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Model UG20DL

Underwater 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.

These operating instructions are available for download on our website www.elcometerndt.com.

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All other trademarks acknowledged.

TMA-0515 Issue 01
Text with cover: 23212

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Thank you for purchasing this Elcometer NDT product. Welcome to Elcometer NDT.
The Model UG20DL Underwater 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 NDT. For more information visit our website at www.elcometerndt.com.

1 ABOUT YOUR GAUGE

The Model UG20DL is an underwater thickness gauge that measures with extreme versatility. It has the ability to measure coatings and material thickness simultaneously while maintaining the ability to locate pits, flaws and defects in the material. Based on the same operating principles as SONAR, the Model UG20DL is capable of measuring the thickness of various materials with accuracy as high as 0.01 millimetres (0.001 inches). 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.
The Model UG20DL includes a data-logging (memory) facility which allows readings to be stored in the memory before being downloaded to a computer.

1.1 STANDARDS

Your gauge can be used in accordance with the following Standards and test methods; ASTM E 797, EN 14127 and EN 15317.

1.2 WHAT THIS BOX CONTAINS

Model UG20DL, Bottle of couplant, Battery (3 x), Carrying case, Test certificate, Operating instructions, CD with software to enable you to transfer your readings and settings to and from a PC, RS232 cable and USB to Serial Converter.

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

1.3 PACKAGING

The gauge is packed inside its carry case within a cardboard box. Please ensure that the packaging is disposed of in an environmentally sensitive manner. Consult your Local Environmental Authority for further guidance.

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

2 SAFE USE OF YOUR GAUGE

This gauge is suitable for use underwater at depths of up to 300 m (1000 ft) provided that the following conditions are followed:

2.1 CARE OF THE HOUSING

1. Keep the gauge out of direct sunlight as much as possible to avoid any potential crazing or stress cracking of the housing, as well as discolouration.
2. Protect the housing from impact.
3. Submerge or rinse the enclosure and transducers in fresh water following use.
4. Do not exceed the depth limitation of 300 m (1000 ft). Failure to adhere to this warning may result in leakage, potential implosion and serious injury.

2.2 CARE OF THE HOUSING SEALS

The housing is sealed by o-rings, one on each end cap, which require meticulous care. In order to maintain a watertight seal, the o-rings and their mating surfaces must be clean, free of foreign material and lubricated with silicone grease.

The following procedure must be performed on the end cap o-rings before each use:

1. Clean all old silicone grease from o-rings and mating surfaces using paper towels.
2. Inspect o-rings for foreign material (sand, seaweed, hair, etc.), cracks, cuts, soft spots, or deformities. Replace o-ring if damaged. Inspect mating surfaces for scratches, rough spots, dents, or cracks.
3. Using a finger, apply a thin, even coat of silicone grease to o-rings on each end cap. Inspect to be sure the o-ring has been properly fitted, and screw the end cap back in place, until it has a nice snug fit.

3 GETTING STARTED

3.1 FITTING BATTERIES

Your gauge may be used with dry cell batteries or rechargeable batteries. 3 x LR6 (AA) alkaline batteries are supplied with this gauge.

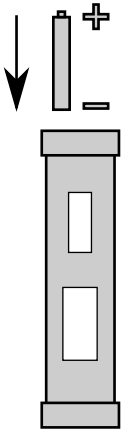
When the battery voltage is low the entire display will start to flash. When this occurs the batteries should be replaced.

To fit or replace batteries:

1. Remove the bottom end cap.
   The battery compartment cover is revealed.
2. Use a screwdriver to unscrew the battery compartment cover.
3. Insert batteries into gauge ensuring correct polarity.
   Note: When inserting batteries into the battery tube, ensure the positive (+) battery terminal is facing up towards the battery compartment cover - see illustration. Incorrect insertion may damage to the gauge.
4. Replace battery compartment cover.
5. Refering to “Care of the housing seals” on page 4, replace the bottom end cap.

Bottom End Cap

Battery compartment cover



Note: 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.

3.2 CHOOSING THE TRANSDUCER

When you purchased your gauge you should have also purchased a suitable transducer for your application. If you have not yet done so, refer to “Transducers” on page 24, which will help you identify the correct transducer type. Alternatively contact Elcometer NDT, your local Elcometer NDT supplier or visit www.elcometerndt.com

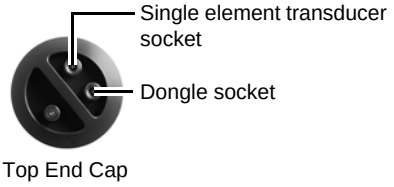
3.3 FITTING THE TRANSDUCER

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

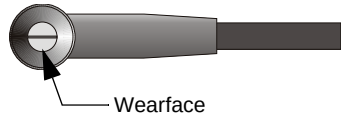
Fitting a dual element transducer: Connect the plugs of a dual element transducer to the sockets on the top end cap of the gauge. When using transducers manufactured by Elcometer NDT, the orientation of the dual connectors is not critical; either plug may be fitted to either socket.

Top End Cap

Fitting a single element transducer: Connect the plug of a single element transducer to the socket on the top end cap of the gauge as shown in the illustration. A special dongle must be fitted to the other socket as shown. Failure to fit the transducer plug and dongle as shown will result in the gauge not identifying the transducer correctly.

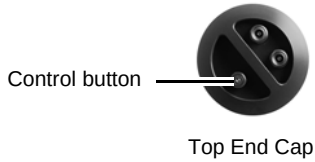


The transducer must be used correctly in order for the gauge to produce accurate, reliable measurements.
The illustration shows the two semicircles of the wearface and the barrier separating them on a typical transducer.
One of the semicircles transmits ultrasonic sound into the material being measured, 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.



