

**Elcometer 207 • 207DL**

**Ultrasonic Thickness Gauge**

**Operating Instructions**



This product meets the Electromagnetic Compatibility Directive.

The product is Class A, Group 1 ISM equipment according to CISPR 11. Group ISM product: A product in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.

Class A product is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

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Material Safety Data Sheets for the ultrasonic couplant supplied with the Elcometer 207 & 207DL and available as an accessory, are available to download via our website:

Elcometer Ultrasonic Couplant Material Safety Data Sheet:

[www.elcometer.com/images/MSDS/elcometer\\_ultrasonic-couplant.pdf](http://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](http://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](http://www.elcometer.com).

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**Thank you for purchasing this Elcometer 207/207DL Precision 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 207/207DL Precision Ultrasonic Thickness Gauge 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](http://www.elcometer.com).

## **1 ABOUT YOUR GAUGE**

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The Elcometer 207/207DL Precision Ultrasonic Thickness Gauges are handheld gauges for fast and accurate measurement of the thickness of thin materials.

Your gauge is capable of measuring the thickness of various materials with accuracy as high as  $\pm 0.02$  mm ( $\pm 0.0008$ ""). 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.

Your gauge is also capable of measuring the thickness of plastics.

There are two versions of the gauge:

- The Elcometer 207 is the basic model.
- The Elcometer 207DL model includes all the features of the Elcometer 207 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 both models - Elcometer 207 and 207DL.

## 1.1 WHAT THIS BOX CONTAINS

- Elcometer 207 or 207DL Gauge
- Bottle of couplant
- Battery, 2 x
- Carrying case
- Operating instructions
- CD with data transfer and data collection software (DL version only)
- Data transfer cable
- 15MHz, 6mm (1/4") microdot right angle transducer

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.

**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.**

## 1.2 FEATURES OF THE GAUGE

**ECHO-TO-ECHO MODE:** Allows measurement of coated materials without having to remove the coating.

**INTERFACE-TO-ECHO MODE:** The gauge switches to this mode automatically when measuring thicker materials and plastic.

**PLAS MODE:** For measuring the thickness of plastics.

**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-LOGGING (207DL VERSION ONLY):** 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.

## **2 QUICK-START**

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To quickly configure the gauge and start taking readings:

1. Fit batteries: . . . . . see page 5
2. Fit transducer: . . . . . see page 6
3. Switch on: . . . . . see page 7/9
4. Try taking a reading: . . . . . see page 13
5. Adjust calibration: . . . . . see page 15

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:

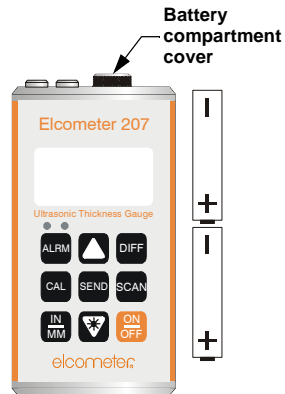
1. Locate battery compartment cover at top of gauge.
2. Unscrew battery compartment cover.
3. Referring to battery polarity instructions on rear of gauge, insert batteries into gauge ensuring correct polarity.
4. Replace battery compartment cover.

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.**



### 3.2 THE TRANSDUCER

The transducer transmits and receives the ultrasonic energy or sound waves that the gauge uses to determine the thickness of the material being measured. The transducer is connected to the gauge via a cable and a coaxial connector (Microdot connector).

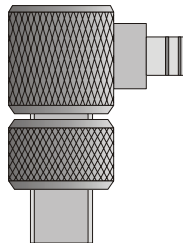
The transducer must be used correctly in order for the gauge to produce accurate, reliable measurements. The Elcometer 207 and the Elcometer 207DL operate only with the 15 MHz precision ultrasonic transducer.

The diagram shows the side view of the 15 MHz, single-element delay line transducer. The delay line is attached to the transducer with a retainer ring. A drop of couplant is applied between the delay line and the transducer body to allow the energy to be coupled in to the delay line. The transducer body has a single crystal element that generates the ultrasonic energy and this energy is coupled to the material to be measured. The energy passes from the transducer in to the material. It is reflected from the far wall of the material and coupled back in to the transducer. The area directly beneath the delay line is that which is measured.

Your gauge is supplied with two replaceable delay lines, 6.35 mm (1/4") and 12.7 mm (1/2"). The 12.7 mm (1/2") is suitable for most applications and measures steel up to 25 mm. Generally, it should be used to measure thicker materials. It will also dampen the signal of noisy materials, providing better accuracy.

The 6.35 mm (1/4") delay line provides more signal strength and may allow you to measure tough-to-penetrate materials.







To change the delay line, unscrew the end of the transducer and apply couplant to the connecting end of the delay line before screwing together.













