CYGNUS INSTRUMENTS
Reliable Ultrasonic Measurement

Cygnus 1 Ex

Intrinsically Safe
Ultrasonic Thickness Gauge

Operating Manual & Instructions for Safety



Cygnus 1 Ex Operating Manual (EN)(Issue 9).docx
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Important Notices



The **Instructions for Safety** section at the beginning of this manual must be followed when using the Cygnus 1 Ex ultrasonic thickness gauge in an explosive environment.

The correct use of Cygnus ultrasonic thickness gauges requires identification of the correct equipment for the specific application coupled with an appropriately trained and qualified operator or technician. The incorrect use of this equipment, along with its incorrect calibration, can result in serious financial loss due to damage to components, facilities, personal injury and even death.

Neither Cygnus Instruments nor any of its employees or representatives can be held responsible for improper use of this equipment. Proper training, a complete understanding of ultrasonic wave propagation, thorough reading of this manual, proper transducer selection, correct zeroing of the transducer, correct sound velocity, correct use of the appropriate test blocks, proper cable length and proper couplant selection all play a factor in successful ultrasonic thickness gauging. Of critical importance is the process of complete and accurate calibration of the instrument.

This manual will provide instructions in the set up and operation of the thickness gauge. Additional factors that can affect the use of ultrasonic equipment are beyond the scope of this manual and to that end it is understood that the operator of this equipment is a well-trained inspector qualified by either their own organisation or another outside agency to the appropriate level of both theory and practical application of ultrasonics.

Therefore, Cygnus Instruments recommends that users of its ultrasonic thickness gauges should be formally qualified to a minimum of UT “Level 1” (ASNT or PCN) which will provide approximately 40 hours of training. Furthermore, when using Manual Gates to make measurements, ISO 9712 recommends the operator holds a UT “Level 2” qualification.

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Section 1 - Introduction

Cygnus 1 Ex

The **Cygnus 1 Ex Ultrasonic Thickness Gauge** is a rugged, handheld, battery-powered, intrinsically safe instrument designed for taking reliable thickness measurements using ultrasound in Zone 0 (Class 1 Division 1) Explosive Atmospheres. It features a large colour LCD display which can be viewed in most light situations including sunlight. A rechargeable battery pack provides 8 hours of use.

The instrument can be used with a choice of Ex Ultrasonic Probes, which can be selected to suit the material and thickness range to be measured.

The Cygnus 1 Ex can measure material thickness using the following measurement modes,

- Single Echo - UT Mode 2
- Echo-to-Echo - UT Mode 3
- Multiple Echo - UT Mode 3

Through-coating measurements are possible using Echo-to-Echo and Multiple Echo modes.

The instrument can easily be calibrated to a known thickness or to a known Velocity of Sound.

The instrument is able to operate accurately over a wide range of ambient temperatures and is environmentally sealed to IP67 for use in wet conditions.



The Cygnus 1 Ex is a solid-state electronic instrument which, under normal operating conditions, will give many years of active service.

Although designed for ease of operation the first-time user should carefully read this manual to familiarise themselves with the features of the Gauge.

Cygnus Instruments

Cygnus Instruments Limited, founded in 1983, pioneered the development of the Digital *Ultrasonic Multiple-Echo Technique* used for measurement through coatings. This has long since been the standard required to ensure that accurate measurements are taken without the need to zero the gauge or remove any coatings first.

Our philosophy is to work closely our customers to provide high quality products, engineered to serve heavy industry & harsh environments. Cygnus Ultrasonic thickness gauges are designed to be reliable and simple to use. We have an unrivalled reputation in over 45 countries around the world.

Contact Details

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For all Cygnus offices in UAE, USA, Singapore, and Authorised Cygnus Service Centres and Distributors please refer to the Cygnus website Worldwide Distribution page.

https://cygnus-instruments.com/about-us/worldwide-distributors/

Kit Contents

Gauge Kit

1. Cygnus 1 Ex Gauge fitted with hand-strap
2. Two rechargeable battery packs
3. Battery charger and battery cradle
4. Ex Ultrasonic Probe(s)
5. Comms Interface & USB Lead
6. Operating Manual
7. Memory Stick with CygLink Installer
8. Probe accessories including gel-couplant
9. Battery securing screw tool
10. Declarations of Conformity (EU, UK)
11. One 15mm or ½" Steel Test Block

Register your Gauge

Please take a moment to register your gauge with Cygnus and start your 3-year warranty, by registering you can receive updates on

- Technical Information
- Notification of new firmware
- Product updates

https://cygnus-instruments.com/service/product-registration/

For Intrinsically Safe equipment users it is important the manufacturer of the equipment is able to contact the end user, should there be a safety update or product recall notice. In most cases this is stipulated in the Ex standards used.

Section 2 - Instructions for Safety

Important Notice

The following information must be read and followed by all users of the Cygnus 1 Ex ultrasonic thickness gauge when used in an explosive environment.

The protective features of the device may be impaired if it is used in a manner not specified by Cygnus Instruments.

Ex Information

The Cygnus 1 Ex gauge is supplied with

- ATEX/IECEx/UKEX certificate marking

ATEX, IECEx and UKEX Marking

I M1 Ex ia Ma
(T_{amb} = 0°C to +50°C)

II 1G Ex ia IIC T4 Ga
(T_{amb} = 0°C to +50°C)

II 2D Ex ib IIIB T100°C Db
(T_{amb} = 0°C to +50°C)



Probe Connector Output Limiting Parameters

Uo : 45.15V
Io : 28mA
Po : 312mW
Co : 10nF
Lo : 10µH

Descriptive System Document

See Descriptive System Document on page 97

Ex Certificate Numbers

- ATEX ExVeritas 21ATEX0860X
- UKEX ExVeritas 21UKEX0861X
- IECEx IECEx EXV 21.0035X

SPECIFIC CONDITIONS OF USE

- Only replace or remove the battery in a Safe Area.
- Charge only in a Safe Area, the marked parameters must be compatible to the charger maximum output parameters.
- The data port can only be used in Safe Area and through the accessory USB Interface part numbers 060-1002 (ATEX/IECEx/UKEX). The use of this port without the Comms Interface accessory invalidates the approval.

Equipment Use

- The Cygnus 1 Ex is an intrinsically safe portable measuring instrument
- The Cygnus 1 Ex must be used in accordance with IEC / EN 60079-14

For use in Gasses, Vapours and Mists

- The Cygnus 1 Ex EPL is **Ga**
- Suitable zones are **Zone 0, Zone 1, Zone 2**

For use in Combustible Dust

- The Cygnus 1 Ex EPL is **Db**
- Suitable zones are **Zone 21, Zone 22**

Standards used for Ex Certification

IECEx Standards

- IEC 60079-0:2017
- IEC 60079-11:2023

ATEX Standards

- EN IEC 60079-0:2018
- EN IEC 60079-11:2024

UKEX Standards

- EN IEC 60079-0:2018
- EN IEC 60079-11:2024

Battery Pack

- Use only with Cygnus Battery Pack part nos. 060-1003 (ATEX/IECEx/UKEX)
- Lithium-Ion, Secondary Cell
- Nominal Output Voltage = 7.4 V
- Capacity = 1960 mAh
- Output current limited by fuse to 750 mA

Battery Charger

- Um = 8.4V current limited to 3 A

USB Interface

- Um = 250 V

Manufacturers Details

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Email: sales@cygnus-instruments.com

Assembling the Instrument

The Cygnus 1 Ex instrument comprises of three parts, shown below



Instrument Body

Cygnus Ex
Ultrasonic Probe

Battery Pack

Fig 1. Cygnus 1 Ex Instrument Parts

Fitting the Battery Pack

Never remove or replace the battery pack in an Explosive Atmosphere.