3.4 SWITCHING ON/OFF

To switch on, press the control button on the top end cap.
To switch off, press and hold the control button. After approximately 10 seconds, POWER OFF is displayed and the gauge will then switch off. Once the gauge has switched off, release the button.
The gauge will switch off automatically after 4 minutes of inactivity. It should be noted that if the transducer face is not wiped clean, there is a chance an echo can continuously be detected. If that happens, the gauge will remain on until the battery life is exhausted. In this instance, switch off the gauge manually as described above.



4 THE CONTROLS

Your gauge is operated by a single button on the top end cap. There are three methods of pressing the button:

Method	Action	Notes
Press and Short Hold	Enters into, or exits out of the menu structure.	If entering into the menu structure, ENTER is displayed, followed by scrolling through the top level menu items. If exiting the menu items, EXIT is displayed, and then the display shows either the current storage location (i.e. A1), or MEMOFF if data storage has been disabled. Once either instance has occurred, the button must be released.
Press and Release	Selects a menu item.	To select a top level menu item, press and release the button. The submenu items will begin scrolling on the display. To select a submenu item, press and release again.
Press and Long Hold (10 seconds)	Switches the gauge on and off.	See “Switching on/off” on page 6.

5 THE DISPLAY

Your gauge is equipped with two LCD displays.

- One display shows the gauge settings and memory location menu items.
- The other display shows measurement readings.

5.1 GAUGE SETTINGS AND CONTROL DISPLAY

The gauge settings and memory locations are displayed as a set of top level menu items, each of which has one or more submenu items.

There are two menu structures used by the gauge. Choice of menu structure is determined automatically by the gauge and depends upon the type of transducer fitted to the gauge; dual element type or single element membrane type.

5.1.1 Menu Structure - Dual Element Type Transducer

STORE	DIRECT	CLEAR	ZERO	GAIN	MATL	UNITS	MODE	UG20DL
A 1	NORTH	LOC	AUTO	VLOW	ALU	IN	P-E	LT ON
	SOUTH		MANUAL	LOW	STL	MM	PECT	LT OFF
	EAST		COATIN	MED	STST		E-E	LT AUTO
	WEST			HIGH	IRON			MEMOFF
				VHIGH	CIRO			
					PVC			
					PLST			
					PLUR			
					CUSTOM			

5.1.2 Menu Structure - Single Element Membrane Type Transducer

STORE	DIRECT	CLEAR	MATL	UNITS	MODE	UG20DL
A 1	NORTH	LOC	ALU	IN	E-E-E	LT ON
	SOUTH		STL	MM		LT OFF
	EAST		STST			LT AUTO
	WEST		IRON			MEMOFF
			CIRO			
			PVC			
			PLST			
			PLUR			
			CUSTOM			

In order to simplify operation of the gauge, some of the menu items listed above will not be visible. Visibility depends upon the gauge settings:

- If MEMOFF is selected (if you do not want to store measurements), the data logging section of the gauge is disabled. As a result, MEMOFF moves to the first top level menu option (in place of STORE) and DIRECT and CLEAR are disabled and not displayed.
- If a custom material type has not been uploaded into the gauge, CUSTOM is disabled and not displayed in the MATL submenu.

The current settings of the gauge are displayed when it is switched on and then every 30 seconds. This provides visual confirmation of the the settings at any time without having to scroll through the menus to find the values of the settings. The gauge settings are displayed in the following order:

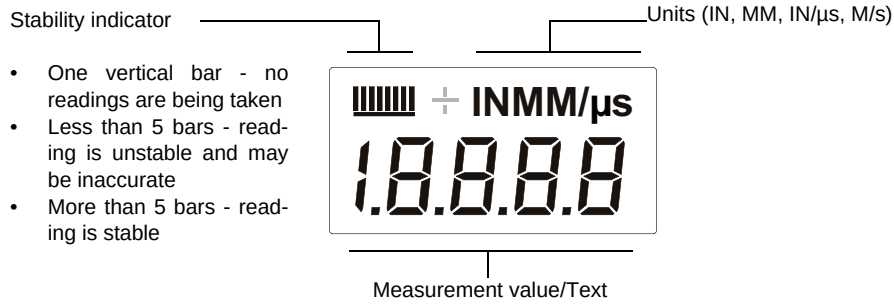
Gauge Model	UG20DL
Battery Status	LO, MED, or HI
Transducer Type Identified	1/2 5, 1/2 3.5, 1/2 2 S or 1/2 5 S
Measurement Mode	P-E, PECT, E-E or E-E-E
Current Gain Setting	VLOW, LOW, MED, HIGH or VHIGH
Material Type	ALU, STL, STST, IRON, CIRO, PVC, PLST, PLUR, or CUSTOM

5.1.3 How to Select an Item in a Submenu

1. Press and hold the control button until the top level menu items begin scrolling, then release the button.
2. When the required top level menu item is displayed, immediately press and release the control button.
   The submenu items begin scrolling.
3. When the required submenu item is displayed, immediately press and release the control button.
   The submenu item is selected and is identified by a comma mark in the top left corner of the display - in the example shown MED is selected.

4. *Optional:* Press and hold the control button to escape out of the menu items at any time.

5.2 MEASUREMENTS DISPLAY



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

Note: The display will hold the last value measured, until a new measurement is made.

Note: When the battery voltage is low, the entire display will begin to flash. When this occurs, the batteries should be replaced.

6 MEASUREMENT - MODES

Your gauge has two basic measurement modes, Pulse-Echo and Echo-Echo, plus other variations on these modes for specific measurement tasks.
If an auto identified transducer is fitted to the gauge the appropriate mode will be automatically set.

To select measurement mode:

Use the control button to select MODE from the top level menu items and then select the mode required from the submenu items.

Note: The availability of the modes depend upon the type of transducer fitted to the gauge.

