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Model PG70ABDL

Precision Gauge

Operating Instructions

This product meets the Electromagnetic Compatibility Directive.

These operating instructions are available for download on our website www.elcometerndt.com. These operating instructions are available in a number of languages. For the avoidance of doubt, please refer to the English language version.

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Thank you for purchasing this Elcometer NDT product. Welcome to Elcometer NDT.
The Elcometer PG70ABDL Precision 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 Elcometer PG70ABDL is a precision 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 Elcometer PG70ABDL is capable of measuring the thickness of various materials with accuracy as high as 0.001 millimetres (0.0001 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 Elcometer PG70ABDL includes a data-logging (memory) facility which allows readings to be stored in batches 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

Elcometer PG70ABDL, 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 THE KEYPAD

MENU	Activates the primary menu structure containing 9 menu tab groups. These tab groups then contain sub menu items, or functions. The sub menu items are organised in tab groups according to how closely they are related to the individual tab group names.
CLR	Clears a measurement from a grid log files cell location or set obstruct, and backspace in an Alpha Edit Box. If you have already saved a measurement and B-Scan to a cell location, use this key to clear the measurement at any time.

	Press to start taking measurements. The readings are displayed in the upper half of the screen and the measurement hot menu items are displayed in the lower half of the screen. Scrolls forward through hot menu items.
	Press to confirm a change or selection. If your gauge is displaying a grid log, this key toggles an advance to row number option.
	In the MENU, MEAS and EDIT functions this key acts as a back or escape function. If your gauge is displaying a grid log, the  key toggles the display options; RF, RECT, B-SCAN or DIGITS. Scrolls back through hot menu items.
	In the menus, scrolls through the menus, increases/decreases values, and toggles functions.
	In menus this key activates list and edit boxes, displays and saves measurements to grid files locations. While making measurements, when COL or ROW is highlighted, opens a log file.
	Press to select a predefined setup (to select a factory or previously saved user setup for a variety of different transducer types and gauge settings).
	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.

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. 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.

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.

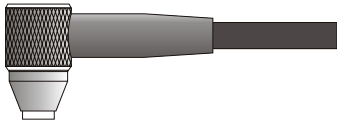
3.2 CHOOSING THE TRANSDUCER

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 38, 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

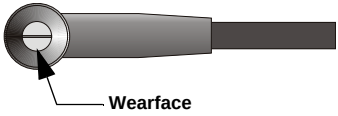
The transducer transmits and receives ultrasonic sound waves that the gauge uses to calculate the thickness of the material being measured.

The transducer connects to the gauge via the attached cable, and two coaxial connectors. When using transducers manufactured by Elcometer NDT, 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 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

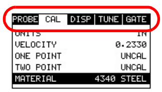
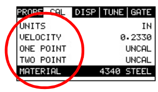
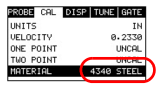
To switch on or off, press the on/off key (⏻).
The gauge will switch off automatically after 5 minutes of inactivity.

4 THE MENUS

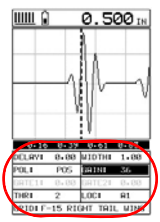
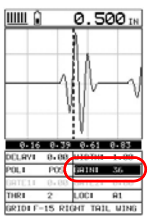
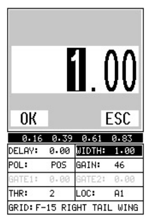
Your gauge has two menu systems:

- Full menu - displays all the functions and settings of the gauge (see also page 43).
- Hot menu - displays a sub-set of functions and settings related to taking measurements.

4.1 FULL MENU

Press MENU once to access the menus...	then press MENU to scroll to the right along the sub menu bar and ESC to scroll left to the sub menu you want.	Use △ and ▽ to scroll to the function you want within the sub menu...	then use ◁ and ▷ to: • scroll to the option you want, or • select/unselect
			

4.2 HOT KEY MENU

Press MEAS once to access the measurement screen. The hot menu functions are displayed at the bottom of the reading screen.	Press MEAS to scroll right along the hot menu functions and ESC to scroll left until the function you want is highlighted.	Use △, ▽, ◁ and ▷ to adjust the value of the function.	Alternatively, adjust values by pressing ENTER then use △, ▽, ◁ and ▷ to scroll and adjust values. Press OK when finished.
			

4.3 SELECTING MENU LANGUAGE

The menus can be displayed in English, Spanish, and German.

1. Press MENU, scroll to the SETUP menu and then highlight the LANGUAGE function.
2. Use the ◁ and ▷ arrows to scroll the language options.
3. Once the desired language is displayed, press MEAS to return to the measurement screen.

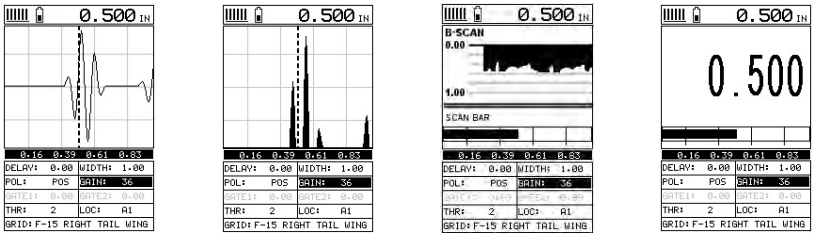
5 THE MEASUREMENT SCREEN

Your gauge has four types of measurement screen:

- A-Scan Waveform, RF
- A-Scan Waveform, RECT
- B-Scan
- Digits

A-SCAN **B-SCAN** **DIGITS**

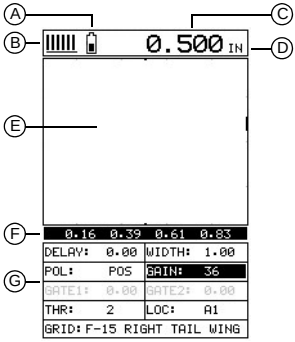
RF **RECT**



To see the measurement screen, press MEAS.
To select which measurement screen to use, press MENU, select DISP, select VIEW and then select RF, RECT, B-SCAN or DIGITS.

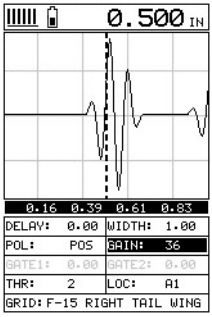
5.1 ITEMS COMMON TO ALL MEASUREMENT SCREENS

A number of items are common to all the measurement screens:



A	Battery Icon	Indicates the battery life remaining.
B	Repeatability/Stability Indicator	When taking readings, this indicator is used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, your gauge is reliably measuring the same value 3 to 32 times per second, depending on which measurement mode and features are enabled.
C	Material Thickness Value	The thickness of the material under the transducer - small digits.
D	Units	The current measurement units (Metric/English).
E	Measurement View Area	RF, RECT, B-SCAN or DIGITS view area (depending upon current settings).
F	Measurement Labels Bar	The measurement labels display the viewable range and are based on the values of DELAY and WIDTH. The grid of grey lines in the measurement view area divide the display up into 5 segments, or quadrants. The measurement labels correspond to the measurement at each of these lines.
G	Hot Menu	Each of the fields located under the display are called the Hot Menu Fields. These fields provide rapid access to some of the functions needed to control the display settings, measurement modes, and grid memory control. All of these fields can be adjusted without having to activate the main menu items and search through a variety of menus to make adjustments.

5.2 RF A-SCAN MEASUREMENT SCREEN



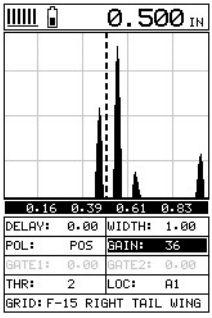
The RF display shows a graphical representation (similar to the trace of an oscilloscope) of the sound reflections returning to the transducer. The waveform display shows the amplitude of the signal received on the vertical (Y) axis and time (shown in units of thickness) on the horizontal (X) axis.

