SEND** key to select the clear batch option. The display will show **CLr?**
8. Press **CLR** key to confirm and clear the contents of the entire batch.
9. Press **MEM** key at any time to exit data logging functions.

9.5 DELETING CONTENTS OF ALL BATCHES

1. Press **ON/OFF** key to switch on the gauge.
2. Immediately press the **CLR** key. The display will show **CLr?**
3. Press **CLR** key once again to clear all batches.

9.6 TRANSFERRING DATA TO A COMPUTER

At the end of the inspection process, or end of the day, the user can transfer the readings in the memory of the gauge to a computer.

TRANSFERRING ONE BATCH

1. Connect the gauge to a computer and start the data transfer software - see “Transferring readings to a computer” on page 28.
2. Press **ON/OFF** key to switch on the gauge.
3. Press **MEM** key to activate the data logging functions and settings.
4. Press **SEND** key to enter batch setup.
5. Press **UP / DOWN** arrow keys to scroll to the batch that is to be sent to the computer.
6. Press **SEND** key once again to select the batch. The display will flash **FILE F-05** (or the batch selected).
7. Press **UP / DOWN** arrow keys to scroll to **LIST F-05** (or the batch selected) flashing on the display.
8. Press the **SEND** key to send readings to the computer.
The display will show **buSY** during data transfer.
Wait until all the data has been transferred.
9. Press the **MEM** key to exit the data logging functions.

TRANSFERRING ALL BATCHES

1. Connect the gauge to a computer and start the data transfer software - see “Transferring readings to a computer” on page 28.
2. Press **ON/OFF** key to switch on the gauge.

3. Press **MEM** key to activate the data logging functions and settings.
4. Press **UP / DOWN** arrow keys to scroll to **SEnd ALL** flashing on the display.
5. Press the **SEND** key to send readings to the computer.
The display will show **buSY** during data transfer.
Wait until all the data has been transferred.
6. Press the **MEM** key to exit the data logging functions.
7. Press the **MEM** key, at any time, to exit the data logging functions.

10 STORAGE



Your gauge has a Liquid Crystal Display. If the display is heated above 50°C (120°F) it may be damaged. This can happen if the gauge is left in a car parked in strong sunlight.

Always store the gauge in its case when it is not being used.

If the gauge is to remain unused for long periods of time, remove the batteries and store them separately. This will prevent damage to the gauge in the event of malfunction of the batteries.

11 MAINTENANCE

The Elcometer 205/206/206DL is designed to give many years reliable service under normal operating and storage conditions.

The transducer will wear with repeated use. Transducer life depends on the number of measurements taken and the manner in which readings are taken. To extend transducer life, always set the transducer down so that it is perpendicular to the panel surface. Dragging the transducer along the surface will reduce the life of the transducer.

Replacement transducers are available from your local Elcometer supplier or directly from Elcometer.

The gauge does not contain any user-serviceable components. In the unlikely event of a fault, the gauge should be returned to your local Elcometer supplier or directly to Elcometer. The warranty will be invalidated if the instrument has been opened.

Contact details can be found:

- On the outside cover of these operating instructions.
- At www.elcometer.com

12 TECHNICAL SPECIFICATION

Range:	0.63 mm to 500 mm (0.025" to 19.999")
Resolution:	0.01 mm (0.001")
Accuracy:	±0.1 mm (±0.004"), depends on material and conditions
Sound-velocity range:	1250 m/s to 10 000 m/s (0.0492 in/μs to 0.3937 in/μs)
Weight:	295 g (10 oz) including batteries
Size:	63.5 mm x 120.6 mm x 31.5 mm (2.5" x 4.5" x 1.24")
Operating temperature:	-30°C to 50°C (-20°F to 120°F) (depending upon climatic conditions)
Case:	Extruded aluminium body Nickel plated aluminium end caps
Battery type:	2 x LR6 (AA), alkaline dry batteries or rechargeable ^a equivalents
Battery life:	200 ^b hours continuous (alkaline dry batteries)

- Rechargeable batteries can be used if they are charged outside the gauge.
- Battery life is reduced to approximately 120 hours when using rechargeable batteries. Follow the instructions provided by the battery manufacturer when charging and disposing of rechargeable batteries.