6.1 PULSE-ECHO MODE (P-E), COATING OFF

This mode measures from the initial pulse (sometimes referred to as an artificial zero) to the first echo (reflection). This mode only requires one reflection and it is therefore the most sensitive mode for measuring weak reflections (flaws) typically found when measuring heavily corroded metals. If this mode is used to measure a coated sample, then the thickness of the substrate plus coating will be measured.

6.2 PULSE-ECHO COATING MODE (PECT), COATING ON

A custom hybrid combination mode which allows you to measure both the coating thickness and the material thicknesses at the same time, while still retaining the ability to locate flaws and pits in materials.

When PECT mode is used, the coating thickness value cannot be viewed on the display of the gauge - only the base material thickness is displayed. If the data logger is selected however, the coating thickness value is stored in memory. When the readings data are downloaded to a PC, the coating thickness measurements can be viewed, together with the A-Scan waveform which is also stored in the file. This waveform can prove very valuable, as it provides the inspector additional confidence that the measurement was successful.

The gauge is preset at the factory with a coating sound velocity of 2159 m/s (0.0850 in/µs). factory. This velocity is a very close approximation of the common coating velocities found in the field. If you want to change this value, connect the gauge to a PC and use Elcometer NDT Link software supplied with the gauge to upload a new value - see “Data Transfer Software” on page 19.

Note: Rough surface conditions can have an effect on the overall accuracy in this mode. If the surface condition is in question, the pulse-echo mode should be used in conjunction with performing an off block automatic zero as the temperature gradient changes.

6.3 ECHO-ECHO MODE (E-E), THRUPAINT™

This mode measures between two reflections. This technique is commonly used to eliminate errors from surface coatings and also to make measurements in multiple layered materials. The disadvantage is that two echoes are needed which requires a much stronger echo (reflection).

Thrupaint™ mode cannot be used for flaw or pit detection. Therefore, inspectors may need to use this mode in conjunction with the standard coating off (pulse-echo) flaw detection mode for some applications. This combination of using both modes is ideal for the advanced inspectors needs.

6.4 SINGLE ELEMENT TRANSDUCER TRIPLE ECHO MODE (E-E-E)

The triple echo mode measures between three reflections and is used only when a single element transducer is connected to the gauge. Similar to E-E mode, this technique is commonly used to eliminate errors from surface coatings and also to make measurements in multiple layered materials. The primary benefit of this mode, is that a comparison is made, between the second and third echoes, to verify that a peak jump has not occurred, providing an additional level of confidence to the measurement.

Generally the disadvantage is that three reflections are needed which requires the use of gates with controllable thresholds to adjust for sensitivity over a given measurement range. However, the time corrected gain feature built into this mode automatically adjusts the gain setting for each individual echo reflection ensuring that the signal levels from each echo are equal in amplitude.

When the element in the transducer sends a pulse of sound waves, it also generates noise. Since only one element is used to both send and receive sound waves, small defects that reflect very little sound energy back to the transducer are lost in the reflection of this background noise. Therefore, these transducers should only be used when general material thickness is required, and *never* used for corrosion inspections. If you need to locate blind surface pitting or internal material flaws, a dual element transducer should *always* be used.

7 SETTING UP THE GAUGE

7.1 AUTOMATIC TRANSDUCER IDENTIFICATION

When you switch on your gauge, it will automatically identify the transducer type connected as described below:

Note: Your gauge will only work correctly when fitted with Elcometer NDT transducers.

1. Connect the transducer to the gauge - see “Fitting the transducer” on page 5.
2. Ensure all couplant has been removed from the face of the transducer.
3. Switch on the gauge - see “Switching on/off” on page 6.
   The settings and memory display will begin scrolling the current gauge settings, one of which is the transducer type (1/2 25 or 1/2 5)...etc.
4. If the display shows NO PRB, and a dual element probe has been connected to the gauge, either the transducer is faulty, or it is not an Elcometer NDT transducer supplied for this gauge type. If a single element membrane transducer has been connected, be sure the dongle is connected to the correct socket on the end cap of the gauge - “Fitting the transducer” on page 5. Switch off the gauge and repeat the above steps until the transducer type has been identified.
   If the probe is identified, the gauge will now automatically perform a probe zero - see “Transducer - Zeroing” on page 11.

7.2 TRANSDUCER - ZEROING

Setting the zero point for the transducer is important for the same reason that setting the zero on a mechanical micrometer is important. If the zero point of the transducer 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 transducer is set, this fixed error value is measured and automatically corrected for in all subsequent measurements.

The gauge will perform a probe zero whenever it is switched on. You should also perform a probe zero whenever you change the transducer and at other times on a regular basis. The zero probe routine *must* be done prior to calibration. This will ensure that the zero point of the instrument is always correct.

When a dual element transducer is connected to the gauge:

- If the selected mode is either pulse-echo (P-E) or pulse-echo coating (PECT), a probe zero will automatically be done following startup.
- If the selected mode is echo-echo, you must first change mode to either pulse-echo (P-E) or pulse-echo coating (PECT), before performing a probe zero.

Note: Multi-echo modes do not require a probe zero.

Your gauge has two methods of conducting a probe zero:

Automatic probe zero (off block): When this function is selected the gauge conducts an electronic zero automatically, eliminating the need for a zero disk or block

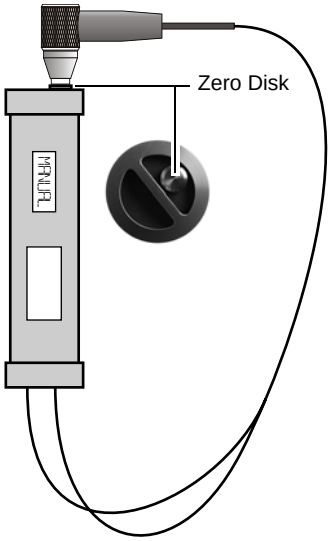
Manual probe zero (on block): When this function is selected the transducer must be placed on the probe zero disk located on the bottom end cap.