### 3.3 THE KEYPAD





#### ELCOMETER 207

Key	Functions	For more information see
	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 switch SCAN mode on or off.	"Scan mode" on page 20.
	Press to adjust calibration.	"Calibration" on page 15.
	Press to change units (metric/imperial)	
	a) Increases values on the display (press and hold to change values quickly).	
	b) Switches between measurement modes (echo-echo, interface-echo or auto).	
	a) Decreases values on the display (press and hold to change values quickly).	
	b) Switches the display backlight between three settings; on, off and auto.	"Backlight" on page 24.
	c) Press and hold during gauge switch on to toggle LOC mode on/off	"Measurement mode" on page 18

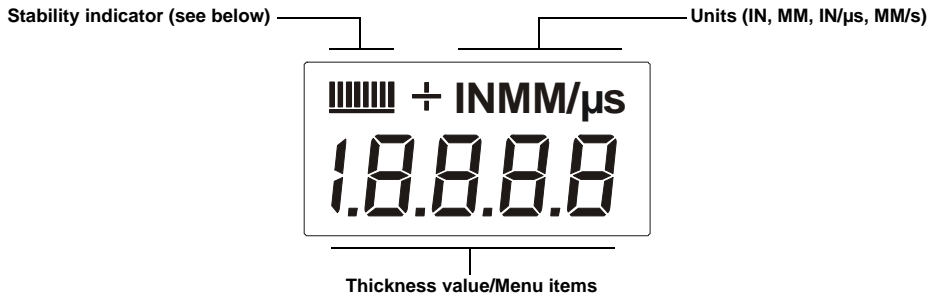
Key	Functions	For more information see
	a) Press and hold during gauge switch on to toggle the audible beeper on or off.	
	b) Press to toggle the alarm on or off, and to adjust the nominal thickness value.	"Alarm" on page 22.
	Press to toggle the DIFFERENTIAL mode on or off, and to adjust the nominal thickness value.	"Differential Mode" on page 21.
	Press to send the displayed thickness measurement to an external storage device via the RS232 port.	"Transferring data" on page 26.

## ELCOMETER 207DL




Key	Functions	For more information see
	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 adjust the features and settings of the gauge (alarm, scan, mode, units, backlight, and beeper).	
	Press to adjust calibration.	"Calibration" on page 15.
	Press to change units (metric/imperial)	
	a) Increases values on the display (press and hold to change values quickly).	
	b) When MODE key has been pressed, scrolls through the various features and settings of the gauge.	
	c) When MEM key has been pressed, scrolls through the various files, memory locations, and functions of the data logger.	

Key	Functions	For more information see
	a) Decreases values on the display (press and hold to change values quickly).	
	b) When MODE key has been pressed, scrolls through the various features and settings of the gauge.	
	c) When MEM key has been pressed, scrolls through the various files, memory locations, and functions of the data logger.	
	Press to switch data logging (memory) on/off.	"Using the data logger" on page 27
	Press when data logger is switched on to clear the contents of an entire batch, or an individual memory location. 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.	"Using the data logger" on page 27.
	a) Press to send the displayed thickness measurement to an internal memory location or an external storage device via the RS232 port.	"Transferring data" on page 26.
	b) Press to select data logging functions.	"Using the data logger" on page 27

### 3.4 THE DISPLAY



#### 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 14 and “Transducers” on page 37 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

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**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

- *Calibrate the gauge.* . . . . . See “Calibration” on page 15.
- *Prepare the surface.* . . . . . See “Condition and preparation of surfaces” on page 39.

#### 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 with the delay line 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 delay line surface 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 CALIBRATION

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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/ $\mu$ s) and the velocity of sound through aluminium is 6350 m/s (about 0.248 in/ $\mu$ 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:

**KNOWN THICKNESS 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.

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

**Note:** *Known thickness calibration 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.*

## 5.1 KNOWN THICKNESS 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.
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/ $\mu$ s**) 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.

## 5.2 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 42.

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/ $\mu$ 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/ $\mu$ s, or M/s flashing in the display), pressing the SCAN key (207) or CLR key (207DL) will restore the gauge to the factory default sound-velocity for steel, 5918 m/s (0.233 in/ $\mu$ 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 batch to batch 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.

## 6 SET-UP OPTIONS

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### 6.1 MEASUREMENT MODE

The gauge has three measurement modes; echo-echo, interface-echo and automatic.

**ECHO-ECHO:** The gauge has the ability to read thin metals from 0.15 mm to 10.14 mm (0.006" to 0.399"). The echo-echo mode also allows the user to measure the thickness of metals that have been previously coated or painted on the surface. This enables the user to determine the thickness of the metal without having to remove the paint.