The waveform includes both the positive and the negative peaks.

The point which is triggering the digital thickness reading (called the detection point) is displayed as a vertical dashed line. This line crosses the measurement labels bar at the material thickness value indicated at the top of the display.

The RF waveform view is typically used for fine tuning of the gauge prior to carrying out an inspection.

5.3 RECT A-SCAN MEASUREMENT SCREEN

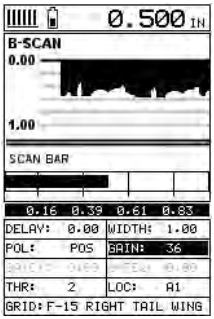


The RECT display is similar to the RF display but shows only half of the waveform. Either the positive or negative peaks are shown, depending on the polarity selected. The correct polarity is typically determined by first using the RF display to select the optimal phase.

The detection point is indicated by the same vertical dashed line as shown in the RF display.

The RECT display is the preferred view for flaw and pit detection applications.

5.4 B-SCAN MEASUREMENT SCREEN



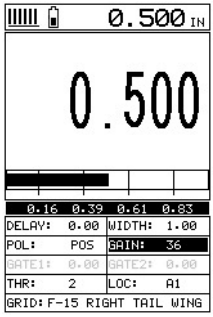
The time-based B-Scan display provides a cross sectional view of the material being tested. In this example, the top, or accessible side of the material is represented as 0.00”, and the bottom, or blind surface at .500”.

This mode is used when you need to inspect the profile of the blind surface. It can also be a useful view when scanning for pits and flaws. The B-Scan display is equipped with a scan bar representing the overall thickness. The scan bar gives the user a visual indication when a flaw or defect is passed over during the scan process.

If you are scanning a pipe, for instance, and pass over a pit during the process, the scan bar will quickly deflect and alarm you to go back and search for the defect.

5.5 DIGITS DISPLAY

The digits display shows the thickness as a value using a large font size. This view is used typically when the gauge is being used as a basic thickness gauge. The digits display includes the same scan bar as the B-Scan display.



5.6 CHANGING THE VIEWABLE RANGE

In RF view, RECT view and B-SCAN view, if the waveform around the detection point is not visible on the display, use one of the following methods to adjust the viewable range off the display:

- Change the values of the DELAY and WIDTH functions until the measurement falls inside the viewable range of the display - see instructions below.
- Use the Auto Find function - see “Auto Find” on page 24.

Note: Even if the waveform is outside of the viewable range of the display, a measurement can be taken and viewed using the DIGITS view.

5.6.1 DELAY

The starting depth DELAY is the starting thickness value. Under normal circumstances this value will be set to zero in order to start measuring at 0.00 mm/inches.

Adjust DELAY to something other than zero if you need to zoom in on a specific measurement range. For example, consider a test material 1 inch in thickness in which potential corrosion is only on the back surface and not possibly deeper than .200". In this case, you may wish to set the DELAY at .700" to zoom in closer to the area where corrosion is likely to be present. In turn, the WIDTH might be set at 1.100" in order to cover the entire range. This will result in better resolution for the Scan Bar and for the RF, RECT and B-Scan measurement screens.

5.6.2 WIDTH

WIDTH represents the overall viewable thickness range being tested. For example, if you are measuring tank walls with a total thickness of .300", and DELAY is set to 0.000", you might consider setting your WIDTH value to 0.400" to cover the entire thickness range being tested.

WIDTH can be thought of as a zoom feature for the Scan Bar and for the RF, RECT and B-Scan measurement screens; the larger the overall thickness range view (WIDTH), the smaller the noticeable shifts in the graphical display. Therefore, it is best to set the DELAY and WIDTH to reasonable values that zoom in and optimise your graphic presentation.

5.6.3 Adjusting DELAY and WIDTH

The quickest way to adjust DELAY and WIDTH is directly from the hot menu. Alternatively, adjust the values using the menus:

1. Press MENU, scroll to the DISP menu and then highlight the DELAY function or the WIDTH function as required.
2. Use ◁ and ▷ to scroll the value. When the correct value is being displayed, proceed to step 7.
3. Alternatively, press ENTER to display the Digits Edit Box.
4. Use △ and ▽ to scroll the highlighted value.

5. Use ◁ and ▷ to scroll the digit locations.
6. Repeat steps 4 and 5 until the value is correct.
7. Press OK to set the value and return to the menu screen, or ESC to cancel.
8. Press MEAS to return to the measurement screen.

5.7 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: When the echo-echo ThruPaint™ measurement mode is selected, the manual gain feature is disabled and greyed out in the menu items. In this mode, your gauge switches to an automatic gain mode (AGC) that optimises the gain setting automatically.

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.

5.7.1 To Adjust the Gain Value

The quickest way to adjust GAIN is directly from the hot menu. Alternatively, adjust the value using the menus:

1. Press MENU, scroll to the TUNE menu and then highlight the GAIN function.
2. Use ◁ and ▷ to adjust the GAIN value. When the correct value is being displayed, proceed to step 7.
3. Alternatively, press ENTER to display the Digits Edit Box.
4. Use △ and ▽ to scroll the highlighted value.
5. Use ◁ and ▷ to scroll the digit locations.
6. Repeat steps 4 and 5 until the value is correct.
7. Press OK to set the value and return to the menu screen, or ESC to cancel.

8. Press MEAS to return to the measurement screen.

5.8 THRESHOLD

The Threshold is the level (sensitivity) of the signal amplitude required to trigger the thickness reading. This level can be used in conjunction with the Gain.
For example, if you can see a potential flaw on the display, but the gauge is not detecting on the flaw because the Gain is too low, or the Threshold to high, the Threshold level can be decreased (lower sensitivity) in order to detect signals with lower amplitudes. This will allow the amplitude from the reflection of the flaw to reach and exceed the Threshold level, and enable the gauge to detect on the flaw or defect. This can also be accomplished by increasing the Gain, allowing the signal to exceed the current Threshold level. Lowering the Threshold increases sensitivity, and raising the Threshold decreases the sensitivity respectively.

5.8.1 To Adjust the Threshold Value

The quickest way to adjust THRESHOLD is directly from the hot menu. Alternatively, adjust the value using the menus:

1. Press MENU, scroll to the TUNE menu and then highlight the THRESHOLD function.
2. Use ◁ and ▷ to adjust the THRESHOLD value. When the correct value is being displayed, proceed to step 8.
3. Alternatively, press ENTER to display the Digits Edit Box.
4. Use △ and ▽ to scroll the highlighted value.
5. Use ◁ and ▷ to scroll the digit locations.
6. Repeat steps 4 and 5 until the value is correct.
7. Press OK to set the value and return to the menu screen, or ESC to cancel.
8. Press MEAS to return to the measurement screen.

5.9 GATES

Your gauge is equipped with gates which control the time measurement process. Using gates to adjust the time measurement process allows you to measure a specific region on and between waveforms.
For instructions on how to use gates, see “Gates” on page 20.

5.10 FRONT PANEL LIGHTS

The green light illuminates when the alarm mode is active and the measured thickness is within limits.
The red light illuminates when the alarm mode is active and the measured thickness is less than the alarm low value, or the measured thickness is greater than the alarm high value.

6 MEASUREMENT - MODES

Your gauge has four measurement modes, Pulse-Echo, Pulse-Echo with Gate, Echo-Echo and Interface-Echo.

To select measurement mode from the measurement screen, either press MULTI MODE repeatedly until the correct mode is displayed, or:

1. Press MENU, scroll to the GATE menu and then highlight the MEASURE MODE function.
2. Use ◁ and ▷ to select the MEASURE MODE (P-E, P-E GT, E-E, I-E).
3. Press MEAS to return to the measurement screen.

Note that the availability of the modes depends upon the type of transducer fitted to the gauge.