7.2.1 To conduct an automatic probe zero (off block)

1. Remove all couplant from the face of the transducer and check that the wearface of the transducer is clean and free of any debris.
2. Use the control button to select ZERO from the top level menu items and then AUTO from the submenu items.

The gauge performs the automatic zero and is then ready to be calibrated for a given material type.

7.2.2 To conduct a manual probe zero (on block)



1. Remove all couplant from the face of the transducer and check that the wearface of the transducer is clean and free of any debris.
2. Use the control button to select ZERO from the top level menu items.
   The zero submenu items begin scrolling.
3. Apply a drop of couplant on the transducer and place the transducer in steady contact with the zero disk (located on the bottom end cap), and obtain a steady reading.
   Note: Do not remove the transducer from the zero disk.
   The display should show a thickness value, and nearly all the bars of the stability indicator should be illuminated.
   Note: The value that is displayed will change depending on the current velocity setting in your gauge. Disregard the value displayed; it is not important. What is important is accurately performing these steps to ensure reliability of the zero calculation.
4. Use the control button to select MANUAL from the sub-menu items.
   The gauge performs the manual zero.
5. Remove the transducer from the zero disk.

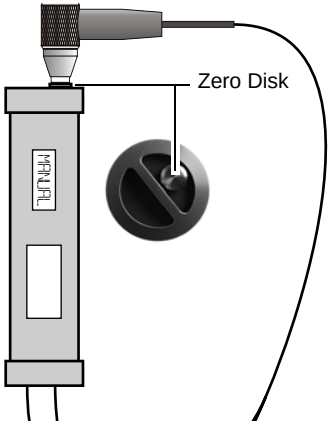
The gauge is now ready to be calibrated for a given material type.

7.3 TRANSDUCER - ZEROING FOR COATING MEASUREMENTS

In order to account for very slight electronic differences in transducers of the same type, frequency, and diameter, your gauge has a "zero coating" feature. This enables your gauge to obtain very accurate readings on coatings, eliminating potential errors incurred from slight differences in the manufacturing processes.

The coating zero should be performed on the zero disk or an uncoated section of the material being tested or something similar.

Note: For this procedure, a coating transducer must be fitted to the gauge.



1. Remove all couplant from the face of the transducer and check that the wearface of the transducer is clean and free of any debris.
2. Use the control button to select ZERO from the top level menu items.
   The zero submenu items begin scrolling.
3. Apply a drop of couplant on the transducer and place the transducer in steady contact with the zero disk (located on the bottom end cap), and obtain a steady reading.
   Note: Do not remove the transducer from the zero disk.
   The measurement display should show a thickness value, and nearly all the bars of the stability indicator should be illuminated.
   Note: The value that is displayed will change depending on the current velocity setting in your gauge. Disregard the value displayed; it is not important. What is important is accurately performing these steps to ensure reliability of the zero calculation.
4. Use the control button to select COAT from the submenu items.
   The gauge performs the coating zero.
5. Remove the transducer from the zero disk.

7.4 CALIBRATING

In order for the gauge to make accurate measurements, it must be calibrated to the sound-velocity of 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/µs) and the velocity of sound through aluminium is 6350 m/s (about 0.248 in/µs). 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.

To calibrate your gauge for the material you are measuring, you select the material from a list of materials stored in the gauge. For each material stored in the list there is a corresponding sound-velocity value. There are eight factory-set materials which you cannot change, plus one user customisable sound-velocity value:

Submenu Item	Material	Sound-velocity	
		m/s	in/µs
ALU	Aluminium	6350	0.2500
STL	Steel 4340	5918	0.2330
STST	Stainless Steel 304	5662	0.2229
IRON	Iron	5893	0.2320
CIRO	Cast Iron	4572	0.1800
PVC	PVC	2388	0.0940
PLST	Polystyrene	2337	0.0920
PLUR	Polyurethane	1778	0.0700
CUSTOM	User-defined sound-velocity	-	-

7.4.1 Selecting a Material and Sound-velocity

Use the control button to select MTL from the top level menu items and then select the material required from the submenu items.
The gauge is now calibrated for the material selected and ready to take readings.

7.4.2 Editing the User Customisable Sound-velocity Value

To calibrate your gauge for the material and coating you are measuring, use NDT Link to define the sound-velocity for the material and for the coating and to upload these values into the gauge - see the instructions included with NDT Link and “Data Transfer Software” on page 19.

8 MEASUREMENT - TAKING READINGS

Disclaimer: Inherent in ultrasonic thickness measurement is the possibility that the instrument will use the second rather than the first echo from the back surface of the material being measured. This may result in a thickness reading that is TWICE what it should be.
Responsibility for proper use of the instrument and recognition of this phenomenon rests solely with the user of the instrument.
Other errors may occur from measuring coated materials where the coating is insufficiently bonded to the material surface. Irregular and inaccurate readings may result. Again, the user is responsible for proper use and interpretation of the measurements acquired.

8.1 BEFORE YOU START

- Prepare the surface - see “Condition and Preparation of Surfaces” on page 26.
- Set the zero point of the transducer - see “Setting up the Gauge” on page 11.
- Select units - see “Units” on page 16

8.2 PROCEDURE

1. **Apply couplant**
   For the gauge to work correctly there must be no air gap between the transducer and the surface of the material to be measured. This is achieved using a couplant. When the gauge is used underwater as intended, the water itself acts as a couplant. However when the gauge is used above water, a couplant will be required.
   Before the transducer is placed on the surface, put a small amount of couplant on the surface of the material. Typically a single drop is sufficient.
2. **Place transducer onto the surface of the 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 the measurement display**
   If six or seven bars of the stability indicator on the measurement display 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 a number of measurements every second when the transducer is in contact with the surface of the material. The measurement display is updated as each reading is taken.
4. **Remove transducer from surface**
   The measurement 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 can be seen 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.