13 SPARES

The following consumables, replacement and optional items are available from your local Elcometer supplier or direct from Elcometer.

Type	Description	Sales Part No.
Consumable	120 ml (4 oz) Ultrasonic couplant	T92015701
Consumable	120 ml (4 oz) High temperature ultrasonic couplant, 343°C (650°F)	T92015874X
Accessory	Fabric carrying case with straps	T92015617
Accessory	Data transfer cable (for connection to a PC)	T92015684
Accessory	USB to COM adapter	T99916716
Accessory	Test wedge 2 mm to 25 mm	T9205243-
Accessory	Test wedge 30 mm to 100 mm	T9205270-
Transducer ^c	5 MHz High damped transducer	T92016967
Transducer	7.5 MHz High damped transducer	T92016968

c. A wide range of other transducers is available - see "Transducers" on page 39 for further details.

14 RELATED EQUIPMENT

Elcometer produces a wide range of material thickness gauges and associated inspection equipment. Users of the Elcometer 205, 206 and 206DL may also benefit from the following Elcometer products:

- Elcometer 207/207DL precision ultrasonic gauges for thin materials
- Elcometer surface profile gauges
- Elcometer surface cleanliness test kits

Further information can be obtained from your local Elcometer supplier, direct from Elcometer, or by visiting www.elcometer.com.

15 WARRANTY

Elcometer Limited warrants the Elcometer 205, 206 and 206DL ultrasonic gauges against defects in materials and workmanship for a period of five years from receipt by the end user.

Additionally, Elcometer Limited warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If Elcometer Limited receives notice of such defects during the warranty period, Elcometer Limited will either, at its option, repair or replace products that prove to be defective.

Should Elcometer Limited be unable to repair or replace the product within a reasonable amount of time, the customer's alternative exclusive remedy shall be refund of the purchase price upon return of the product.

15.1 Exclusions

The above warranty shall not apply to defects resulting from: improper or inadequate maintenance by the customer; unauthorised modification or misuse; or operation outside the environmental specifications for the product.

Elcometer Limited makes no other warranty, either express or implied, with respect to this product. Elcometer Limited specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. Some states or provinces do not allow limitations on the duration of an implied warranty, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the five-year duration of this written warranty.

This warranty gives you specific legal rights, and you may also have other rights, which may vary from country to country, state to state or province to province.

15.2 Obtaining service during warranty period

If your hardware should fail during the warranty period, contact Elcometer Limited and arrange for servicing of the product. Retain proof of purchase in order to obtain warranty service.

For products that require servicing, Elcometer Limited may use one of the following methods:

- Repair the product
- Replace the product with a re-manufactured unit
- Replace the product with a product of equal or greater performance
- Refund the purchase price.

15.3 After the warranty period

If your hardware should fail after the warranty period, contact Elcometer Limited for details of the services available, and to arrange for non-warranty service.

APPENDIX A. TRANSDUCERS

Your gauge is capable of performing measurements on a wide range of materials, from various metals to glass and plastics. Different types of material, however, have different properties. The following paragraphs highlight the important properties of transducers which should be considered when assessing a particular measurement task.

The best measurement condition is one where sufficient ultrasonic energy is sent into the material being measured such that a strong, stable echo is received by the gauge.

Several factors affect the strength of ultrasound as it travels. These are outlined below:

A.1 Initial signal strength

The stronger a signal is to begin with, the stronger its return echo will be. Initial signal strength is largely a factor of the size of the ultrasound emitter in the transducer. A large emitting area will send more energy into the material being measured than a small emitting area. Therefore a 6 mm (1/4") transducer will emit a stronger signal than a 3 mm (1/8") transducer.

A.2 Absorption and scattering

As ultrasound travels through any material, it is partly absorbed. If the materials through which the sound travels have any grain structure, the sound waves will experience scattering. Both of these effects reduce the strength of the waves.

Higher frequency ultrasound is absorbed and scattered more than ultrasound of a lower frequency. It may seem therefore that using a lower frequency transducer might be better in every instance, however low frequencies are less directional than high frequencies.