Always take the equipment into a safe area to remove or replace the battery pack.

The Battery Pack is fitted to the rear of the instrument body,

- first align and insert the two lugs at the bottom of the battery pack with the instrument body,
- then drop-in the top of the battery pack so the securing screw falls into the thread in the instrument body,
- hand-tighten the battery securing screw with a ball-end SW2.5mm hexagonal screwdriver.

Take care not to overtighten the battery pack, it should end up flush with the instrument body.



Fig 2. Cygnus 1 Ex Battery Pack Fitting.

Connecting the Ultrasonic Probe

Only Cygnus Ex Ultrasonic Probes designed to for this product can be used in an Explosive Atmosphere as they contain energy limiting devices not found in standard probes.

The Ultrasonic Probes are connected to the instrument using the connector at the rear of the gauge body,

- Align the dots on both the connector parts,
- Push the probe connector by its body until it snaps into place,
- To release the probe connector, pull back on the probe connector barrel (the part with the dot), this will release the latch enabling the probe connector to be pulled free.



Fig 3. Cygnus 1 Ex Probe Connector.

It is safe to unplug and replace Cygnus Ex Ultrasonic Probes in an Explosive Atmosphere.

Charging the Battery

The battery pack must only be removed and charged in a Safe Area.

The battery pack must only be charged with the charger supplied with the kit.

The Charger comprises of a mains plug-in Charger and Cradle to hold the battery.

Removing the Battery Pack

- Use a ball-end SW2.5mm hexagonal screwdriver to loosed and unscrew the battery securing screw until the battery can be lifted out from the instrument body.

Charging

The battery pack is fitted to the Charging Cradle, there is an alignment lug on the cradle that fits into a recess in the battery, then the battery just drops onto the cradle and is secured in place with the retaining screw using a SW2.5mm hex screwdriver.



Fig 4. Cygnus 1 Ex Battery Charger Cradle and Battery.

Plug the Charger into the AC power socket, having fitted the appropriate plug-adapter to the Charger.

There is a light on the front of the Charger to show the state of charge,

- Orange = Charging
- Green = Charged

The charge time for a fully exhausted battery is around 4 hours.

Discharging Batteries for Safe Air Transport

IATA require all Li-Ion batteries to have a state-of-charge of 30% or less for safe air transport. The C1Ex gauge has a Battery Discharge facility that quickly discharges the battery down to 20%.

You can find this facility in the **Menu->Setup->Battery Discharge**.

Connecting to a Computer

You must only connect the Cygnus 1 Ex Instrument to a computer using the Cygnus 1 Ex USB Interface.

You must only connect the Cygnus 1 Ex Instrument to a computer in a Safe Area.

To transfer data between the Cygnus 1 Ex instrument and a Windows® computer, a USB Interface module is supplied. This module also acts as a Ex Protection Barrier to protect the instrument from over-voltages from a faulty computer. Connection to a computer must only be done in a safe area.



Fig 5. Cygnus 1 Ex USB Interface.

Connecting to the Instrument

The lead coming from the USB Interface has a silver connector that is plugged into the data port on the rear of the Cygnus 1 Ex instrument.

- Push-down the sealing cap on the data port connector on the rear of the Cygnus 1 Ex instrument to expose the connector socket,
- Align the red marks on both connector parts,
- Push the connector into the socket until it latches into place.
- To remove the connector, pull-back on the body of the connector to release the latch, the connector can then be removed.



Fig 6. Cygnus 1 Ex Data Port Connection.

Cleaning The Instrument

See the section on Cleaning on page 89.

Section 3 – Gauge Features

The Cygnus 1 Ex gauge is available to order in four variants, you can change the variant or add certain features at a later date by purchasing an Update Code from Cygnus.

Feature	Variant			
	SC	TC	PLUS	PRO
Measurement Units, Resolution, Velocity of Sound	■	■	■	■
Single Echo Measurements (SE)	☐ [1]	■	■	■
Echo-Echo Measurements (EE)	☐ [1]	■	■	■
Multiple-Echo Measurements (ME) including Deep Coat	■	☐ [1]	■	■
Measurement Limits	■	■	■	■
Material List	■	■	■	■
Calibration 1 & 2 Point	■	■	■	■
Indoor/Outdoor Display Colours	■	■	■	■
Measurement Freeze	■	■	■	■
Auto Probe Detection		■	■	■
A-Scan Display	☐ [1]	☐ [1]	■	■
Manual Gain Control	☐ [1]	☐ [1]	■	■
High Temperature Measurement [2]	☐ [1]	☐ [1]	☐ [1]	■
Data Logging (Basic)			■	-
Data Logging (Advanced)	☐ [1]	☐ [1]	☐ [1]	■
B-Scan		☐ [1]	■	■
Manual Gates (A & B)		☐ [1]	☐ [1]	■
Fast Update Rate (32Hz)			■	■
Measurement Setups				■
User Access Control				■

[1] Feature can be purchased as an upgrade.
[2] With suitable high temperature Ex probe when available.

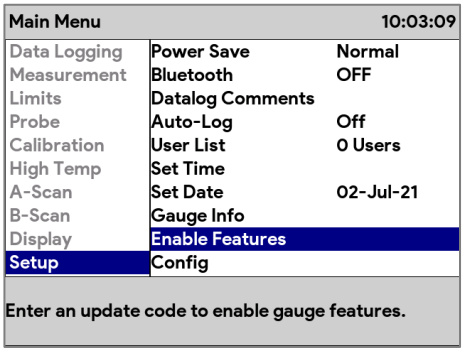
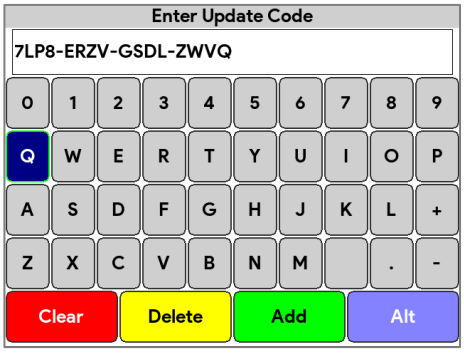
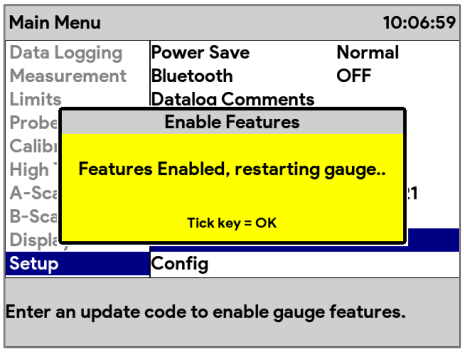
Upgrading

Purchasing an Update Code

To purchase an Update Code, you will need to provide the serial number of the gauge, its current variant and feature code.