9 THRUPAINT™ MEASUREMENT TECHNIQUE

9.1 Introduction

The principle behind ThruPaint™ measurement is to measure the time between two backwall echoes returning from the test material. Since both of these backwall echoes travel the same path through the paint or coating, the thickness of the coating is subtracted out of the measurement so that only the material thickness is measured. This feature saves you a great deal of time scraping and removing the coating from tanks and pipes during the inspection process.

The primary purpose of ThruPaint™ measurement is to determine overall material thickness; ThruPaint™ mode cannot be used for flaw or pit detection. Therefore, inspectors typically use this echo-echo ThruPaint™ mode in conjunction with a standard pulse-echo flaw detection mode. The combination of using both modes is ideal for the advanced inspectors needs.

9.2 Setting Up ThruPaint™ Mode

When you select the appropriate transducer type from the list of probes stored in the gauge, a basic echo-echo ThruPaint™ configuration is recalled from memory. Each of the transducers in the list contain pre-configured echo-echo settings. However, fine adjustments may be necessary for specific applications. Once the transducer type has been selected and the appropriate calibration procedure completed, you can toggle between pulse-echo (flaws and pits), and echo-echo (ThruPaint™) modes by pressing MULTI MODE.

Note: When you have configured your gauge settings, save these changes to a setup location prior to switching off the gauge. Failure to do so will result in losing your changes.

10 MEASUREMENT OPTIONS

10.1 GAIN

The gain (the amplitude of the return echo) can be adjusted to suit a variety of applications. To obtain valid readings the gain must be set to the correct level to give reliable return echoes:

- Too much gain may result in erroneous measurements by detecting noise rather than the material back wall itself.
- Not enough gain may result in intermittent detection. It may also result in lack of detection on internal flaws, pits, or porosity.

The gain setting on your gauge can be compared to the volume control of a home stereo system. If you turn it up too much you cannot hear the music clearly. If it is turned down too much, you cannot hear it at all.

Note: GAIN will only be displayed as a top level menu item if a dual element style transducer has been connected, and the gauge is in either pulse-echo mode (P-E) or pulse-echo coating mode (PECT). Multiple echo modes, which include both single and dual style probes, are equipped with automatic gain control that optimises the gain setting automatically and in these modes, GAIN is disabled and not displayed.

Your gauge has been optimised for a medium gain setting and for the majority of applications it can be used at this setting. Some applications however may require lower or higher gain settings:

- **Lower values** might be necessary for noisy or granular cast materials. If the reading becomes sporadic and will not settle down or resolve on a thickness value, it is reasonable to assume that the material is either very noisy aluminium, or granular cast iron. In this instance, reduce the gain to see if the reading settles down and becomes stable.
- **Higher values** may be necessary when trying to measure a material that is hard to penetrate (due to the material type, or the overall thickness of the material) and when locating fine pits or flaws. In these instances, increase the gain to see if the reading settles down and becomes stable.

To select a gain setting:

Use the control button to select GAIN from the top level menu items and then select the gain setting required from the submenu items:

- VLOW
- LOW
- MED
- HIGH
- VHIGH

10.2 UNITS

The measurement readings can be displayed in metric units (mm) or English units (inches):

Use the control button to select UNITS from the top level menu items and then select the units setting from the submenu items:

- IN
- MM

10.3 DISPLAY BACKLIGHTS AND LEDS

Your gauge has three lighting options. Choose the option which best meets your requirements for visibility versus power consumption:

Use the control button to select LIGHTS from the top level menu items and then select the required option from the submenu items:

- LT ON - Select to switch on all the LEDs and display backlights.
- LT OFF - Select to switch off all the LEDs and display backlights.
- LT AUTO - Select to switch on all the LEDs and display backlights when the gauge takes a measurement.

11 MEASUREMENT - RECORDING YOUR READINGS

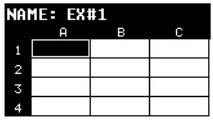
Your gauge is equipped with a data logger - an essential feature for improving the efficiency of product inspection. With a data file open, all your readings values are saved into the file, therefore eliminating the need to manually record measurements during the inspection process. Once all the measurements have been taken, the gauge can then be connected to a computer or serial printer to save and print the results of the inspection.

11.1 ABOUT THE DATA LOGGER

With a data file open, as you take measurements, the measurement data is stored in files in the gauge memory.

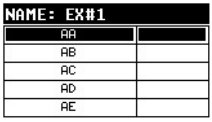
Data logger file format: You have a choice of two different file formats:

- *Grid format*: Similar to a spreadsheet format in which each cell is used to store a reading. Cells are referenced by the row number (1 to 999) and the column label (A to ZZ).



Grid format

- *Sequential format*: A single column of up to 512 possible rows (readings), and a column of corresponding identifiers associated with each individual reading. The identifier can be a combination of up to 10 alphanumeric/special characters (see below), however it must not start or end with a special character. Once a start and end ID are entered into the gauge and the log created, the gauge automatically generates all the identifiers within that range.



Sequential format

Data logger filename character sets: Any combination of the following characters can be used for file names and sequential format identifiers:

- Numeric characters: 0 - 9
- Alpha Characters: A - Z
- Special Characters: ! ' _ # space / . - ( )

What measurement data is saved: When a measurement is taken (irrespective of log file format), the following information is saved:

- The reading value.
- A screenshot of the echo waveform plus all the gauge settings. This ‘Save Graphics’ option can be toggled on/off.

Memory capacity: You can create and save as many data files as required up to the maximum capacity of the gauge memory (32 Mbit). If you try to create a new file which exceeds the memory capacity, the gauge will display an error message. In this instance, to free some space in memory, you should consider deleting some of the existing files or transferring them to a computer

Note: Multiple grids can be created and saved as template files on a PC, using NDT Link software, but only one grid can be uploaded into the gauge at a time.