A.3 Geometry of the transducer

The physical constraints of the measuring environment sometimes determine the suitability of a transducer for a given job. The transducer may simply be too large to be used in confined areas. Also, the surface area available for contacting with the transducer may be limited. Measuring on a curved surface may require the use of a transducer with a matching curved wearface.

A.4 Temperature of the material

When it is necessary to measure on surfaces that are exceedingly hot, special high-temperature transducers may be necessary. Additionally, care must be taken when performing a 'Calibration to Known Thickness' with a high temperature application - see "Measuring hot surfaces" on page 43.

A.5 Selecting the correct transducer

Elcometer have a complete range of transducers to meet your requirements, including:

- A range of frequencies and sizes

- Straight and right angle
- Transducers available as potted or microdot transducers:
 - Potted* transducers - transducer cable is permanently fixed to the transducer head.
 - Microdot* transducers - transducer cable is fixed to the transducer head by a connector - allows transducer heads to be replaced quickly and easily.
- High temperature transducers - temperature up to 340°C (650°F)

When selecting a transducer, it is important to choose one which will best meet your application, taking into consideration:

- The measurement range
- The type of material to be tested
- The design of the transducer probe type

For full details of the Elcometer range of transducers contact your local Elcometer supplier, or visit the Elcometer website www.elcometer.com

APPENDIX B. CONDITION AND PREPARATION OF SURFACES

The shape and roughness of the test surface are of paramount importance when carrying out ultrasonic thickness testing. Rough, uneven surfaces may limit the penetration of ultrasound through the material, and result in unstable, and therefore unreliable, measurements.

The surface being measured should be clean, and free of any small particles, rust, or scale. The presence of such obstructions will prevent the transducer from seating properly against the surface. Often, a wire brush or scraper will be helpful in cleaning surfaces. In more extreme cases, rotary sanders or grinding wheels may be used, though care must be taken to prevent surface gouging, which will inhibit proper transducer coupling.

Extremely rough surfaces, such as the pebble-like finish of some cast iron, will prove most difficult to measure. These kinds of surfaces act on the sound beam like frosted glass acts on light, the beam becomes diffused and scattered in all directions.

In addition to posing obstacles to measurement, rough surfaces contribute to excessive wear of the transducer, particularly in situations where the transducer is 'scrubbed' along the surface.

APPENDIX C. APPLICATION NOTES

C.1 Measuring tubing

When measuring a piece of pipe to determine the thickness of the pipe wall, orientation of the transducers is important.

If the diameter of the pipe is larger than approximately 100 mm (4"), measurements should be made with the transducer oriented so that the gap in the wearface is perpendicular (at right angles) to the long axis of the pipe.

If the diameter of the pipe is small, two measurements should be performed, one with the wearface gap perpendicular to the long axis of the pipe, another with the gap parallel to the long axis of the pipe (Figure 7). The smaller of the two displayed values should then be taken as the thickness at that point.

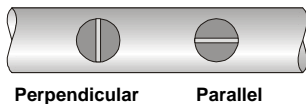


Figure 7. Transducer positioning on small diameter pipe

C.2 Measuring hot surfaces

The velocity of sound through a material depends upon the temperature of the material. As materials heat up, the velocity of sound in the material decreases. In most applications with surface temperatures less than approximately 100°C (~200°F), no special procedures are required. At temperatures above 100°C

(~200°F), the change in sound-velocity of the material being measured starts to have a noticeable effect upon the accuracy of ultrasonic measurement.

At such elevated temperatures, it is recommended that the user perform a calibration procedure (see “Calibration” on page 18) on a sample piece of known thickness, which is at, or near, the temperature of the material to be measured. This will allow the gauge to correctly calculate the velocity of sound through the hot material.

When performing measurements on hot surfaces, it may also be necessary to use a high-temperature transducer. It is recommended that the transducer be left in contact with the surface for as short a time as needed to acquire a stable measurement. While the transducer is in contact with a hot surface, it will begin to heat up, and through thermal expansion and other effects, may adversely affect the accuracy of measurements.