6.1 PULSE-ECHO MODE (P-E)

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 MODE (P-E GT)

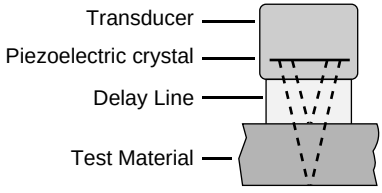
This is the same as the standard Pulse-Echo mode described above, but Gate 1 is active.

6.3 ECHO-ECHO MODE (E-E)

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).
Echo-echo 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. Chassis tubing inspectors and sanctioning bodies will typically use the echo-echo mode for tubing with powder coatings, and pulse-echo mode for tubing without coating. This combination of using both modes is ideal for very detailed inspections.

6.4 INTERFACE-ECHO MODE (I-E)

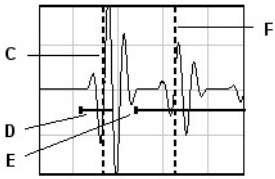
This mode measures from the end of an interface (delay line), to the first return reflection of the test material. Although this mode is similar to echo-echo mode (both modes use two gates and virtually look the same on the display), they are measuring in different ways and are used to accomplish different application tasks.
The diagrams below explain in more detail the differences between interface-echo mode and echo-echo mode.
The diagram illustrates the sound path in a delay line single element transducer being used in Interface-Echo mode. The piezoelectric crystal in the transducer emits the sound wave. The delay line is commonly made of acrylic or graphite. The tip of the delay line forms the interface with the test material. Two signals are received; one is the reflection from the end of the delay line and one is the reflection from the back wall of the test material.



The measurement will be made from the reflection off the end of the delay tip and back wall of the test material.

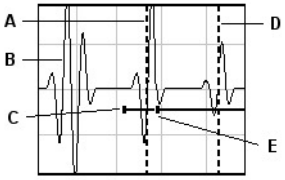
The next diagram shows the waveform displayed in **interface-echo mode**. When **idle**, a waveform from the end of the delay line will always be displayed and active on the screen (A). Since the gates are also used in interface-echo mode, they will be displayed (B). When **measuring**, two detects will be displayed between two waveforms at (C) and (F). The measurement starts at (C), the end of the delay line, and measures to the back wall of the test material at (F). Point (D) represents GATE1, the gate 1 start position, and (E) HOLDOFF2, the gate 2 holdoff. Notice that the start position of the gate 2 holdoff (E) has been adjusted to the right of the delay line waveform. This is done to avoid potential detection on the ring down of the delay line interface, and allow a detection to occur on the back wall of the test material at (F).

Interface-Echo (idle)



Interface-Echo (measuring)

This diagram illustrates a typical view of **echo-echo mode** using a delay line style transducer. The end of the interface or delay line is displayed at (B). However, unlike interface echo mode the measurement is occurring between two return reflections (A) and (B). Recall that in interface echo mode, the measurements occurred between the interface (B) and the first return reflection (A). This is the primary difference between the two modes. An important thing to note is that the ring down cycles from the transducer are much less than in interface echo mode. This allows the gauge to see much closer to the first return reflection making it possible to measure very thin materials. This mode is also used for thru-paint measurements. By measuring between two echoes, the thickness of paint and coatings will be eliminated completely. Therefore, any paint or coating on the surface of the test material will not be added to thickness of the test material.

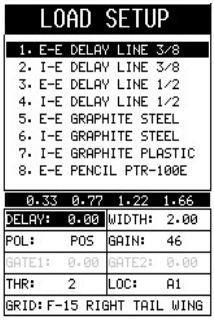


Echo-Echo Measurement (w/Delay-Line)

7 SETTING UP THE GAUGE

7.1 TRANSDUCER - SETTING TYPE OF

The first step in using your gauge is to select the transducer type from the predefined list of setups stored in the gauge.
There are delay tip lengths of 3/8" and 1/2". There is also a pencil style transducer option, Part number TX10M0BM-1. This option offers both a .060" and .125" diameter contact area tip. By selecting the setup associated with a specific transducer type, all the gauge settings will also be loaded and setup.
Once the setup has been selected, your gauge will recall these settings every time it is switched on. The setup will only change if you select a previously saved setup from the list.
Follow these steps to select your transducer type:



1. Press MULTI MODE.
   A list of setups of measurement modes and transducers is displayed.
2. Use △ and ▽ to scroll through the list until the appropriate type is highlighted and then press ENTER.
   Note: Ensure the transducer type you select is the same as the transducer plugged into your gauge; ***failure to do this will result in erroneous measurements***.
3. When the CONFIRM screen displays 'OVERWRITE CURRENT SETTINGS', press OK to overwrite the existing transducer type with the newly selected transducer type.

You now need to perform a probe zero before taking measurements.

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.
Though the gauge will remember the last zero point, it is generally a good idea to set the zero point whenever the gauge is switched on, as well as any time a different transducer is used. This will ensure that the zero point of the instrument is always correct.
The zero probe routine ***must*** be done prior to calibration. If you do not conduct the zero probe routine, your gauge will force you to conduct the routine at regular intervals during operation.

Note: This function is only used when using a contact style transducer with a pulse-echo contact setup selected. All the other transducer types use multiple echo modes and the zero function is not needed.

Note: If you intend to switch between measurement modes, setup up the gauge in pulse-echo mode, perform the probe zero, and then save the setup to one of the empty setup locations. Once this is completed, you can switch between modes toggling between two setups.

In order to perform the zero probe routine, your gauge must be in pulse-echo mode.
The following steps describe the zero probe procedure:

1. Press MEAS to display the measurement screen.
2. Ensure the gauge is in pulse-echo mode (P-E).
3. Remove all couplant from the face of the transducer and check that the wearface of the transducer is clean and free of any debris.
4. Apply a drop of couplant on the transducer and place the transducer in steady contact with the probe zero disk (the battery cover located on the top of the unit), and obtain a steady reading.
   The display should show some 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.
5. Press MENU, scroll to the PROBE menu, scroll to the ZERO TRANSDUCER function and then press ENTER.
   The ZERO TRANSDUCER screen is displayed.
6. Press OK (or ESC to cancel).
7. Remove the transducer from the probe zero disk.

Your gauge should now be calibrated.

7.3 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.

There are three methods of calibrating your gauge:

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

Known thickness calibration: The gauge is calibrated by setting it to a single known thickness (one-point) or two known thicknesses (two-point):

- **One-point** calibration is the simplest and most commonly used calibration procedure - optimising linearity over ***large*** ranges.
- **Two-point** calibration allows for greater accuracy over ***small*** ranges.
  Note: If you create a completely new setup for interface-echo (I-E) mode, a two point calibration **must** be performed.

Known material calibration: The material you are measuring is selected from a list of materials stored in the gauge.

To achieve the most accurate measurements possible, it is generally advisable to calibrate the gauge to a sample piece of known thickness. Material composition (and thus, its sound-velocity)

sometimes varies from lot to lot and from manufacturer to manufacturer. Calibration to a sample of known thickness will ensure that the gauge is set as closely as possible to the sound-velocity of the material to be measured.

7.3.1 Known Velocity Calibration

If the material velocity is known, you can enter the velocity value directly into the gauge. A list of the sound velocities of common materials is given at the end of this instruction manual.

1. Press MENU, scroll to the CAL menu and then highlight the VELOCITY function.
2. Press ENTER to display the Digits Edit Box.
3. Use ▲ and ▼ to scroll the highlighted value.
4. Use ◀ and ▶ to scroll the digit locations.
5. Repeat steps 3 and 4 until the velocity number is correctly displayed.
6. Press OK to set the velocity and return to the menu screen, or ESC to cancel.
7. Press MEAS to return to the measurement screen.

7.3.2 Known Thickness Calibration

If the sound velocity of a material is unknown, a sample with one or two known thicknesses can be used to determine the sound velocity.

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.