To find the Variant, Serial Number and Feature Code of the gauge, navigate to **Menu->Setup->Gauge Info**. See Menu Group - Setup on page 87.

Entering an Update Code

1.	Access the Menu and scroll down to the **Setup** group. Then scroll right and select **Enable Features**. Press the √ key to start and enter in the update code.	
2.	Enter the update code exactly as shown, the format is: **XXXX-XXXX-XXXX-XXXX**	
3.	If the code is accepted the gauge will update and require a re-start.	

Section 4 – Operating Instructions

In this manual all the features are described, but the features available on your gauge will depend on its variant.

Quick Start Guide

1. Fit a Battery Pack.
2. Turn on the gauge.
3. Connect a Probe.
4. Select the Probe (if prompted).
5. Zero the Probe (if prompted).
6. Select the Measurement Mode required.
7. Check the measurements are correct using the Test Block – Calibrate if measurements are incorrect.
8. Start taking measurements.

Taking Measurements

Ultrasonic Probes

The performance of any thickness gauge and its ability to get a reliable measurement depends on selecting the right ultrasonic probe for the application and conditions. The Cygnus 1 Ex gauge is therefore offered with a selection of probes suitable for most thickness gauging applications.

The following section helps you select the right probe for the application.

The gauge **must** be set for the probe connected to it, see Setting the Probe Type on page 49.

Measuring Metals

Material	Coating	Corrosion	Typical Thickness	Recommended..	
				Probe	Measurement Mode
Steels	Any	Non to Moderate	1 mm+ (0.04”+)	**S5A**	**Multiple Echo**
Steels	Any	Non to Moderate	2 mm+ (0.08”+)	**S3C**	**Multiple Echo**

Steels	Any	Non to Moderate	3 mm+ (0.12”+)	**S2C**	**Multiple Echo**
Steels	Non	Non to Heavy	0.8 mm+ (0.03”+)	**T7A**	**Single Echo**
Steels	Non	Non to Heavy	1.0 mm+ (0.03”+)	**T5A**	**Single Echo**
Steels	Non	Non to Heavy	1.5 mm+ (0.06”+)	**T5B**	**Single Echo**
Cast Iron	Non	Non to Moderate	2.5 mm+ (0.1”+)	**T2C**	**Single Echo**

The table above shows to be able to measure both coated and un-coated steels with non to heavy corrosion ideally you will require at least two probes, in almost all applications this will be a **S2C** probe and a **T5B** probe.

When measuring in Multiple Echo mode the coating will be ignored and just the metal thickness measured.

It is possible to use a Twin Element (T**) probe in Echo-Echo Mode to ignore thin paint coatings. However, this method does not have the ability to verify measurements and without observing the A-Scan display it is possible to get incorrect measurements.

Measurement Modes

Single Echo Mode (SE) (Mode 2)

Single Echo measurement mode is most useful on heavily corroded metals where Multiple Echo fails. Because it only needs the first return echo to take a measurement it performs well on virtually all steel conditions.

However single echo mode will not ignore any surface coatings, so if you measure through a coating it will give an incorrect metal thickness measurement. If the surface coating is very thin (0.2mm / 0.01”) paint you can make an allowance for this error, but thicker coatings introduce too much error to be practical.

Single echo measurements use a twin element (twin crystal) probe, because there are two elements angled to a focal point there is a v-path error introduced. However, this v-path error is mostly corrected by the gauge, and furthermore by performing a two-point calibration.

Twin element probes require “zeroing” at regular intervals, especially if the ambient temperature is changing.

To overcome some of the drawbacks of Single Echo measurements the gauge has an A-Scan display that can be used to visually verify the thickness measurements are sensible and therefore reliable.

Echo-Echo Mode (EE) (Mode 3)

Echo-Echo mode uses a twin element probe, but measures between the first two significant back-wall echoes. This method is intended to ignore any thin surface coatings whilst still using a twin element probe.

Echo-echo mode is not able to verify its measurements unlike Multiple echo mode, therefore it is possible to give incorrect readings. But as the Cygnus 1 Ex gauge has an A-Scan display you can use this to visually decide if the measurement given is correct.

Echo-echo mode must therefore be used with caution, and only on thin paint surface coatings (less than 0.5mm/0.02”). It is recommended a Single Echo measurement should also be made to help verify the measurement makes sense (the Single Echo measurement should always be thicker due to the coating thickness).

Multiple Echo Mode (ME) (Mode 3)

Multiple Echo measurement mode is by far the most reliable and quickest method for thickness measurements because it works by looking for three matched echoes it can verify the thickness measurement is valid. This method has been used in all Cygnus gauges since the late 1970s.

Multiple echo mode will ignore surface coatings (Through Coating mode) there is no need to remove the paint to take a measurement.

Also, because it uses a single element (or single crystal) probe there are no errors due to the V-path of the ultrasound beam found in all twin element probes. This makes it simple to calibrate – two-point calibrations are not required.

However, because it requires three echoes to take a measurement, in heavily corroded steels there is often an insufficient number of echoes so measurements may not be possible.

Measuring Non-Steels

The gauge will measure the following non-steels.

- Aluminium alloys
- Copper and Brass alloys
- Titanium

Use the same rules as steels when selecting a suitable probe. The gauge will ideally be re-calibrated to suit the metal being measured, or the standard velocity of sound for the specific material would be entered into the gauge.

Measuring Non-Metals

You can measure certain types of plastics with the gauge using a twin element probe and the gauge set to Single Echo measurement mode. Generally, the harder the plastic the better, soft materials like rubber or TPEs tend to absorb too much ultrasound so only thin samples can be measured.

Engineering plastics like Acetal, Tufset (Polyurethane), Nylon and High-density polyethylene (HDPE) can be measured successfully.

Rotationally Moulded parts can generally be measured successfully.

- You must use Single Echo mode to measure plastics.
- You must generally use a low frequency probe (the **T2C** probe is recommended) to measure plastics, but this will depend on the properties of the material.
- Any material with a closed-cell construction cannot be measured.
- Any material with internal voids, air bubbles or honeycomb cannot be measured.

Typically, these materials cannot be measured with the gauge.

- Concrete
- Wood
- Thermal insulation materials
- Foams
- Composites

Twin Element Probes

Probe Faces or Tips

Twin element probes have a hard acrylic ‘tip’ or contact point of the probe. There are two sections to this tip – one for transmit and receive.

During normal use this top can become scratched when the probe tip is in contact with rough metal surfaces. This can cause the performance of the probe to reduce, meaning more gain is required and thin sections become harder to measure.