Save Graphics Option	Memory Capacity (readings)
On	16 000 +
Off	210 000 +

11.2 CREATING A DATA LOGGER FILE

You define the parameters of a data logger file using NDT Link software. Once the file has been defined and saved, you then transfer the file to the gauge using the supplied PC connection cable. For full instructions on how to define the parameters of a data logger file and save it, see the help included with NDT Link. The following sections describe the data logger file parameters which must be defined:

11.2.1 Coordinates/Identifiers

Grid files: A grid is defined by using coordinates to define the Top Left and the Bottom Right corners of the grid. Alpha coordinates are horizontal across the top, and numeric coordinates are vertical down the side - similar to the coordinates of a cell in a spreadsheet.
The boundaries of the grid are set by defining the coordinates for the top left cell and the lower right cell.

Sequential files: A sequential file is a single column of up to 512 possible rows (readings), and a column of corresponding identifiers associated with each individual reading.
The boundaries of the column are set by defining a start ID and an end ID (the gauge will automatically generate all the identifiers within this range).
With both file formats (Grid/Sequential), if you attempt to create a file that is larger than the stated boundaries, an error message OUT OF MEMORY is displayed.

11.2.2 Auto Increment Direction

The Auto Increment function allows you to specify which direction to advance the cursor after storing a reading.

11.2.3 Save Graphics Option

When you create a data logger file you have the option of specifying whether a screenshot of the echo waveform plus all the gauge settings is saved with each reading value. Saving the waveform and settings for each reading may be of benefit for reporting purposes, and gives additional confidence in the measurements, as the waveform can be studied to review and confirm the validity of the measurement values.

11.3 ENABLING THE DATA LOGGER

1. Switch on the gauge - see “Switching on/off” on page 6.
   - If the display shows a storage location in the left most top level menu item (i.e. A1), the data logger is already enabled and ready to store readings.
   - If the display shows MEMOFF in the left most top level menu item, the data logger is disabled and must be enabled.
2. To enable the data logger, select LOGGING and then select MEM ON from the submenu items.
   When the data logger is enabled, the current storage location is displayed in the left most top level menu item (i.e. A1).

11.4 MOVING STORAGE LOCATION WITHIN A DATA FILE

When you define a data file using NDT Link software one of the selection options is Increment Direction. The increment directions are those of a compass; NORTH, SOUTH, EAST, WEST and NONE.

- When the increment direction is set to NORTH, SOUTH, EAST, or WEST, the gauge will automatically move to the next storage location in the defined direction.
- When the increment direction is set using NDT Link to NONE, you have to manually set the increment direction in the gauge.

When a data file is open, you can navigate your way through the file using these increment directions (for instance, to save a reading in an alternative location, or just to review measurements):

Use the control button to select DIRECT from the top level menu items and then select the direction required from the submenu items:

- NORTH
- SOUTH
- EAST
- WEST

Note: If you want to step quickly through storage locations in a single direction, follow the steps above, and then continuously press and release the control button to move in the direction chosen.

11.5 SAVING READINGS IN A DATA FILE

To save readings in a data file:

1. Create a data file and transfer it to the gauge using NDT Link - see “Creating a Data Logger File” on page 18.
2. Ensure the data logger file is enabled - see “Enabling the data logger” on page 18.
3. Take a reading - see “Measurement - Taking Readings” on page 14.
4. Press and release the control button.
   The measurement value and data is saved to the current storage location of the data file.
   The storage location is then advanced automatically in the direction defined.

Note: The storage location must be empty. If the storage location already contains measurement data, the gauge will not take a measurement. Either clear the storage location, or move to an empty location.

11.6 CLEARING A STORAGE LOCATION

To delete measurement data from a storage location:

1. Move to the storage location you want to clear - see “Moving Storage Location within a data file” on page 18.
1. Use the control button to select CLEAR from the top level menu items.
   CLEAR and then the storage location (i.e. A1) are shown alternating on the display.
2. Press and release the control button.
   The storage location is cleared.

12 DATA TRANSFER SOFTWARE

Software is available which allows data and settings to be transferred between your gauge and a PC. Presently Elcometer supplies NDT Link software for this purpose.

To set-up other types of communications software:

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.

12.1 TRANSFERRING DATA AND SETTINGS

12.1.1 Data port

The data port socket (LEMO type) is located behind the bottom end cap of the gauge. It is designed to connect directly from the gauge to a standard AT serial port on a PC. The cable supplied with the gauge is a LEMO to 9 pin serial cable.

Data port socket

12.1.2 Computer System Requirements

NDT Link will run on many different operating systems: Windows 98 (1st or 2nd edition), Windows NT 4.0 with Service Pack 5, Windows ME, Windows XP, Windows 2000 Professional, Windows 2000 Server, or Windows 2000 Advanced Server operating systems running on Intel or AMD hardware.
A Pentium 166MHz or faster processor with at least 32 megabytes of physical RAM is required. You should have 40 megabytes of free disk space before attempting to install NDT Link.
NDT Link requires an available communications port in order to transfer data to and from the gauge. NDT Link supports COM1, COM2, COM3, and COM4.

12.1.3 USB to Serial Converter

Some newer laptop computers do not have standard serial ports. In this case it is possible to use a USB to Serial converter. If a serial to USB cable is needed, contact Elcometer (part number: TL-24032).

12.1.4 Installing NDT Link

NDT Link comes on a CD-ROM with an automatic installer program. Place the CD in your computer's CD tray and close the door. Open the CD-ROM by double clicking on the My Computer ICON, then double click on the CD. Finally, double click on the SETUP icon to begin the installation. Refer to the help section in NDT Link software for the complete operating manual, setup, and operation.

13 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.

14 MAINTENANCE

You own one of the finest underwater thickness gauges in the world. If looked after, it will last a lifetime.