One-point Thickness Calibration: The one point calibration option is most suited for linearity over large ranges. You should always calibrate on high side of the intended measurement range. For example, if the measurement range is 2.54 mm to 25.4 mm (.100" to 1.0"), you should calibrate on a known thickness sample close to 25.4 mm (1.0").

Note: Before you start this calibration procedure, perform a probe zero.

1. Physically measure an exact sample of the material or a location directly on the material to be measured using a set of callipers or a digital micrometer.
2. Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or the material being tested. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable.
3. Press MENU, scroll to the CAL menu and then highlight the ONE POINT function.
4. Press ENTER to display the Digits Edit Box.
5. Use ▲ and ▼ to scroll the highlighted value.
6. Use ◀ and ▶ to scroll the digit locations.
7. Repeat steps 5 and 6 until the known thickness value is correctly displayed.
8. Press OK to calculate the velocity and return to the menu screen, or ESC to cancel.

9. Press MEAS to return to the measurement screen.

Note: CHECK YOUR CALIBRATION! Place the transducer back on the calibration point. The thickness reading should now match the known thickness. If the thickness is not correct, repeat the steps above.

Two-point Thickness Calibration: For improved accuracy over a smaller measurement range, conduct a one-point calibration followed by a two-point calibration. For example, if the measurement range is 2.03 mm to 6.35 mm (.080" to 0.250"), perform a one point calibration on a known thickness sample close to 6.35 mm (.250"), followed by a two-point calibration close to 2.03 mm (.080").

Note: Before you start this calibration procedure, perform a probe zero.

1. Conduct a one point calibration routine as described previously in this section. You should conduct this routine at the high end of the measurement range.
2. Physically measure an exact sample of the material or a location directly on the material to be measured using a set of callipers or a digital micrometer. You should measure at the low end of the measurement range.
3. Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or the material being tested. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable.
4. Press MENU, scroll to the CAL menu and then highlight the TWO POINT function.
5. Press ENTER to display the Digits Edit Box.
6. Use ▲ and ▼ to scroll the highlighted value.
7. Use ◀ and ▶ to scroll the digit locations.
8. Repeat steps 6 and 7 until the known thickness value is correctly displayed.
9. Press OK to calculate the velocity and return to the menu screen, or ESC to cancel.
10. Press MEAS to return to the measurement screen.

Note: CHECK YOUR CALIBRATION. Place the transducer back on both calibration points. If the coating thickness readings match the known thickness values of each sample calibration has been successful and you are now ready to take measurements. If the thickness is not correct, repeat the steps above.

7.3.3 Known Material Calibration

If the material velocity is unknown, and a sample thickness cannot be taken from the material, you can choose a material type from a list stored in the gauge. For each material stored in the list there is a corresponding velocity value.

Note: These velocities will not always be an exact representation of the material being tested. Use these values only if a close approximation is acceptable.

1. Press MENU, scroll to the CAL menu and then highlight the MATERIAL function.
2. Press ENTER to display the list of material types.
3. Scroll through the material list until the appropriate material is highlighted.
4. Press ENTER to choose the material type.
5. Press OK to select the material type and display the menu items with the new material type selected
6. Press MEAS to return to the measurement screen.

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 40.
- Ensure the correct setup is selected and set in the gauge, see “Transducer - Setting Type Of” on page 15.
- Set the zero point of the transducer, see “Transducer - Zeroing” on page 15.
- Calibrate the gauge, see “Calibrating” on page 16.
- Choose the measurement view (RF, RECT, B-SCAN or DIGITS), see “The Measurement Screen” on page 7.

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.
   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 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:
   - adjust the gain, or
   - select a different transducer (size or frequency) for the material being measured.

   The gauge will perform a number of 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 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 GATES

Your gauge is equipped with gates which control the time measurement process. Using gates to adjust the time measurement process allows you to measure a specific region on and between waveforms.
Your gauge is equipped with two gates, Gate 1 and Gate 2.

- In pulse-echo mode, only Gate 1 is used - typically to eliminate surface noise.
  It may be advantageous to activate a gate when measuring aluminum, titanium, and stainless steel using lower frequency transducers. However, if a high frequency transducer is being used, the gate may not be necessary. Aluminum sometimes has an inherent surface noise problem that can cause erroneous readings from the noise just following the initial pulse. By blocking the surface noise with Gate 1 this error is eliminated.
- In echo-echo mode, both Gate 1 and Gate 2 are used.
  The first gate has a start time and threshold.
  The second gate has a start time that is determined by adding an adjustable delay (hold off) and uses the same threshold as the first gate.

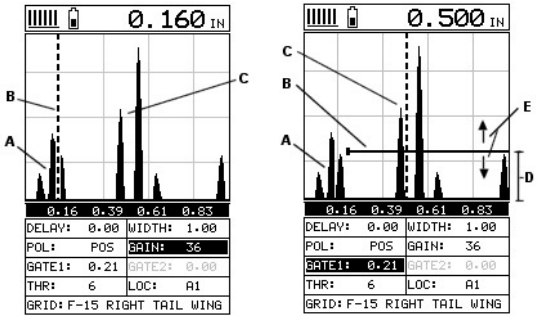
Note: In order to adjust the gates they must be activated. The gates will only be active if the measurement mode is set to P-E GT (Pulse-Echo with Gate 1), or E-E (Echo-Echo with Gate 1 and Gate 2). If the gates are not active, they will be greyed out in the hot menu and main menu.

9.1 GATE 1

Gate 1 is used in both pulse-echo and echo-echo modes. It has a threshold and a start time.

- In pulse-echo mode, Gate 1 is used to prevent the gauge from measuring unwanted surface noise. This is accomplished by changing the start time of Gate 1.

- In echo-echo mode, Gate 1 is used to force the gauge to measure between the first and second back wall echoes, by moving the start to the first back wall reflection of the test material.



No Gate **With Gate**

A typical surface noise problem

Refering to the No Gate diagram: (A) refers to the noise in front of the back wall signal (C). Notice that without a gate activated, the gauge is detecting on the noise (A) as shown at point (B). However, the true measurement should be taken at point (C). Given the threshold and gain levels the gauge is currently set to in the NO GATE diagram, the amplitude from the noise is sufficient enough to cause the gauge to detect, or measure the noise rather than the true back wall thickness (C). Therefore, the gauge is making an incorrect reading at point (B).
Now refer to the With Gate diagram. The horizontal line at the top of (D), is Gate 1. The start point of Gate 1 has been adjusted to just beyond the noise (A) so that the gauge ignores the noise and detects the true back wall (C). Note: the gauge will only detect on signals that are located inside the dimensions of Gate 1 (B). Therefore, the gauge cannot see (A) at all, with respect to the starting point of (B). Also notice, the THR (threshold) level is the height of the distance (D) from the baseline. Zero threshold is indicated by the bottom of the range (D), and THR: 6 (threshold) is indicated at the top of the range at (D). Therefore, the vertical height of Gate 1 is the THR (threshold) level. The threshold level can be increased to decrease sensitivity, or decreased to increase sensitivity.
If the threshold level was increased in the NO GATE diagram, so that the level was higher than the amplitude of the noise (A), the gauge would have detected on the true back wall (C). Alternatively, if the gain level was decreased, the signal amplitude of the noise (A) would have decreased below the threshold level, and the gauge would have also detected the true back wall (C). This example brings all the fine adjustments into consideration, and demonstrates the versatility of having a fully functional scope rather than a basic digital thickness gauge.

9.2 GATE 2

The Gate 2 hold off is only used in the echo-echo mode. Gate 2 is sometimes called a Hold-Off or Delay. The function of the Gate 2 hold off is to prevent the second gate from triggering on noise associated with ring down of the first echo. The Gate 2 hold off is visible as the distance from the end of Gate 1 at the first detect, to the start of Gate 2 as display by the horizontal bars on the display. A further explanation suggests the hold off is a time delay that simply extends the end of Gate 1 further out in time to prevent Gate 2 from starting. This is commonly used to avoid detecting interface noise or transducer ring down.