**INTERFACE-ECHO:** The gauge has the ability to read thicker metals from 1.65 mm to 25.4 mm (0.065" to 1.0"), plastics and other difficult materials.

**AUTOMATIC:** In Automatic, the gauge will automatically switch between modes according to the different materials being measured.

**PLAS:** Plas mode can be used to measure thin plastics using a special graphite tip - see "Spares" on page 35.

The automatic (Auto) mode will generally be the mode of choice for the majority of common applications with the following exceptions:

- The gauge should be set to echo-echo mode when through-coating measurements are required.
- The gauge should be set to interface-echo when plastics above 1.52 mm (0.060") are being measured.

### 6.1.1 To select measurement mode

#### Elcometer 207

1. Press **ON/OFF** key to switch on the gauge.
2. Press **UP arrow** key to switch between the measurement modes. The gauge will display **GAtE I-E, GAtE E-E, GAtE Auto or GAtE PLAS** depending on which mode the gauge is in.
3. Repeat step 2 until correct mode is displayed.

#### Elcometer 207DL

1. Press **ON/OFF** key to switch on the gauge.
2. Press **MODE** key to activate features and settings. The gauge will display **GAtE I-E, GAtE E-E, GAtE Auto or GAtE PLAS** depending on which mode the gauge is in.
3. Press **SEND** key to switch between the measurement modes.
4. Press **MODE** key when correct mode is displayed.

Selection of measurement mode is now complete.

**Note:** *Once the measurement mode has been selected, use LOC mode to prevent accidental modification of the measurement mode. When your gauge is in LOC mode, all features (with the exception of the calibration and units), are locked and cannot be altered by the user.*

*Press and hold the DOWN arrow key while switching on the gauge to toggle LOC mode on/off.*

## 6.2 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 207

1. Switch on the gauge.
2. Press **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 207DL

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 toggle scan mode on or off.
5. Press **MODE** key when finished.

### 6.3 DIFFERENTIAL MODE

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 207

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 toggle 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 **SEND** key to select the nominal value entered.

#### Elcometer 207DL

1. Switch on the gauge.
2. Press **MODE** key.
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.

## 6.4 ALARM

The **Alarm** feature of your gauge allows you 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 207

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 **bEEP OFF** or **bEEP On** depending on whether the beeper is on or off.
4. Repeat steps 1 to 3 to toggle between **bEEP ON** and **bEEP OFF**.

#### Elcometer 207DL

1. Switch on the gauge.
2. Press **MODE** key to activate features and settings.
3. Press **UP** or **DOWN** arrow keys to scroll to **bEEP**.  
The gauge will display **bEEP OFF** or **bEEP 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 207

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 Lo alarm thickness value.
4. Press **SEND** key when correct value is displayed.  
The Hi value will now be displayed.
5. Repeat steps 3 and 4 to adjust and set the Hi alarm thickness value.

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

### To switch alarm off

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

### Elcometer 207DL

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.

## 6.5 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).

### 6.5.1 To set backlight mode

#### Elcometer 207

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 207DL

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 **LiE** symbol.  
The gauge will display **LiE OFF**, **LiE On** or **LiE Auto**, depending on backlight setting.
4. Press **SEND** key until the correct setting is displayed.
5. Press **MODE** key.

## 7 TRANSFERRING READINGS TO A COMPUTER

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Readings can be transferred from your gauge to a computer. The Elcometer 207 will transfer readings as they are taken. The Elcometer 207DL 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 an Elcometer 207DL, but must be ordered separately for an Elcometer 207 - see “Spares” on page 35.

Elcometer recommends the use of ElcoMaster® software to transfer the data - see “Data transfer software” on page 41. Other types of software may also be used.

ElcoMaster® is supplied with the Elcometer 207 & 207DL.

### 7.1 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.
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.



## 7.2 SETTING-UP THE SOFTWARE

- **ElcoMaster® Software for Measurement Data.** This software allows the user to transfer data from the memory of the gauge to a PC for archiving, analysis and reporting. Data can be transferred using the PC connection cable. ElcoMaster® includes all the charts that you may need together with a report designer to let you design your reports the way you wish to see them.

All this software can also be downloaded from the Elcometer website [www.elcometer.com](http://www.elcometer.com).

## 7.3 TRANSFERRING USING A CABLE

1. Connect your gauge to your PC using the optional cable.
2. Switch on your gauge.
3. Start the software and follow the instructions included with the software.

## 7.4 TRANSFERRING DATA

### Elcometer 207

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

### Elcometer 207DL

Follow the instructions in “Using the data logger” on page 27.

## 8 USING THE DATA LOGGER

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*(Elcometer 207DL only)*

The Elcometer 207DL 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).

### 8.1 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.

## 8.2 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.

## 8.3 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 8.1 and 8.2 have been completed, and 8.2 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.