14.1 FAULTS

Your gauge is designed to give many years reliable service under normal operating and storage conditions. 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 NDT supplier or directly to Elcometer NDT. The warranty will be invalidated if the instrument has been opened.

14.2 TRANSDUCER

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 NDT supplier or directly from Elcometer NDT.

15 TECHNICAL SPECIFICATION

Measuring Range[a]	Pulse-Echo P-E	0.63 mm to 500 mm (0.025” to 19.999”)
	Pulse-Echo Coating PECT	Material: 0.63 mm to 500 mm (0.025” to 19.999”) Coating: 0.01 mm to 2.54 mm (0.001” to 0.100”)
	Echo-Echo E-E	2.54 mm to 102 mm (0.100” to 4.0”) Range will vary +/- depending on the coating.
	Triple Echo E-E-E	1 mm to 150 mm (0.040” to 6.0”) in steel Range will vary +/- depending on the coating.
Measurement Rate (Manual)		4 readings per second
Measurement Resolution		0.01 mm (0.001")
Velocity Calibration Range		1250 m/s to 13995 m/s (0.0492 in/µs to 0.5510 in/µs)
Velocity		1 user-programmable velocity (for material and coating) 8 pre-calibrated velocities (aluminium, cast iron, iron, polystyrene, polyurethane, PVC, stainless steel and steel)
Weight (including batteries)		680 g (1.5 lbs)
Dimensions (Length x Dia.)		229 mm x 60.33 mm (9.0” x 2.375”)
Gauge Operating Temperature		-29°C to 60°C (-20°F to 140°F)
Case		High strength transparent plastic housing with gasket sealed end caps and magnetically coupled operating button. Depth rating of 300 m (1000 ft).
PC Connection		RS232 serial port. Windows PC interface software
Display		12.7 mm (1/2”) 4.5 Digit LCD (Measurement Display) 9.5 mm (3/8”) 6 Character LCD (Settings and Memory Display) Both displays have LED backlight (on/off/auto).
Power Source		Three 1.5 V alkaline or 1.2 V NiCad AA cells. With LED backlight off, typically operates for 50 hours on alkaline and 15 hours on NiCad (charger not included.) *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.*

a. Measuring Range depends on material, surface conditions and the transducer selected.

16 WARRANTY

Elcometer NDT warrants your gauge against defects in materials and workmanship for a period of two years from receipt by the end user.
Additionally, Elcometer NDT warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If Elcometer NDT receives notice of such defects during the warranty period, Elcometer NDT will either, at its option, repair or replace products that prove to be defective. The warranty will be invalidated if the instrument has been opened.

16.1 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 NDT makes no other warranty, either express or implied, with respect to this product. Elcometer NDT 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 two-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.
This warranty is void in the event of negligent handling of the housing including, but not limited to, dropping the housing, modifications to the housing by other than the manufacturer, improper care of the sealing components, and exceeding the specified depth limitation of 300 m (1000 ft).

16.2 OBTAINING SERVICE DURING WARRANTY PERIOD

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

16.3 AFTER THE WARRANTY PERIOD

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

17 SPARES

Your gauge is complete with all the items required to get started and take measurements (transducers must be ordered separately). Over the life of the gauge replacement items may be required. The following replacement and optional items are available from your local Elcometer NDT supplier or directly from Elcometer NDT.

Description	Sales Part No.
3.5 MHz 1/2” Potted Top Dual Element Underwater Transducer	TX3M50EP-3
5.0 MHz 1/2” Potted Top Dual Element Underwater Transducer	TX5M00EP-8
2.25 MHz 1/2” Lemo Single Element Membrane Underwater Transducer	TX2M25EL-2
5.00 MHz 1/2” Lemo Single Element Membrane Underwater Transducer	TX5M00EL-2
Underwater Gasket Lubricant, 6 g	TC-24034-6
O-Ring Kit (1 lubricant, 2 gaskets)	TZ-24037

Note: A wide range of other transducers and accessories is available - see www.elcometerndt.com for details.

18 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:

18.1 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.

18.2 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.

18.3 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.

18.4 TEMPERATURE OF THE MATERIAL

When it is necessary to measure on surfaces that are exceedingly hot, special high-temperature transducers may be necessary.

18.5 SELECTING THE CORRECT TRANSDUCER

Elcometer NDT has 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 480°C (896ºF)

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 and the design of the transducer probe type.

The following table gives guidance on the type of transducer required for a range of measurement tasks:

Material being measured	Mode	Transducer type required	Notes
High penetration plastics and castings	PULSE-ECHO (P-E) COATING OFF	Cast iron - 1MHz to 5MHz transducer. Cast aluminium - 10MHz transducer. Plastics typically require lower frequency transducers depending on the thickness and make-up of the material.	Your gauge has been optimised for cast materials. Larger diameters offer greater penetration power because of the crystal size, for difficult to measure materials.
Corrosion and pit detection in steel and cast materials	PULSE-ECHO (P-E) COATING OFF	Typically a 5MHz transducer or higher is required.	Use lower frequencies for greater penetration and use higher frequencies for better resolution.
Total thickness of material plus coatings	PULSE-ECHO COATING (PECT) COATING ON	A special coating style transducer is required.	There are a variety of coating transducers in various frequencies available from Elcometer.
Material thickness measured through a coating	ECHO-ECHO (E-E) THRUPAINT™	Special high damped transducers are required; typically the 3.5MHz, 5MHz, and 7.5MHz hi damped transducers.	These transducers are suitable for use in both pulse-echo and echo-echo modes. This enables you to measure overall material thickness using the THRUPAINT™ mode, and then switch to pit detection mode (COATING OFF) without changing transducers.