9.3 ADJUSTING THE GATES

The quickest way to adjust GATE 1 and GATE 2 is directly from the hot menu. Alternatively, adjust the values using the menus:

1. Press MENU, scroll to the GATE menu and then highlight GATE 1 or GATE 2 as required.
2. Use ◁ and ▷ to scroll the value. When the correct value is being displayed, proceed to step 7.
3. Alternatively, press ENTER to display the Digits Edit Box.
4. Use △ and ▽ to scroll the highlighted value.
5. Use ◁ and ▷ to scroll the digit locations.
6. Repeat steps 4 and 5 until the value is correct.
7. Press OK to set the value and return to the menu screen, or ESC to cancel.
8. Press MEAS to return to the measurement screen.

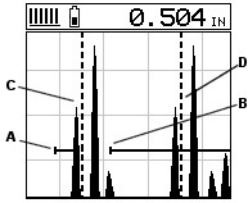
10 THRUPAINT™ MEASUREMENT TECHNIQUE

10.1 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.

The illustration shows a typical example of an echo-echo mode setup commonly used for a through paint or coatings application. The measurement is taken between the first and second echo reflections. Point (C) represents the detection on the back wall of the first reflection. Notice that GATE 1 has been set up so that the gauge can only see the first back wall reflection (C), and cannot see anything before the first reflection. Remember that the gauge can only see those signals inside the dimensions of the gate.



Echo-Echo Mode Two Gates

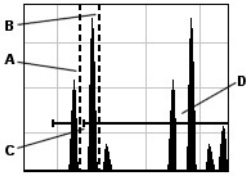
GATE 2 (hold-off) has been set at point (B), so that the transducer ring down noise following the first detection (C) cannot interfere with the second back wall reflection (D). The distance from point (C), which is the end of the first gate (A), to the start of GATE 2 (B), is the hold-off time or delay. This type of setup allows the user to eliminate the paint or coating, and measure only the thickness of the metal

10.2 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.

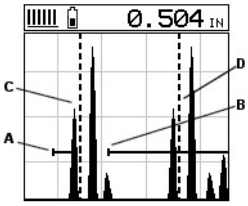
In the incorrect through paint illustration, (A) represents the detection on the first back wall echo. The true, second back wall, reflection should be detecting at (D). However, the hold-off (C) is setup incorrectly and the gauge is detecting the ring down noise of the transducer, on the first reflection, rather than the true second back wall reflection shown at (D).



ThruPaint™ Incorrect

Before we look at the diagram with the correct configuration, let us consider all of our options on how to fix the problem beforehand. Our delay and width will simply change the view options of the screen, but this is not needed in this example. Will a gain or threshold adjustment fix the problem? Unfortunately, not. Why? Notice the amplitude of the cycle just to the left of (B). If we tried to increase the threshold level above the height of the cycle, we would lose our detection for both echoes resulting in no reading at all. If we decrease our gain, reducing the signal amplitudes, we would also lose our detection of both back wall echoes.

Note the amplitude of the cycle just to the left of (C). The amplitude of the cycle, at (C), is less than the amplitude of the cycle at (B), in terms of overall height. If we decreased our gain, we would lose the first cycle (C) long before losing the second cycle (B). Therefore, adjusting the gain or threshold levels will not help us in this example. Our final option is adjusting the GATE 2 hold-off, shown at (C) in the incorrect diagram, to (B) in the correct diagram. If we adjust the GATE 2 hold-off further to the right of the first reflection, the ring down noise from the first back wall echo no longer interferes with the true detection (D), shown in the correct diagram. The adjustment considerations in the example above will typically be used for all ThruPaint™ applications respectively. In some applications the hold-off may be sufficient, while a gain or threshold adjustment will solve the problem. A similar process of elimination should be considered for all ThruPaint™ applications.



ThruPaint™ Correct

11 MEASUREMENT - OPTIONS

11.1 PULSE WIDTH

Your gauge has an adjustable pulse width option. Pulse width refers to the duration of time the pulser is switched on. Pulse width determines the amount of energy transmitted into the material being tested.
There are three pulse width options:

Spike: The Spike option is used for high resolution and general applications and can be considered as the standard setting.

Thin: When additional energy is needed for more penetration, the Thin option may be necessary.

Wide: When additional energy is needed for more penetration, the Wide option may be necessary. High frequency applications, where resolution is a requirement, may require the Spike or Thin settings to achieve optimal results. Low frequency applications, where more penetration is a requirement, may require the Thin or Wide settings, offering increased penetration. The variety of transducer frequencies and diameters used in conjunction with the pulse width setting, enable you to fine tune the gauge to your application needs.

To adjust the Pulse setting:

1. Press MENU, scroll to the PROBE menu and then highlight the PULSE function.
2. Use ◁ and ▷ to adjust the value of PULSE (SPIKE, THIN, WIDE).
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

11.2 AUTO FIND

Your gauge includes a function for locating the detection point of a back wall echo that is not currently in the viewable region of the display. Suppose the gauge is currently setup with a delay of 0.0 and a width of 1.0, and you are measuring material with a thickness of 2.5. The gauge will make the correct measurement and display it digitally, however, the waveform will not be visible in both A-Scan views, and will be displayed incorrectly in the B-Scan view without adjusting the values of Delay and Width.
The AUTO FIND function solves this problem by letting the gauge find the detection point and bring the waveform signal into view automatically. You can then make small adjustments to the range once the signal is displayed on the screen.

To use the AUTO FIND function:

1. Press MENU, scroll to the UTIL menu and then highlight the AUTO FIND function.
2. Place the transducer on the test material and obtain a reading.
3. Press ENTER.
   The display settings are adjusted automatically and the waveform is brought into view on the measurement screen.
4. Press MEAS to return to the measurement screen, ready to begin taking readings.

11.3 HIGH SPEED SCAN

Although your gauge excels at making single point measurements, it is sometimes desirable to examine a larger region, searching for the thinnest point. The gauge includes a feature, called Scan Mode, which allows it to do just that.

This mode increases the overall repetition rate from 4 readings a second to 32 readings a second. This feature enables you to make scanned passes over an arbitrary length of the test material while still maintaining a reasonable representation of thickness over the scanned area or region. This feature can be used in conjunction with High and Low alarm limits features to keep track of both values dynamically.

To enable/disable the high speed Scan Mode:

1. Press MENU, scroll to the UTIL menu and then highlight the SCAN MODE function.
2. Use ◁ and ▷ to adjust the value of SCAN MODE (ON, OFF).
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

11.4 ALARM MODE

Your gauge includes an Alarm Mode. You set the limits, and if a measurement falls outside of these limits your gauge will signal an alarm (a red light on the front panel of the instrument and/or an audible beep).

This feature may be used for a variety of applications to verify the material is within the manufacturer specifications.

There are two limit values, ALARM LO LIMIT and ALARM HI LIMIT. You can choose to activate both or just one of these values depending on your requirements.

To enable/disable Alarm Mode:

1. Press MENU, scroll to the UTIL menu and then highlight the ALARM STATUS function.
2. Use ◁ and ▷ to adjust the value of ALARM STATUS (ON, OFF, AUDIBLE).
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

To set the Alarm limits:

1. Press MENU, scroll to the UTIL menu and then highlight the ALARM LO LIMIT or ALARM HI LIMIT function.
2. Use ◁ and ▷ to scroll the value. When the correct value is being displayed, proceed to step 8.
3. Alternatively, press ENTER to display the Digits Edit Box.
4. Use △ and ▽ to scroll the highlighted value.
5. Use ◁ and ▷ to scroll the digit locations.
6. Repeat steps 4 and 5 until the value is correct.
7. Press OK to set the alarm value and return to the menu screen, or ESC to cancel.
8. Press MEAS to return to the measurement screen.