You can re-face the tip of the probe using light abrasive sheets or an oil stone with a film of light oil as a lubricant. When re-facing you must ensure the face is kept

flat and even. Most probes allow up to 1mm of re-facing before they are considered unserviceable.

Surface Temperatures

Standard twin element probes must only be used on surfaces with a temperature under **70°C** (160°F).

The T5BH High Temperature Probe

The Cygnus **T5BH** probe is suitable for measuring surface temperatures up to 300°C (570°F) when used with a suitable high temperature couplant. This probe has been developed with Ionix® Advanced Technologies and has been certified for use with the Cygnus 1 Ex gauge.

Single Element Probes

Protective Membranes

All Cygnus single element probes have a soft face and therefore are fitted with a Polyurethane Membrane which provides better contact on rough surfaces and protects the probe face from wear, prolonging the life of the probe.

Check the membrane regularly as it is important the membrane is changed as soon as it shows any signs of wear.

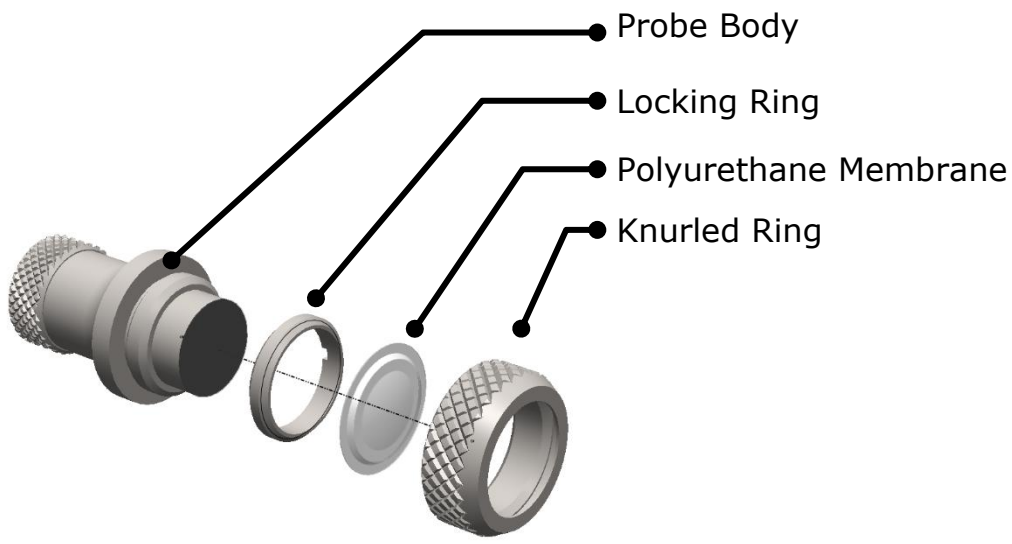


Fig 7. Single Element Probe Membrane Parts.

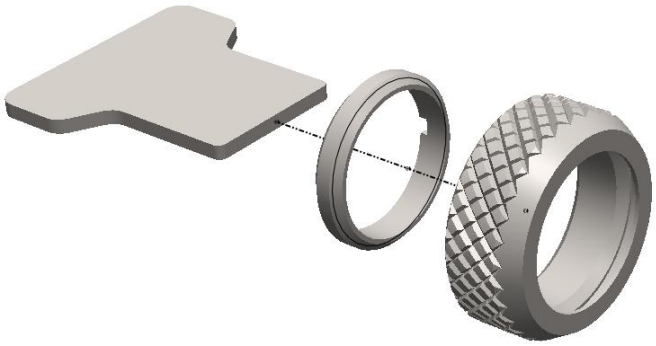
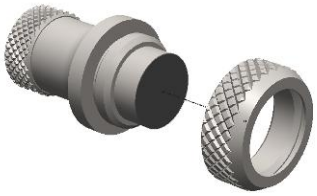
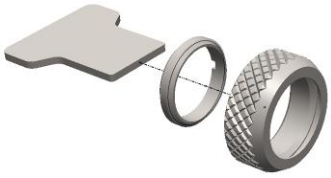
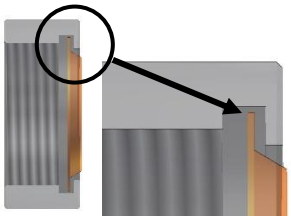
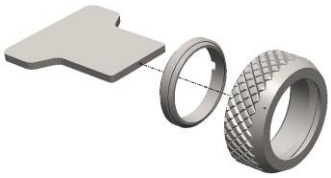


Fig 8. Single Element Probe Membrane Locking Key

Changing the Protective Membrane

1.	Unscrew the Knurled Ring from the end of the Probe.	
2.	Use the Membrane Key to unscrew the Locking Ring from inside the Knurled Ring. The old membrane can then be removed and discarded.	
3.	Place a new membrane into the end of the Knurled Ring ensuring it locates in the groove.	
4.	Screw the Locking Ring back inside the Knurled Ring and tighten with the Membrane Key.	
5.	Place a few drops of Membrane Couplant on to the probe face.	
6.	Screw the Knurled Ring back onto the probe. Use your thumb to squeeze the couplant from under the membrane as you tighten the Knurled Ring down.	
7.	You should see the membrane has a very thin film of couplant between itself and the probe face with no air bubbles.	

Measuring Higher Temperatures

The standard polyurethane membrane fitted to the single element probes are suitable for measuring surface temperatures up to **70°C** (160°F).

For measuring higher temperatures Teflon membranes are available and suitable for surface temperatures up to **150°C** (300°F) with intermittent contact. Contact Cygnus instruments to order Teflon membranes.

When measuring high temperatures limit the time the probe is in contact with the hot surface to less than 4 seconds and ensure the probe has sufficient time between measurements to cool down.

Summary of Cygnus Probe Types

Twin Element probes

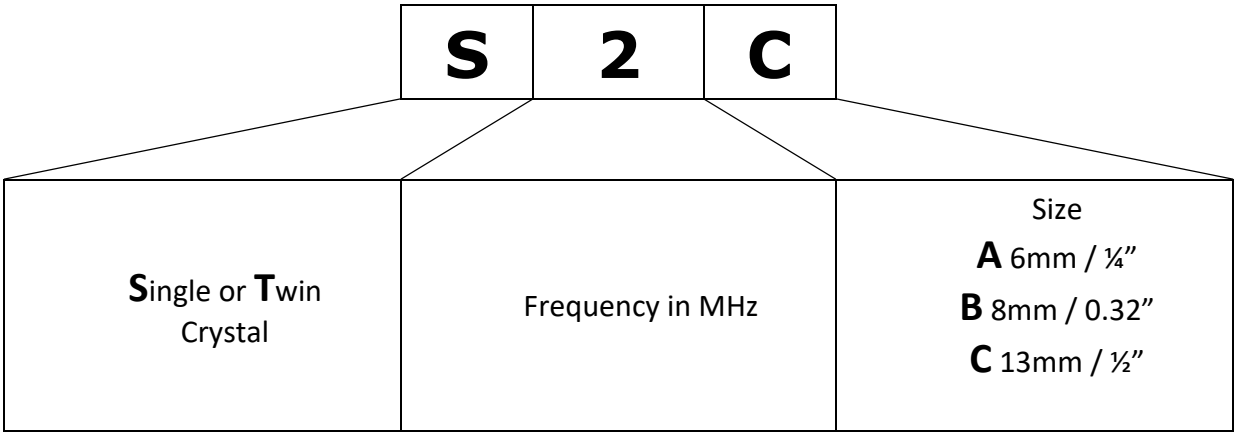
Probe Type	Size	Frequency	Range in Steel (SE Mode)	Typical Uses
T2C	12mm 0.5”	2 MHz	2.5 to 250 mm 0.1 to 10”	Attenuative materials Cast irons, Plastics
T5B	8mm 0.32”	5 MHz	1.5 to 200 mm 0.06 to 8”	General purpose Most metals
T5A	5mm 0.2”	5 MHz	1.0 to 150 mm 0.04 to 6”	General purpose Most metals
T7A	5mm 0.2”	7.5 MHz	0.8 to 50 mm 0.03 to 2”	General purpose Thinner metals
T5BH	8mm 0.32”	5 MHz	1.5 to 200 mm 0.06 to 8”	High Temperature Measurements, General purpose

