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Elcometer 204

Steel 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 1 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 are 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.

Material Safety Data Sheets for the ultrasonic couplant supplied with the Elcometer 204 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

Elcometer Ultrasonic Couplant (High Temperature) Material Safety Data Sheet:
www.elcometer.com/images/MSDS/elcometer_ultrasonic_couplant_hi_temp.pdf

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 204 Steel 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 204 Steel Ultrasonic Thickness Gauge is a world beating product. 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 204 Steel Ultrasonic Thickness Gauge is a handheld gauge for fast and accurate measurement of the thickness of steel.

Your gauge is capable of measuring the thickness of material such as steel plate with accuracy as high as ± 0.01 mm (± 0.001"). 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.

1.1 WHAT THIS BOX CONTAINS

- Elcometer 204 Steel Ultrasonic Thickness Gauge
- Transducer
- Bottle of couplant
- Battery, 2 x
- Carrying case
- Operating instructions

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 STANDARDS

The Elcometer 204 Steel Ultrasonic Thickness Gauge can be used in accordance with the following National and International Standards ASTM E 797, EN 15317.

2 GETTING STARTED

2.1 FITTING BATTERIES

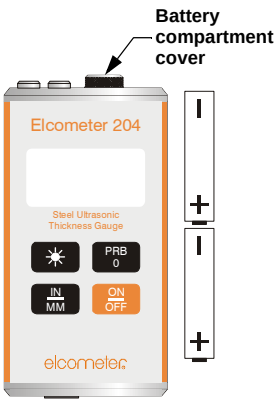
Your gauge may be used with dry cell batteries or rechargeable batteries. 2 x LR6 (AA) alkaline batteries are supplied in the kit.

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.

Note: *An interface is located on the bottom of your gauge. This interface is used to program the gauge at the factory and has no function for users of the gauge.*

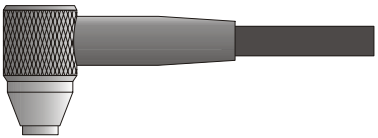
2.2 THE TRANSDUCER

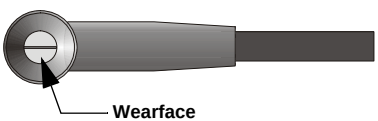
The transducer transmits and receives the ultrasonic energy or sound waves that the gauge uses to determine the thickness of the material being measured.

The transducer connects to the gauge via the attached cable, and two coaxial connectors. 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.

The diagram 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.





2.3 THE KEYPAD

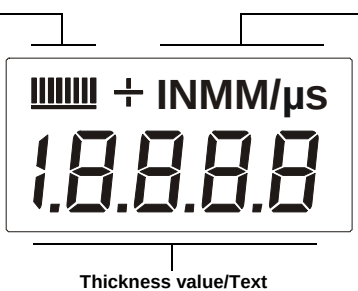
Key	Functions
	Press to switch the gauge on or off. When switching off, the gauge retains all of its settings. If the gauge is idle for 5 minutes, it will switch itself off.
	Press to change units (metric/imperial)
	Switches the display backlight between three settings; on, off and auto. • ON - backlight 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).
	Press to zero the gauge - see “Probe Zero” on page 10.

2.4 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 9 and “Transducers” on page 16 for information on how to achieve a stable measurement).



3 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. 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.

3.1 BEFORE YOU START

- *Prepare the surface.* . . . . . See “Condition and preparation of surfaces” on page 17.
- *Zero the gauge.*. . . . . See “Probe Zero” on page 10.

3.2 PROCEDURE

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 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 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.