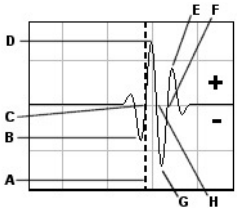
11.5 POLARITY

Your gauge is equipped with an option to select the polarity, or phase +/- of the waveform. Changing the phase may be necessary in the following situations:

- when the signal returning from the test material is marginal,
- when you are using a low frequency transducer
- when you are measuring very thick materials.

In these situations it is possible that the signal will become so weak that it falls below the threshold, and the peak jumps to the next cycle altogether. This peak jump represents a shift of the detection further out in time, resulting in incorrect measurements; the material being measured will appear thicker than it actually is.

Notice the +/- positions in the diagram. The positive phase is everything above the horizontal center line, and the negative everything below the center line.



Your gauge uses a zero crossing (flank) method for detection. Therefore, the detect line (A) is represented by the broken vertical dotted line, and is currently detecting on the negative portion of the waveform (B) at the zero crossing (C). The signal amplitude (B) is shown as the negative vertical height at (B) in the diagram. Refer to the height of the second negative peak at (G). It is clear that the amplitude of (G) is much greater than that of (B). Therefore, if you were measuring thick attenuative material, and the amplitude of (B) decreased substantially, the gauge would lose the first cycle (B) and peak jump to the second cycle (F). The detect (A), would move to (F), resulting in incorrect measurements.

If you were to select the positive phase in the diagram above, the detect would measure at (H). (A) would move to (H). Notice the height of (D) with respect to the height of (E) in the diagram. If you were measuring thick attenuative material using this phase, the signal (E) will certainly be lost long before (D). Therefore, the positive phase is a much better choice in the diagram above.

To adjust POLARITY:

The quickest way to adjust POLARITY is directly from the hot menu. Alternatively, adjust the value using the menus:

1. Set the measurement screen view to RF.
2. Press MENU, scroll to the TUNE menu and then highlight the POLARITY function.
3. Use ◁ and ▷ to adjust the value of POLARITY (NEGATIVE, POSITIVE).
4. Press MEAS to return to the measurement screen.
5. ***If a contact transducer is being used in pulse-echo mode, after changing POLARITY, always conduct a probe zero before you start taking readings.***

11.6 RECTIFIED WAVEFORM DISPLAY OPTIONS

When the measurement screen is set to RECT, you have the option of displaying the waveform filled in black, or outlined (unfilled).

To set this option:

1. Press MENU, select DISP, select VIEW and then select RECT to set the RECT display view.
2. Press MENU, scroll to the TUNE menu and then highlight the RECT WAVEFORM function.
3. Use ◁ and ▷ to adjust the value of RECT WAVEFORM (FILLED, OUTLINE).
4. Press MEAS to return to the measurement screen.

12 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.

12.1 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: Measurements are stored in a file which has a grid format (similar to the format of a spreadsheet) in which each cell of the grid is used to store a reading. Cells of the grid are referenced by the row number (1 to 999) and the column label (A to ZZ).

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, the following information is saved:

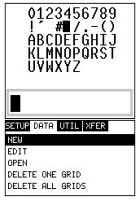
- The reading value.
- A screenshot of the measurement screen plus all the gauge settings. The screenshot stored with the reading will depend on what view the gauge was in at the time the reading was taken. For example, if the view was in B-SCAN, then a B-SCAN screenshot will be saved with the reading.

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. Your gauge can store a total of 12 000 readings with a corresponding screenshot of every reading.

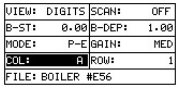
12.2 CREATING A NEW DATA LOGGER FILE

To create a GRID log data file:

1. Press MENU, scroll to the DATA menu and then highlight the NEW function.
2. Press ENTER to display the grid edit box.
3. Scroll to NAME and then press ENTER to edit its value:
   - Use ▲, ▼, ◀, and ▶ to scroll through the characters, ENTER to select characters, and CLR to backspace through the characters.
   - When you have finished, press OK to enter the value.



4. If you want to add a note (the name of the inspector for example), repeat step 4 for NOTE.
5. Scroll to TOP LEFT and then press ENTER to edit its value:
   - Use ◀ and ▶ to scroll the column value.
     Use ▲ and ▼ to scroll the row value.
   - When you have finished, press OK to enter the value.
6. Repeat step 5 for LOWER RIGHT.
   Note: TOP LEFT and LOWER RIGHT represent the range of the grid - analogous to the top left and bottom right cells of a range in a spreadsheet. An individual grid can have a maximum of 999 rows and 52 columns.
7. Scroll to INCR. DIR and then use the ◀ and ▶ arrows to select the option required (NONE, NORTH, EAST, SOUTH, WEST).
   Note: INCR. DIR determines in which direction the cursor moves each time a reading is stored.
8. When you have finished defining your GRID log data file, scroll to CREATE NEW GRID?, press ENTER and then OK to confirm (or ESC to cancel).
9. Press MEAS to return to the measurement screen.
   The measurement screen hot menu now includes the column and row coordinates and the name of the grid log file - in this example 'BOILER #E56'



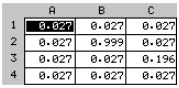
12.3 OPENING AN EXISTING DATA LOGGER FILE

1. Press MENU, scroll to the DATA menu and then highlight the OPEN function.
2. Press ENTER.
   The LOAD FILE screen is displayed and lists all the data files stored in your gauge memory.
3. Scroll through the list until the data file you want is highlighted.
4. Press ENTER and then press OK (or ESC to cancel).

The data file is opened and displayed in the hot menu area of the measurement screen.

12.4 STORING READINGS IN A DATA LOGGER FILE

1. Create a new data logger file or open an existing file.
   The name of the grid file is displayed in the hot menu area of the measurement screen.
   Note: Once the file is open, it will remain open until it is closed or another file is opened. If the gauge is switched off, the file will be opened automatically when the gauge is switched on again.
2. Press MEAS to display the measurement screen, then use MEAS and ESC to highlight either COL or ROW and then press ENTER.
   The grid view box displays the readings in the data file.



3. If you want to save the reading to a particular cell location, use ▲, ▽, ◁ and ▷ to scroll to the cell.
   Note: The cell location must be empty. If it already contains a reading and you want to save a new reading to the same location, press CLR and then OK to delete the existing reading.
4. Take a reading and then press ENTER.
   The reading value is saved in the file at the location selected and the cursor advances to the next cell according to the INCR. DIR rules set for the data logger file. When the cursor reaches the last cell in the row or column it will return to the other end of the row or column.
5. If you are unable to take a measurement due to the measurement location being physically inaccessible, press CLR.
   The cell location in the data file is marked OBST (Obstruct).
6. The display of the log data file on the measurement screen can be switched on and off:
   - To switch off, press MEAS
   - To switch on, press ENTER when either COL or ROW is highlighted in the hot menu.

12.5 VIEWING AND DELETING READINGS

With a data file open:

1. Use the arrows to scroll through the cells in the data file.
   As the cursor is moved to a different cell, the display is updated with the display view saved with the reading.
2. To delete a reading, scroll to the cell location, press CLR and then OK (or ESC to cancel).
   The reading is deleted and if you wish you can now take another measurement and save the reading in this cell location.

12.6 EDITING A DATA LOGGER FILE

You can edit the following fields of data files: NOTE, and INCRement DIRection.
To edit a file:

1. Open the data file.
2. Press MENU, scroll to DATA, highlight the EDIT function and then press ENTER.
   The EDIT LIST screen is displayed and lists the fields which can be edited.
3. Scroll to the field you want to edit, press ENTER and then adjust the contents of the field using the techniques previously described to create a data file - see page 28.
4. When finished, scroll to SAVE CHANGES?, press ENTER and then OK (or ESC to cancel).