Single Element probes

Probe Type	Size	Frequency	Range in Steel	Typical Uses
S2C	13mm 0.5”	2.25 MHz	3 to 250 mm 0.12 to 10”	General purpose probe suitable for most applications that can use Multiple Echo measurement. Coated metals

S3C	13mm 0.5”	3.5 MHz	2 to 150 mm 0.08 to 6”	Coated metals
S5A	6mm 0.25”	5.0 MHz	1 to 50 mm 0.04 to 2”	Small diameter tubes Thin metals Coated metals

The ‘Probe Type’ Code



Controls

There are 12 tactile keys on the front of the gauge under the display.

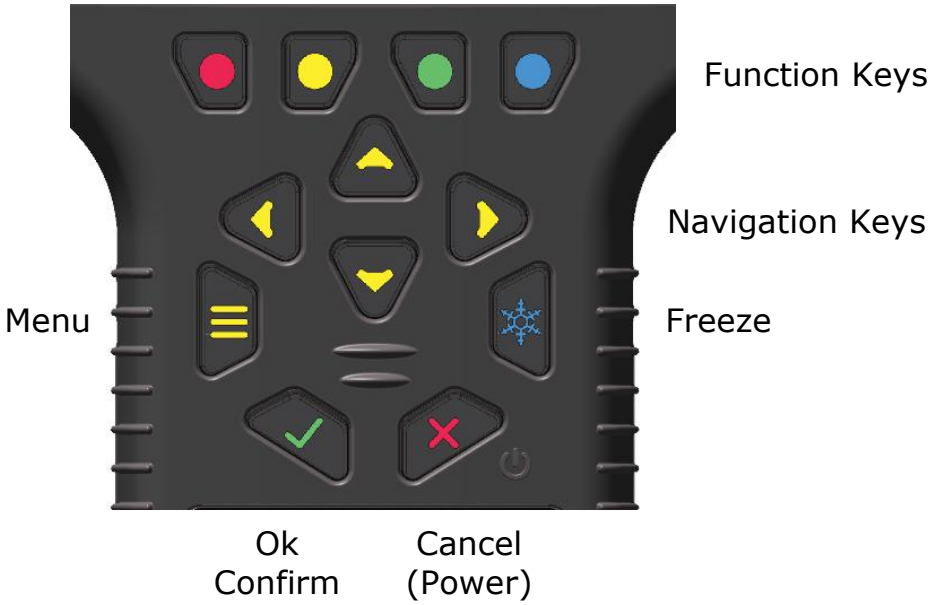


Fig 9. Keys

Function Keys

Under the display are 4 function keys each with a different colour circle. The display shows the function of each key in a coloured rectangle matching the key colour.

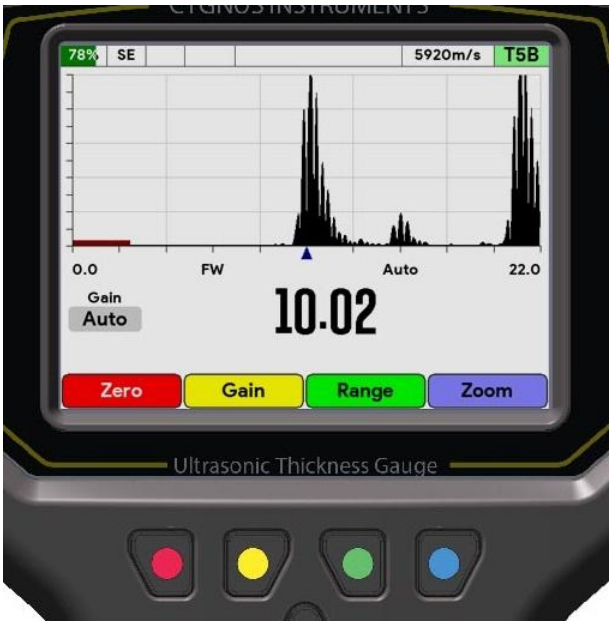


Fig 10. Function Keys

In the above example,

- Red function key = Zero
- Yellow function key = Gain
- Green function key = Range
- Blue function key = Zoom

Changing Values

Numbers

Numeric values are adjusted using a common dialog. Use the left and right ◄ ► navigation keys to select a digit, then use the ▲ ▼ navigation keys to increase or decrease the digit's value. Press the √ key to save the value or press the **X** key to cancel your changes.

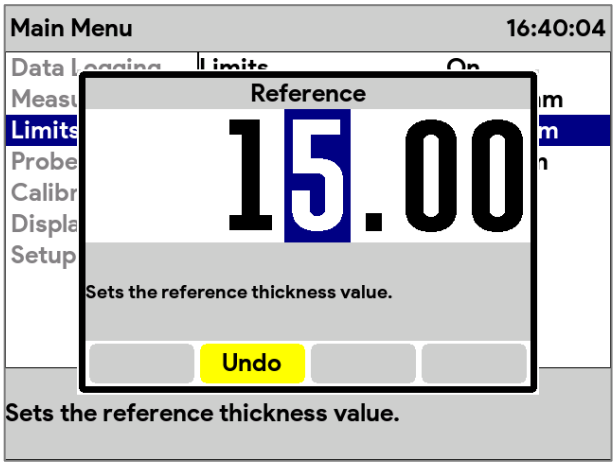


Fig 11. Adjusting Numeric Values.

Lists

Items in Lists are selected using a common dialog. Use the ▲ ▼ navigation keys to select an item in the list. Press the √ key to save the choice or press the **X** key to cancel.