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.*

4 PROBE ZERO

Setting the Zero Point (Probe Zero) of your gauge is important for the same reason that setting the zero on a mechanical micrometer is important. If the gauge is not 'zeroed' correctly, all the measurements the gauge makes will be in error by a fixed amount. When your gauge is zeroed, this fixed error value is measured and automatically corrected for in all subsequent measurements. To zero your gauge:

1. Switch on the gauge and connect the transducer.
2. Check that the wearface of the transducer is clean and free of any debris.
3. On the top of your gauge, above the display, is the battery compartment cover. This metal disc is also used when zeroing your gauge. Apply a single drop of ultrasonic couplant to the face of this disc.
4. Press the transducer against the disc, making sure that the transducer sits flat against the surface of the disc. The display should show some thickness value, and the Stability Indicator should have nearly all its bars illuminated.
5. While the transducer is firmly coupled to the disc, press the PRB-0 key on the keypad. The display will show 'Prb0' while it is calculating its zero point.
6. Remove the transducer from the probe-disc.

At this point, your gauge has successfully calculated it's internal error factor, and will compensate for this value in any subsequent measurements. Though the Elcometer 204 will remember the last probe-zero performed, it is generally a good idea to perform a probe-zero whenever the gauge is turned on. This will ensure that the instrument is always correctly zeroed.

5 CALIBRATION

The Elcometer 204 is a fixed velocity gauge setup for measuring 4340 mild carbon steel. Therefore, the Elcometer 204 is pre-calibrated for this specific material and cannot be calibrated for any other material types. The velocity of sound in mild carbon steel is 5920 meters/second (0.2330 inches/microsecond). However, because the material velocities of steel are relatively close in value from one type to the next, different grades are still able to be measured within an accuracy range of approximately ±2% of reading or ±0.5 mm (±0.02"). The accuracy will be dependent on the grade, granularity, and surface condition of the steel. If greater accuracy and calibration are needed, please consider some of the other models in our product line that will be suitable for your requirements.

6 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.

7 MAINTENANCE

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 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

8 RELATED EQUIPMENT

Elcometer produces a wide range of material thickness gauges and associated inspection equipment. Users of the Elcometer 204 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.

9 TECHNICAL SPECIFICATION

Range:	0.63 mm to 500 mm (0.025" to 19.999")
Resolution:	0.01 mm (0.001")
Accuracy:	±2% of reading or ±0.5 mm (±0.02"), whichever is the greater and depends on material and conditions
Weight:	295 g (10 oz) including batteries
Size:	63.5 mm x 120.6 mm x 31.5 mm (2.5" x 4.75" 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)

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.

10 SPARES

The following spare parts are available from your local Elcometer supplier or direct from Elcometer.

120 ml (4 oz) Ultrasonic couplant:	T92015701
Transducer: Potted Right angle, 5.0 MHz, 1/4":	T92015646
Fabric carrying case with straps	T92015617
Transducer	T92015646
Test Wedge 2-25mm	T9205243
Test Wedge 30-100mm	T9205270

11 WARRANTY

Elcometer Limited warrants the Elcometer 204 Steel Ultrasonic Thickness Gauge 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.

11.1 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. The warranty will be invalidated if the instrument has been opened.

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.

11.2 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.

11.3 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.

12 TRANSDUCERS

The following paragraphs highlight the important properties of your transducer 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:

12.1 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.

12.2 GEOMETRY OF THE TRANSDUCER

The physical constraints of the measuring environment sometimes determine the suitability of the 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 not be possible.

13 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.

14 APPLICATION NOTES

14.1 MEASURING TUBING

When measuring a piece of pipe to determine the thickness of the pipe wall, orientation of the transducer 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. The smaller of the two displayed values should then be taken as the thickness at that point.

14.2 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.

14.3 MEASURING LAMINATED MATERIALS

Your Elcometer 204 is not suitable for measuring the thickness of laminated materials. If you need to measure this type of material, please consider using one of the other ultrasonic thickness gauges available from Elcometer - please refer to the full details at www.elcometer.com

14.4 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/µsec), and the sound-velocity of the paint is 2286 m/s (.0900 in/µsec). Your gauge is calibrated for mild steel 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.