12.7 DELETING A DATA LOGGER FILE

1. Press MENU, scroll to the DATA menu, highlight the DELETE ONE GRID function and then press ENTER.
   The DELETE FILE screen is displayed and lists all the data files stored in your gauge memory.
2. Scroll through the list until the data file you want to delete is highlighted.
3. Press OK (or ESC to cancel).

The file is deleted.

12.8 DELETING ALL DATA LOGGER FILES

Note: This will delete all the data logger files in gauge memory - use with caution.

1. Press MENU, scroll to the DATA menu, highlight the DELETE ALL GRIDS function and then press ENTER.
   The CONFIRM screen is displayed with a warning message.
2. Press OK to confirm (or ESC to cancel).

The data logger memory is erased - all files are deleted.

13 GAUGE SETUPS

Your gauge contains 64 configurable preset locations in which you can store custom gauge setups, each one optimised for a specific measuring application.
These gauge setups can save time when conducting routine inspections of the same job or project. This feature also helps to eliminate error between two or more users during the setup and calibration process.
The setups store:

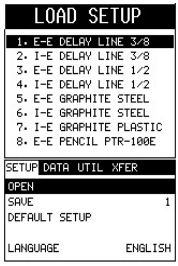
- Measurement mode
- Transducer type
- Gain setting
- Scan mode setting
- Alarm settings
- Display type setting

As well as storing the setups in your gauge, you can also store the setups on a computer and transfer them bi-directionally using the PC interface software included with the gauge.
The factory supplied setups stored in the gauge cover some of the more typical applications commonly used with this type of instrument. These setups can be recalled, modified, and overwritten to one of 64 setup locations. Therefore, these factory setups can also be considered a good starting point to be modified for custom applications.
The PC interface software includes a default setup file that can be uploaded to the gauge at any time to restore factory settings. However, you should consider saving modified setups to an empty location rather than overwriting the factory setups in your gauge.

13.1 OPENING A SETUP

You can open a setup by pressing MULTI MODE, or use the menus as follows:

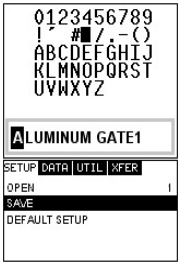
1. Press MENU, scroll to the SETUP menu and then highlight the OPEN function.
2. Press ENTER to display the Setup List Box.
3. Scroll through the list of setups until the required setup is highlighted.
4. Press ENTER to activate the confirmation screen.
5. Press OK to load the setup from memory.
6. Press MEAS to return to the measurement screen.



13.2 SAVING AND EDITING A SETUP

Once the parameters and features have been adjusted for an application, you can save these setting to a specific setup location for future use.
It is sometimes necessary to rename a previously saved setup, or add additional comments about a particular setup. The setup name may have been entered incorrectly, or you may need to use the setup for a completely different project. An inspector's name or other comments about the project may also be required for additional documentation purposes.
The following procedures outline the necessary steps for saving and editing a setup:

1. Press MENU, scroll to the SETUP menu and then highlight the SAVE function.
2. Press ENTER to display the Save Setup edit box.
3. Scroll to NAME and then press ENTER to edit its value:
   - Use ▲, ▼, ◀, and ▶ to scroll through the characters, ENTER to select characters, and CLR to backspace through the characters.
   - When you have finished, press OK to enter the value.
4. If you want to add a note, repeat step 3 for NOTE.
5. When you have finished, scroll to SAVE SETUP? and press ENTER.
   The setup list screen is displayed.
6. Scroll through the list of setups until the required location to save the setup is highlighted.
7. Press OK to activate the confirmation screen.
8. Press OK to save the Setup, or ESC to cancel.
9. Press MEAS to return to the measurement screen.



Note: The Name and Note parameters of a Setup can be edited at any time by repeating the Save Setup routine described above. Therefore, the Save Setup function can also be considered an Edit Function.

13.3 USING THE DEFAULT SETUP

Your gauge includes a default setup which you can use (as a last resort) if there are no other setups stored in the gauge. The only time this might possibly occur is if the setup file in your gauge was somehow corrupted, and you do not have immediate access to a computer to re-load the factory setups back into the gauge. This gives you the ability to load and modify a basic setup as follows:

1. Press MENU, scroll to the SETUP menu and then highlight the DEFAULT SETUP function.
2. Press ENTER to activate the confirmation screen.
3. Press OK to confirm.
4. Press MEAS to return to the measurement screen,

14 DATA TRANSFER SOFTWARE

Software is available which allows data to be transferred from your gauge to 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.

14.1 TRANSFERRING MEASUREMENT DATA TO YOUR COMPUTER

14.1.1 RS-232 Connector

The RS-232 connector, located on the bottom end cap of the gauge, is a 2 pin female Lemo connector. It is designed to connect directly from the gauge to a standard AT serial port on a PC. A Lemo to 9 pin serial cable is supplied with the gauge.

Note: This connector is also used to upgrade the gauge with the latest version of firmware.

14.1.2 USB to Serial Converter

Some newer laptop computers do not have standard serial ports. In this case, use the USB to Serial converter supplied with the gauge.

14.1.3 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.

14.1.4 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.

14.1.5 Using the XFER menu

The XFER menu of your gauge is used in conjunction with the NDT Link PC software. The steps below outline the procedure for accessing the XFER menu and basic operation as follows:

1. Press the MENU key once to activate the menu items tab. Press the MENU key multiple times to tab right, and the ESC key multiple times to tab left, until the XFER menu is highlighted and displaying the submenu items.
2. Use the ▲ and ▽ arrow keys to scroll through the sub menu items until the desired option is highlighted.
3. Press the ENTER key to activate the option selected.
4. Once the Backup or Restore function has been completed, press the MEAS key once to return to the menu items, or twice to return to the measurement mode.

15 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.

16 MAINTENANCE

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

16.1 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.

16.2 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.

17 TECHNICAL SPECIFICATION

Measurement Rate	Manual	4 readings per second
	Scan mode	32 readings per second
Measuring Range[a] - Sound Velocity		1250 m/s to 10000 m/s (0.0492 in/µs to 0.3930 in/µs)
Measuring Range - Thickness	Pulse-Echo P-E (contact) on steel	1.000 mm to 254 mm (0.040” to 10.0”)
	Pulse-Echo P-E (contact) on plastic	0.254 mm to 254 mm (0.010” to 10.0”)
	Interface-Echo I-E on steel	1.27 mm to 25.4 mm (0.050” to 1.0”)
	Interface-Echo I-E on plastic	0.127 mm to 25.4 mm (0.005” to 1.0”)
	Echo-Echo E-E (contact) on steel	2.54 mm to 76.2 mm (0.10” to 3.0”) - ThruPaint™
	Echo-Echo E-E on steel	0.15 mm to 12.7 mm (0.006” to 0.50”)
Measurement Resolution	Sound Velocity	1 m/s (0.0001 in/µs)
	Thickness	0.001 mm (0.0001") or 0.01 mm (0.001”) - selectable
Velocity Calibration Range		1250 m/s to 10000 m/s (0.0492 in/µs to 0.3937 in/µs)
Weight (including batteries)		380 g (13.5 oz)
Dimensions (W x H x D)		63.5 mm x 165 mm x 31.5 mm (2.5” x 6.5” x 1.24”)
Gauge Operating Temperature		-10°C to 60°C (14°F to 140°F)
Case		Aluminium case with gasket sealed end caps and waterproof membrane keypad
PC Connection		RS232 serial port. Windows PC interface software
Display		Backlit VGA greyscale display (240 x 160 pixels). Viewable area 62 mm x 45.7 mm (2.4” x 1.8”). EL backlit (on/off/auto).
Power Source		Three 1.5 V AA alkaline or rechargeable cells. Typically operates for 200 hours on alkaline cells and 120 hours on rechargeable cells (charger not included.) *Note: Alkaline cells 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 cells in fire.*

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

18 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.

18.1 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.

18.2 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.

18.3 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.