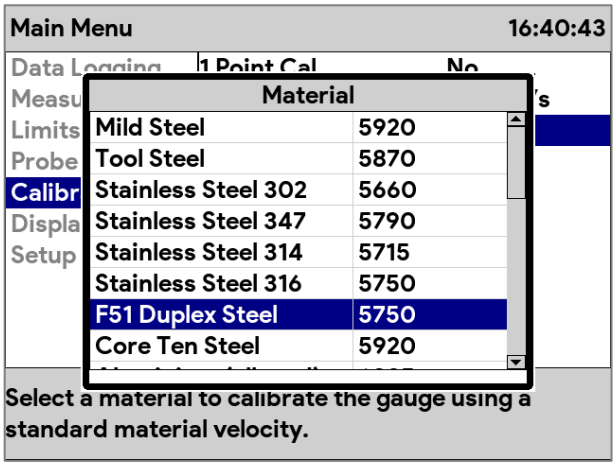


Fig 12. Selecting from a List.

Text

Text is entered using a common dialog. Use all the ►◄▼▲ navigation keys to highlight a character to enter, then press the **Add** function key to add it to the text.

- Pressing the **Clear** function key will clear the whole text.
- Pressing the **Delete** function key will delete the last character.
- Pressing the **Add** function key will add the highlighted character.
- Pressing the **Alt** function key will step through alternative characters - uppercase, lowercase and special characters.

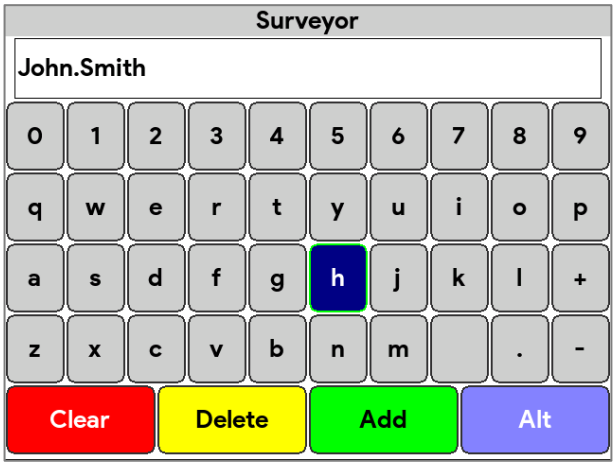


Fig 13. Entering Text.

You can use the ▲ navigation key to move up into the 'text' area where a thin **Edit Cursor** can be positioned using the ►◄ navigation keys so you can edit the text at that point, use the ▼ navigation key to move back to select a character.

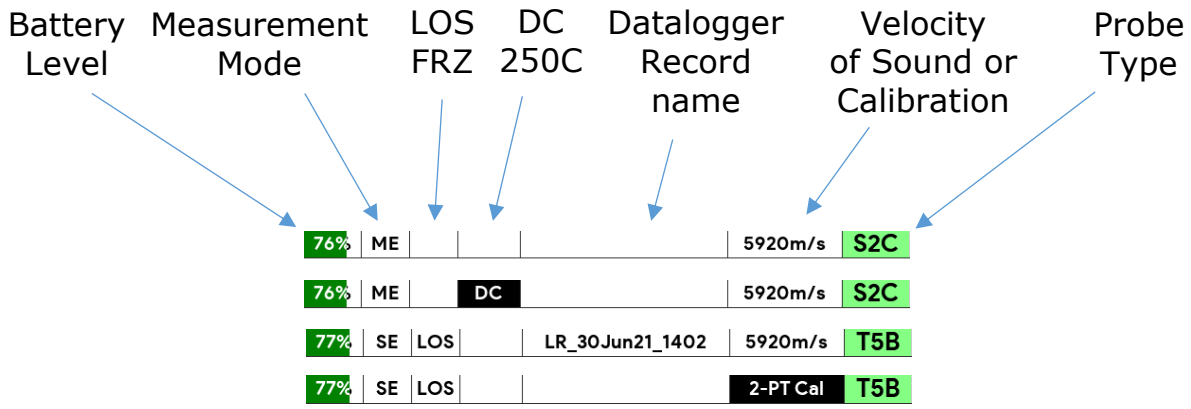


Fig 14. Positioning the Edit Cursor.

Finally press the √ key to save the value or press the **X** key to cancel your changes.

Status Information

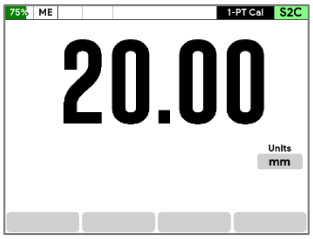
Status information is displayed at the top of the display.



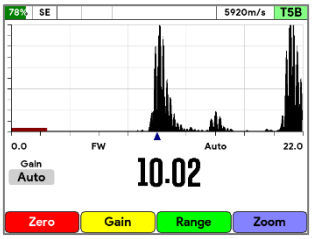
SE	Single Echo Measurement Mode
EE	Echo-Echo Measurement Mode
ME	Multiple-Echo Measurement Mode
MM	Manual Measurement Mode
LOS	Loss of ultrasound Signal
FRZ	Frozen Measurement
DC	Deep Coat feature is active
250C	High Temp Compensation is active, set to 250°C
1-PT Cal	One-point calibration active
2-PT Cal	Two-point calibration active
Material	Material Calibration active

Measurement Screens

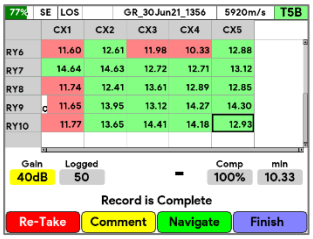
Depending on the features available in the gauge, there are 4 possible measurement screens available. Use the left and right ◄ ► navigation keys to move between each screen.



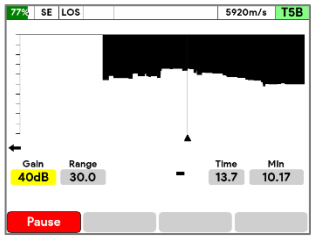
Measurement Screen



A-Scan Screen



Datalogging Screen



B-Scan Screen

Status Message Area

There is a section in the measurement screens just above the function keys where status messages are displayed.

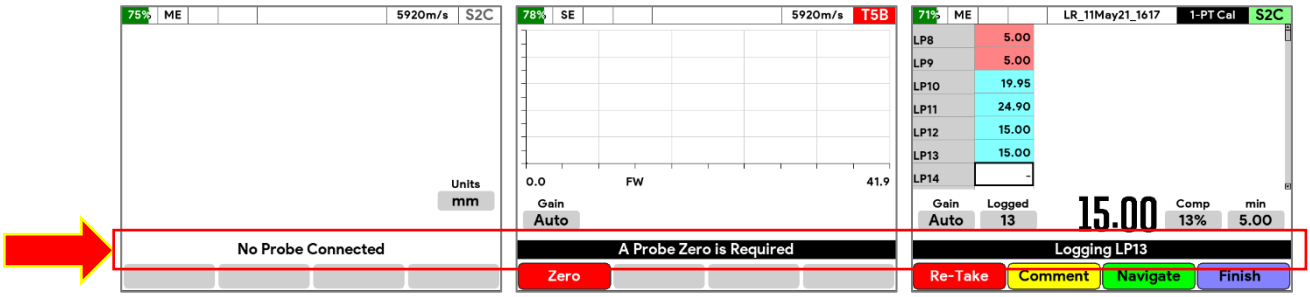


Fig 15. Status Messages.