C.3 Measuring laminated materials

The density (and therefore sound-velocity) of laminated materials may vary considerably from one piece to another. Some laminated materials may even exhibit noticeable changes in sound-velocity across a single surface. The only way to reliably measure such materials is by performing a calibration procedure on a sample piece of known thickness. Ideally, this sample material should be a part of the same piece being measured, or at least from the same lamination batch. By calibrating to each test piece individually, the effects of variation of sound-velocity will be minimised.

An additional consideration when measuring laminates, is that any air gaps or pockets within the laminate will reflect the ultrasound beam. This will be noticed as a sudden decrease in thickness in an otherwise regular surface. While this may impede accurate measurement of total material thickness, it does provide positive indication of air gaps in the laminate.

C.4 Measuring through paint and coatings

When measuring through paints and coatings the sound-velocity of the paint/coating may be significantly different from the sound-velocity of the actual material being measured. An example of this would be a mild steel pipe with approximately 0.6 mm (.025") of coating on the surface. The sound-velocity of the pipe is 5918 m/s (.2330 in/ μ sec), and the sound-velocity of the paint is 2286 m/s (.0900 in/ μ sec). If the gauge is calibrated for mild steel pipe and measures through both materials, the actual coating thickness will appear to be 2.5 times thicker than it actually is, as a result of the differences in sound-velocity.

The error can be eliminated by using the echo-echo mode to perform measurements for applications such as these. In echo-echo mode, the paint/coating thickness will be eliminated entirely and the steel will be the only material measured.

APPENDIX D. DATA TRANSFER SOFTWARE

Software is available which allows data to be transferred from an Elcometer 206/206DL to a PC. Presently Elcometer supplies ElcoMaster.

The Elcometer 206 gauge is supplied without any software but ElcoMaster is available as a free download from the Elcometer website www.elcometer.com.

The Elcometer 206DL gauge is supplied with a CD containing ElcoMaster.

To set-up other types of communications software

Elcometer 206

1. Start the communications software.
2. Configure the software using the following parameters:
Data Bits - 8, Parity - None, Stop Bits - 1, Baud Rate 1200.
3. Set the communications software COM port to the port number that the gauge is connected to.

Elcometer 206DL

1. Start the communications software.
2. Configure the software using the following parameters:
Data Bits - 8, Parity - None, Stop Bits - 1, Baud Rate 1200 (to print a report), or 9600 to transfer data file.
Note: A report can be printed to a communications program (i.e. HyperTerminal), or printed to a serial printer using A4 or 8.5" x 11" paper.
3. Set the communications software COM port to the port number that the gauge is connected to.

APPENDIX E. SOUND VELOCITIES OF COMMON MATERIALS

Material	Sound-velocity (m/s)	Sound-velocity (in/ μ s)
Aluminium	6350	0.250
Bismuth	2184	0.086
Brass	4394	0.173
Cadmium	2769	0.109
Cast Iron	4572	0.180 (Approximate)
Constantan	5232	0.206
Copper	4674	0.184
Epoxy Resin	2540	0.100 (Approximate)
German Silver	4750	0.187
Glass, Crown	5664	0.223
Glass, Flint	4267	0.168
Gold	3251	0.128
Ice	3988	0.157
Iron	5893	0.232
Lead	2159	0.085
Magnesium	5791	0.228
Mercury	1448	0.057
Nickel	5639	0.222
Nylon	2591	0.102 (Approximate)
Paraffin	2210	0.087
Platinum	3962	0.156

Material	Sound-velocity (m/s)	Sound-velocity (in/μs)
Plexiglas	2692	0.106
Polystyrene	2337	0.092
Porcelain	5842	0.230 (Approximate)
PVC	2388	0.094
Quartz Glass	5639	0.222
Rubber, Vulcanised	2311	0.091
Silver	3607	0.142
Steel	5918	0.233
Steel, Stainless	5664	0.223
Stellite	6985	0.275 (Approximate)
Teflon	1422	0.056
Tin	3327	0.131
Titanium	6096	0.240
Tungsten	5334	0.210
Water	1473	0.058
Zinc	4216	0.166