19 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.
15 MHz 1/4” Single Element Delay Line Microdot Side Transducer	TX15M0CM
20 MHz 1/4” Single Element Delay Line Microdot Side Transducer	TX20M0CM
10 MHz 3/16” Single Element Delay Line Pencil Microdot Top 1/16” Tip Transducer	TX10M0BM-1
10 MHz 3/16” Single Element Delay Line Pencil Microdot Side 90° Right Angle Transducer	TX10M0BM-2
Delay Line Tip, Acrylic, 1/4” Dia x 1/12”	TD-24033-6
Delay Line Tip, Acrylic, 1/4” Dia x 3/8”	TD-24033-7
Delay Line Tip, Graphite, 1/4”	TD-24033-8
Delay Line Tip (Pencil), Acrylic, 1/16” Dia x 0.45”	TD-24033-4
Delay Line Tip (Pencil), Acrylic, 1/8” Dia x 0.45”	TD-24033-5
Ultrasonic Couplant, 120 ml (4 oz)	TC-24034-1
Ultrasonic Couplant, 360 ml (12 oz)	TC-24034-2

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

20 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:

20.1 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.

20.2 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.

20.3 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.

20.4 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.

20.5 SELECTING THE CORRECT TRANSDUCER

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

- A range of frequencies and sizes
- Straight and right angle
- Transducers available as potted or microdot transducers:
  Potted transducers - transducer cable is permanently fixed to the transducer head.
  Microdot transducers - transducer cable is fixed to the transducer head by a connector - allows transducer heads to be replaced quickly and easily.
- High temperature transducers - temperature up to 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
- 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 castings	PULSE-ECHO (P-E)	Cast iron - 1MHz to 5MHz transducer. Cast aluminium - 10MHz transducer.	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)	Typically a 5MHz transducer or higher is required.	Use lower frequencies for greater penetration and use higher frequencies for better resolution.
Material thickness measured through a coating	ECHO-ECHO (E-E)	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 Echo-echo mode, and then switch to pit detection mode (Pulse-echo) without changing transducers.
Thin materials	PULSE-ECHO (P-E)	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"	

Material being measured	Mode	Transducer type required	Notes
Plastics		Delay line transducer and special graphite tip	The velocity of the graphite tip allows an impedance mismatch to occur between materials, hence the plastic can successfully be measured. When measuring thicker plastics, a lower frequency contact transducer should be used typically 1 - 2.25MHz. Larger crystal diameters offer greater penetration capabilities. Therefore, for thicker and hard to penetrate plastics, use larger diameter transducers if possible.

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

21 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.

22 APPLICATION NOTES

22.1 SEARCHING FOR SMALL DEFECTS

Dual element delay line transducers are especially useful in searching for small defects. In the pulse-echo mode with high amplifier gain, very small defects can be measured. The A-Scan display of your gauge can be used to see the defect and optimise placement of the transducer. Sometimes a grain particle or air bubble will cause a reflection. Without the A-Scan display it is impossible to know if this is a thin area or just a harmless defect. The A-Scan allows you to see the backwall as well as the defect similar to a flaw detector.

22.2 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**

22.3 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 on a sample piece of known thickness, which is at, or near, the temperature of the material to be measured. This will allow the gauge to correctly calculate the velocity of sound through the hot material.

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

22.4 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.

22.5 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). 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.

23 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

24 THE MENU COMMANDS

Menu	Function	Description
PROBE	ZERO TRANSDUCER	Zeros your gauge in much the same way that a mechanical micrometer is zeroed. If your gauge is not zeroed correctly, all of the measurements made may be in error by some fixed value. You can choose between automatic zero or manual zero.
	PULSE	Your gauge has adjustable pulse width for both high penetration and resolution applications. The pulse width refers to the duration of time the pulser is on. The options are SPIKE, THIN, and WIDE.

Menu	Function	Description
CAL (CALIBRA-TION)	UNITS	Toggle between Metric (millimetres) or English (inches) units.
	VELOCITY	This function calibrates your gauge to a specific material type by entering a material velocity.
	ONE POINT	Performs a single point calibration. This function allows you to automatically calculate the velocity by entering a known sample thickness.
	TWO POINT	Performs a two-point calibration. This function allows you to automatically calculate the velocity by entering a second known sample thickness.
	MATERIAL	Select the material velocity from a chart of basic material types when a known sample thickness, or material velocity cannot be obtained.
DISP (DISPLAY)	VIEW	Choose between RF wave, RECT (rectified) wave, BSCAN (cross section), and DIGITS (large digits) views.
	BACKLIGHT	Choose between OFF, ON, AUTO, or INVERT backlight.
	CONTRAST	Adjust the display contrast for variable light conditions.
	DELAY	Adjust where the left side of the display window starts according to thickness, in inches or millimeters.
	WIDTH	Set the overall depth of the viewable measurement area. It functions a lot like a zoom on a camera.
TUNE	GAIN	Increases or decreases the overall amplitude of the signal. Gain is similar to the volume control on a stereo receiver.
	AGC	When operating in echo-echo mode, the gauge adjusts the gain automatically. Alternatively, the AGC can be manually controlled.
	THRESHOLD	Adjust the sensitivity level of the gauge. The amplitude of the signal must reach and exceed the threshold level before a measurement is detected.
	POLARITY	The gauge operates on a zero crossing detection principle. This feature toggles which stroke of the cycle the crossing detection uses, either positive or negative.
	RECT WAVE-FORM	Toggles between an outlined or filled view option when the display setting is in RECT (rectified) wave mode.
GATE	MEASURE MODE	Select the measurement mode for different application requirements. The modes are P-E (pulse-echo), E-E (echo-echo) and I-E (interface-echo).
	GATE 1	Set the value of Gate 1. Gate 1 can be used in pulse-echo, echo-echo and interface-echo measurement modes.
	GATE 2	Set the value of Gate 2. Gate 2 can be used in echo-echo and interface-echo measurement modes only.

Menu	Function	Description
SETUP	OPEN	Displays a list of factory and user-defined setups currently stored in memory. These setups can be recalled and used at any time.
	SAVE	Save a custom setup that you have modified or created.
	DEFAULT SETUP	Loads a basic default setup. Use only as a last resort if the setups in your gauge have been corrupted and a computer is not accessible.
	LANGUAGE	Select the menu language
DATA	NEW	Creates a new alpha numeric grid file with auto identifiers. You can customise the file according to your requirements.
	EDIT	Modify the parameters of grid files previously saved. *Note: Predefined coordinates cannot be changed once they have been created.*
	OPEN	Recalls existing grid files from gauge memory.
	DELETE ONE GRID	Deletes a single file from the gauge memory.
	DELETE ALL GRIDS	Deletes all files from the gauge memory.
UTIL (UTILITIES)	AUTO FIND	Automatically locates the detection point if the measurement is out of the viewable display area.
	SCAN MODE	Enables a high speed scan mode that increases the sample rate to 32 measurements per second.
	ALARM STATUS	Toggles alarm mode on, off, or audible.
	ALARM LO LIMIT	Sets the LO (Low) limit parameter. If the measurement falls below this value, a red light will illuminate and the alarm will sound.
	ALARM HI LIMIT	Sets the HI (High) limit parameter. If the measurement exceeds this value, a red light will illuminate and the alarm will sound.

Menu	Function	Description
XFER (TRANSFER)	BACKUP SET-UPS	Allows you to backup the setups currently stored in your gauge to a computer via the RS232 port.
	RESTORE SETUPS	Allows you to restore setups saved on a computer to your gauge via the RS232 port.
	BACKUP GRID	Allows you to backup grid files stored in your gauge to a computer via the RS232 port.
	RESTORE GRID	Allows you to restore grid files saved on a computer to your gauge via the RS232 port.
	ABOUT	Provides Elcometer NDT contact information and your gauge software version. Refer to the help section of your gauge NDT Link software for a complete electronic manual covering data transfer.