Display Colours

There are two display colour settings, Indoor and Outdoor. To change this setting see Menu Group - Display on page 86.

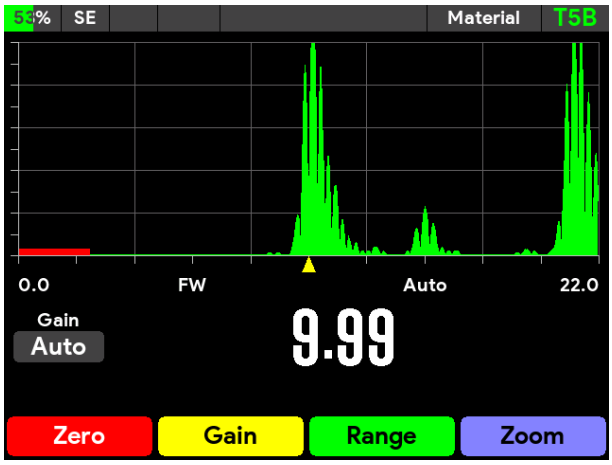


Fig 16. Indoor Display Colours

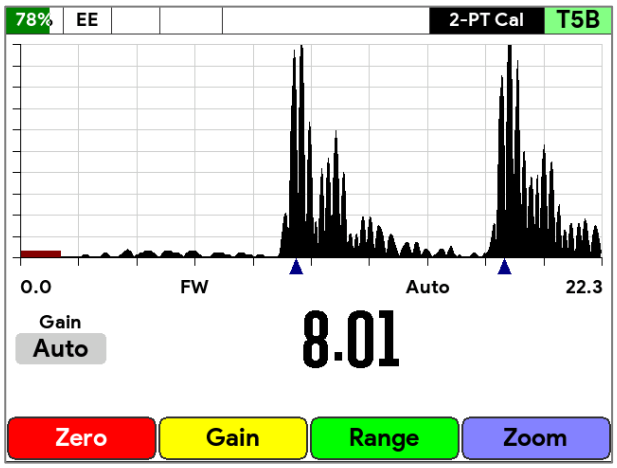


Fig 17. Outdoor Display Colours

Operation

Turning the Gauge On

To turn the gauge on press the power **X** key once. After a short delay, a start-up screen is displayed followed by the Cygnus logo. The gauge will then display a measurement screen.

Turning the Gauge Off

To turn the gauge on press the power **X** key for 2 seconds until the "Shutdown Gauge" message is displayed.

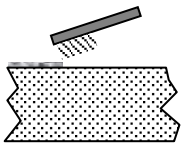
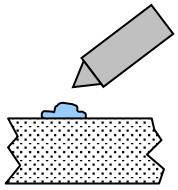
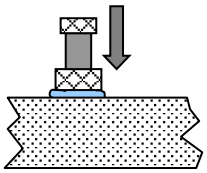
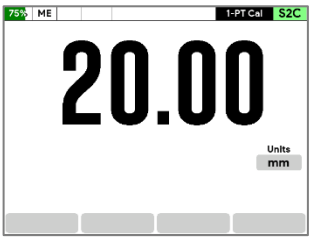
Taking Measurements

Taking ultrasonic thickness measurements is a straightforward process that first requires making sure the surface is clean and prepared, applying an ultrasonic couplant gel then placing the probe on the surface and observing the display for the measurement.

Zeroing Twin Element Probes

When using a twin element probe you must perform a **Probe Zero** before you can begin taking measurements. See Probe Zeroing (twin element probes) on page 50.

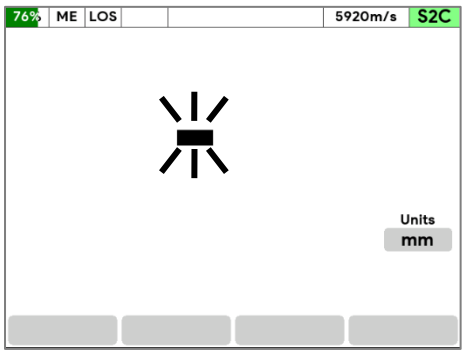
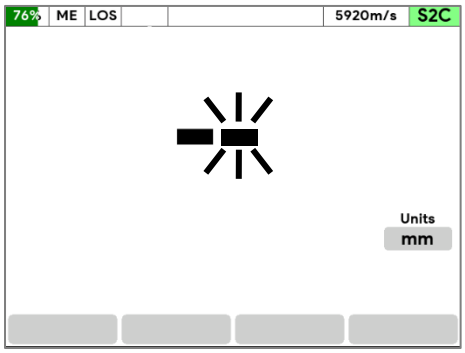
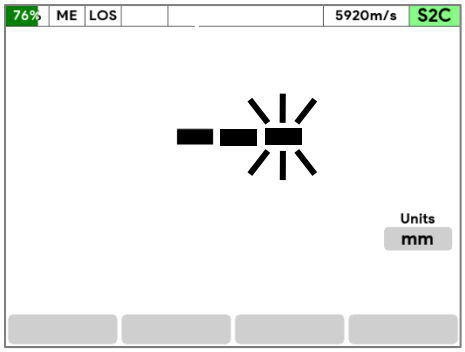
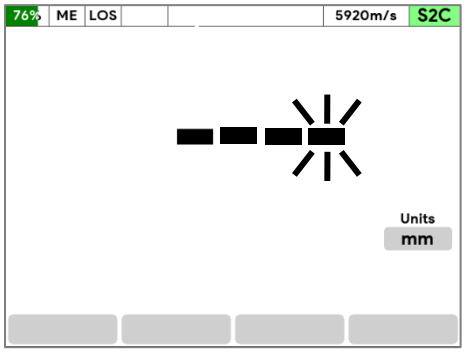
Perform a Probe Zero frequently, especially if conditions such as temperature are changing. At least every 30 minutes.

1.	Remove all scale, rust, dirt or loose coatings and brush the test area clean.	
2.	Apply ultrasonic couplant to the test surface.	
3.	Place the probe-face on the clean, lubricated test surface and make firm contact applying gentle pressure.	
4.	The gauge will display a thickness measurement. (Or an indication of Echo Strength if no valid measurement has been found in Multiple Echo mode).	

Echo Indicators in Multiple Echo Mode

If the gauge is unable to detect a stable multiple echo signal, it displays an Echo Indication to help the operator locate a suitable position.

To help obtain a multiple echo reading the operator should continue to move the probe around to locate a suitable reflector, using a slight rocking motion.