Material being measured	Mode	Transducer type required	Notes
Thin materials	PULSE-ECHO (P-E) COATING OFF	High frequency transducers are required; typically the 7.5MHz and 10MHz models with extra resolution.	The higher frequencies provide greater resolution and a lower minimum thickness rating overall.
High temperature	PULSE-ECHO and ECHO-ECHO	Special 2.25MHz and 5 MHz High temperature transducers are required.	Echo-echo mode will eliminate error caused by temperature variations in the delay line of the transducer.
Noisy material		Select a higher frequency transducer to reduce this noise - 7.5MHz and higher for better resolution.	Materials such as titanium, stainless steel, and aluminium may produce surface noise. This is a signal that appears at the surface of the material when using a dual element delay line probe.
Measuring extreme curvatures or areas of restricted access		Higher frequency transducers with smaller diameters are required. The smallest diameter uses 3/16" crystals with a contact area of .250"	

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

19 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.

20 APPLICATION NOTES

20.1 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 - see illustration. The smaller of the two displayed values should then be taken as the thickness at that point.

Perpendicular **Parallel**

20.2 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.

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.

20.3 MEASURING LAMINATED MATERIALS

Your gauge 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 NDT - please refer to www.elcometerndt.com for details.

21 SOUND VELOCITIES OF COMMON MATERIALS

Material	Sound-velocity	
	(m/s)	(in/µs)
Aluminium	6350	0.250
Bismuth	2184	0.086
Brass	4394	0.173
Cadmium	2769	0.109
Cast Iron	4572	0.180 (Approx.)
Constantan	5232	0.206
Copper	4674	0.184
Epoxy Resin	2540	0.100 (Approx.)
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 (Approx.)

Material	Sound-velocity	
	(m/s)	(in/µs)
Paraffin	2210	0.087
Platinum	3962	0.156
Plexiglas	2692	0.106
Polystyrene	2337	0.092
Porcelain	5842	0.230 (Approx.)
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 (Approx.)
Teflon	1422	0.056
Tin	3327	0.131
Titanium	6096	0.240
Tungsten	5334	0.210
Water	1473	0.058
Zinc	4216	0.166

22 THE MENU COMMANDS

Note: The availability of these commands depends upon the transducer type and gauge settings.

Top Level Menu Item	Submenu Item	Description
STORE	A 1	Displays the current measurement reading storage location. This location can refer to either a grid cell location (similar to a cell in a spreadsheet), or a sequential format location, depending on which file format was uploaded into the gauge. *Note: A grid file structure is loaded into the gauge prior to despatch from the Elcometer NDT factory.* If MEMOFF is selected, the STORE top level menu item is replaced by MEMOFF.
DIRECT	NORTH	Part of the data logger. The submenu item selected specifies in which direction to advance the cursor after a measurement is stored. If a two dimensional grid format is being used, all direction options can be used, however if a sequential file format is used, only NORTH and SOUTH are applicable. If MEMOFF is selected, DIRECT is disabled and not displayed.
	SOUTH	
	EAST	
	WEST	
CLEAR	LOC	Part of the data logger. If a measurement is stored by mistake, or in the wrong location, the measurement can be cleared from memory using this option. Use DIRECT to advance to the location, then select CLEAR to erase the stored measurement. If MEMOFF is selected, CLEAR is disabled and not displayed.

Top Level Menu Item	Submenu Item	Description
ZERO	AUTO	Initiates an off-block electronic zero automatically, eliminating the need for a manual zero on a specified disk or block. When the gauge is switched on, it performs an auto zero during the boot sequence. However, another auto zero may be needed to account for changes in temperature, or an incorrect zero due to couplant on the end of the transducer during the zeroing process.
	MANUAL	Initiates an on-block manual zero. This zero is used to reset the internal zero for of the gauge, as a reference point for the auto zero. *Note: The reference disk is located on the bottom end cap.*
	COATIN	In order to account for very slight electronic differences in transducers of the same type, frequency, and diameter, your gauge has a zero coating feature. This enables your gauge to obtain very accurate readings on coatings, eliminating potential errors incurred from slight differences in the manufacturing processes. This zero is only used when the PECT coating mode feature is being used. Although the coating thickness is not displayed on the display, the coating thickness is stored with the base material thickness when a measurement is saved to memory. Once the data is downloaded to a PC, the coating thickness will be displayed with the PECT measurement stored.
GAIN	VLOW	Select to eliminate unwanted noise or for maximum resolution.
	LOW	Select to reduce unwanted noise or for better resolution.
	MED	The standard setting.
	HIGH	Select for better penetration.
	VHIGH	Select for maximum penetration.

Top Level Menu Item	Submenu Item	Description
MATL	ALU	Aluminium: 6350 m/s (0.2500 in/µs)
	STL	Steel: 5918 m/s (0.2330 in/µs)
	STST	Stainless Steel:
	IRON	Iron:
	CIRO	Cast Iron:
	PVC	PVC:
	PLST	Polystyrene:
	PLUR	Polyurethane:
	CUSTOM	Custom material. The common material types listed above each have a standard factory-set sound-velocity. Materials of the same type, can have varying grades and consistencies and as a result, the material sound-velocity will also have slight variations. CUSTOM is included to allow you to add your own sound-velocity, and can be programmed via NDT Link PC software
UNITS	IN	Select for measurements in inches.
	MM	Select for measurements in millimetres.
MODE	P-E	Select to measure non-coated material (bare metals).
	PECT	Select to measure coated materials. Measures the thickness of both the base material and coating.
	E-E	Select to measure coated materials. Measures the base material only without having to remove the coating.
	E-E-E	Special multiple echo mode used only with Elcometer NDT single element membrane transducers.
UG20DL	LT ON	Select to switch on all the LEDs and display backlights.
	LT OFF	Select to switch off all the LEDs and display backlights.
	LT AUTO	Select to switch on all the LEDs and display backlights when the gauge takes a measurement.
	MEMOFF	Select to disable data logging. When selected, this submenu item moves to the start of the top level menus.