#### 8.4 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.

#### 8.5 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.

## 8.6 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 25.
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 25.
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.

## 8.7 PRINTING A BATCH

A batch can, very simply, be sent to a communications program on a PC (e.g ElcoMaster®), and then printed. The procedure for printing a batch is outlined below:

1. Connect the gauge to a computer and start the data transfer software - see “Transferring readings to a computer” on page 25.
2. Press **ON/OFF** key to switch on the gauge.
3. Press the **MEM** key to activate the data logging functions and settings.
4. Press the **SEND** key to enter batch setup.
5. Press the **UP / DOWN** arrow keys to scroll to the batch to be printed (F-01, F-05, etc.).
6. Press **SEND**, once again, to select the batch to be printed. The display will flash **FILE F-05** (or the batch selected).
7. Press the **UP / DOWN** arrow keys to scroll to the flashing **Prnt F-05** (or the batch selected).
8. Press the **SEND** key to print the contents of the batch.
9. Press the **MEM** key, at any time, to exit the data logging functions.

## 9 STORAGE

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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.

## 10 MAINTENANCE

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Your gauge 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 direct 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](http://www.elcometer.com)

## 11 RELATED EQUIPMENT

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Elcometer produces a wide range of material thickness gauges and associated inspection equipment. Users of the Elcometer 207 and 207DL may also benefit from the following Elcometer products:

- Elcometer range of ultrasonic gauges
- 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](http://www.elcometer.com).

## 12 TECHNICAL SPECIFICATION

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Range:	0.15 mm to 25.4 mm (0.006" to 1.000")
Resolution:	0.002 mm (0.0001")
Accuracy:	$\pm 0.02$ mm ( $\pm 0.0008$ " ), depends on material and conditions
Sound-velocity range:	1250 m/s to 10 000 m/s (0.0492 in/ $\mu$ s to 0.3937 in/ $\mu$ s)
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 <sup>a</sup> equivalents
Battery life:	200 <sup>b</sup> hours continuous (alkaline dry batteries)

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a. Rechargeable batteries can be used if they are charged outside the gauge.

b. 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

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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
Transducer	15 MHz 6 mm (1/4") Microdot Transducer	T92016526
Transducer	Transducer Cable	T92016527
Transducer	Transducer delay line for PLAS mode	T92016871
Transducer	6 mm Dia x 9.5 mm Approx. Delay Line Tip	T92016528
Transducer	6 mm Dia x 12.7 mm Approx. Delay Line Tip	T92016529
Transducer	3 mm Dia x 9.5 mm Approx. Delay Line Tip	T92016530

## 14 WARRANTY

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Elcometer Limited. warrants the Elcometer 207 and 207DL 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.

#### **14.1 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.

#### **14.2 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.

### **14.3 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.

## **15 TRANSDUCERS**

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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:

### **15.1 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.

## **15.2 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.

## **15.3 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.

## **15.4 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 40.



## **16 CONDITION AND PREPARATION OF SURFACES**

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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.

## **17 APPLICATION NOTES**

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### **17.1 MEASURING TUBING**

When measuring a piece of tubing for wall thickness, it may prove beneficial to have multiple delay lines with different radiuses for different tubing diameters. The delay lines can be easily radiused by placing a piece of emery cloth around the tubing and moving the transducer back and forth until a radius has formed on the tip of the delay line.

## 17.2 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 15) 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 specially constructed high-temperature delay line. It is recommended that the probe 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 begin to adversely affect the accuracy of measurements.

## 17.3 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.

## **17.4 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/ $\mu$ sec), and the sound-velocity of the paint is 2286 m/s (.0900 in/ $\mu$ 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.

## **18 DATA TRANSFER SOFTWARE**

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Software is available to transfer data from the memory of your Elcometer 207/207DL to a PC. This is ElcoMaster, which provides data management and archiving and reports and charts. The report designer ensures you can layout your own report the way you wish to see it.

ElcoMaster is available as a free download from [www.elcometer.com](http://www.elcometer.com). The Elcometer 207DL is supplied with a CD containing ElcoMaster.

**18.1**

ElcoMaster is compatible with computers operating on Windows™ 7 and Vista. the installation conforms to the standard Windows™ method using 'Setup.exe'.

**19 SOUND VELOCITIES OF COMMON MATERIALS**

<b>Material</b>	<b>Sound-velocity (m/s)</b>	<b>Sound-velocity (in/μs)</b>
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

<b>Material</b>	<b>Sound-velocity (m/s)</b>	<b>Sound-velocity (in/<math>\mu</math>s)</b>
Nickel	5639	0.222
Nylon	2591	0.102 (Approximate)
Paraffin	2210	0.087
Platinum	3962	0.156
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