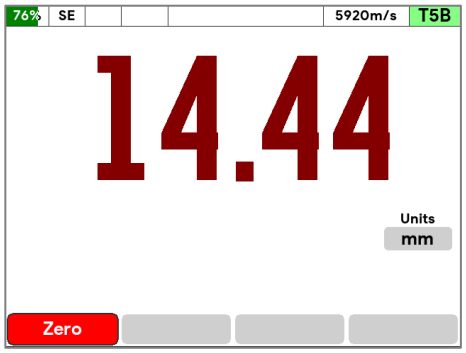
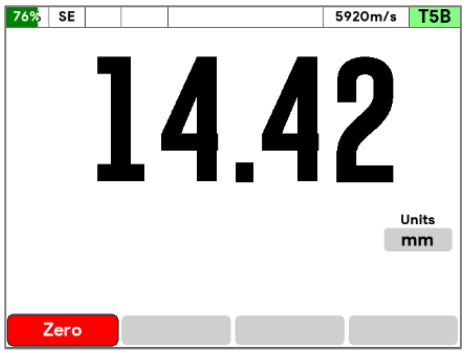
1.	1 Bar Flashing: *No echoes detected*	
2.	1 steady + 1 Bar Flashing: *Only 1 echo detected*	
3.	2 steady + 1 Bar Flashing: *Only 2 echoes detected*	
4.	3 steady + 1 Bar Flashing: *3 echoes detected but they are not matched*	

Measurement Stability Indication in SE & EE Modes

To help indicate a stable Single Echo or Echo-Echo measurement – and thus probably reliable – the thickness measurement number colour is Red to indicate an unstable measurement.

When measuring using Single Echo or Echo-Echo mode, once you have a measurement keep the probe still and wait for the gauge to signal a "stable reading".

If the ultrasound signal is poor or erratic, then the thickness value may remain red – thus indicating the measurement may not be reliable.

1.	Initial and 'unstable' measurements will be displayed as red numbers.	
2.	If the measurement remains stable for 2 consecutive seconds, then the measurement will change to black or green.	

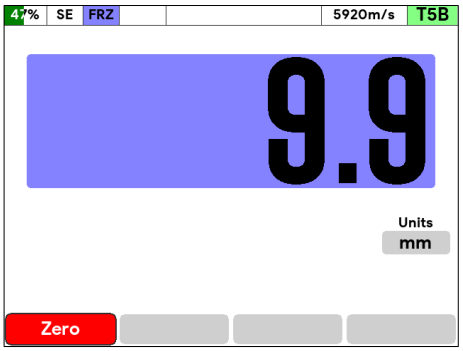
Stable is defined as; the thickness measurement changing no more than + or - the Resolution setting.

Example.

> *The Resolution is set to 0.05mm, therefore the thickness measurement must not change by more than +0.05mm or*
> *-0.05mm for 2 seconds or more to be "stable".*
>
> *The Resolution is set to 0.002", therefore the thickness measurement must not change by more than +0.002" or*
> *-0.002" for 2 seconds or more to be "stable".*

Measurement Freeze Feature

The thickness measurement can be 'frozen' by pressing the **Freeze** key while in any measurement screen.

1.	Press the **Freeze** key to hold the thickness measurement.	
2.	Press the **Freeze** key to un-freeze the thickness measurement.	

A-Scan Screen

To help ensure measurements are reliable in Single Echo and Echo-Echo measurement modes the A-Scan can be used to visually verify the thickness measurements are sensible and therefore reliable. With some experience a user can quickly decide if the measurement is correct.

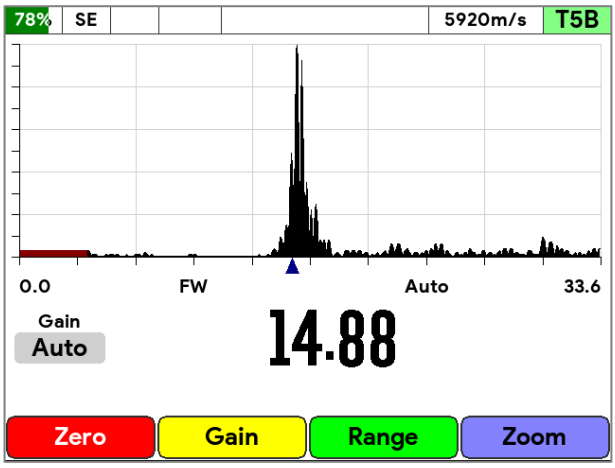


Fig 18. The A-Scan screen displaying a good echo signal.

A-Scan Range

The X axis range of the A-scan graph can be set manually or automatically by pressing the **Range** function key.

You can then set a range value or press the **Auto** function key for Automatic mode.

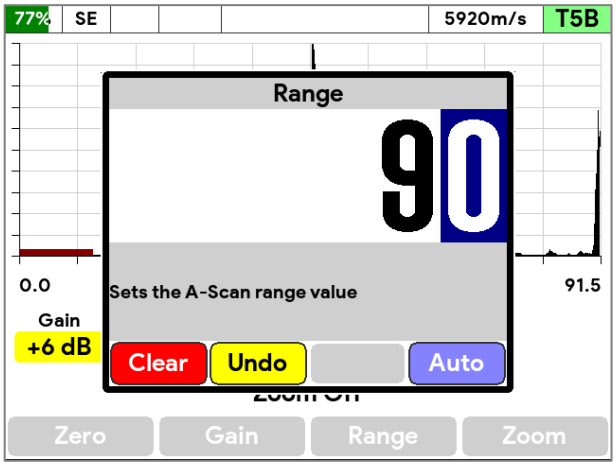


Fig 19. A-Scan Range Setting.

When Auto Range is selected, the A-scan range is automatically set using the current thickness measurement value so all detected echoes are visible.

The axis range values are shown at the start and end of the X axis on the A-scan graph.

You can also change the A-Scan Range settings from the Menu, see Menu Group - A-Scan on page 85.

A-Scan Zoom

You can Zoom in on echo signals using the **Zoom** function key. Pressing the Zoom function key will step through each zoom mode (depending on the measuring mode set.)

Zoom Mode	Details
Zoom Off	Zoom is off
Zoom All	Zoom to all detected echoes using for the measurement.
Zoom E1	Zoom to Echo 1
Zoom E2	Zoom to Echo 2 (EE & ME Modes)
Zoom E3	Zoom to Echo 3 (ME Mode)
Zoom Gate A	Zoom to cover Gate A (MM Mode)
Zoom Gate B	Zoom to cover Gate B (MM Mode)
Zoom Gate A-B	Zoom to cover Gate A and B (MM Mode)

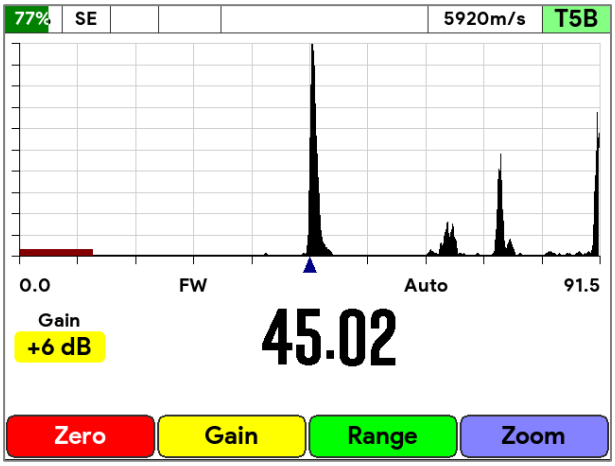


Fig 20. Zoom Off

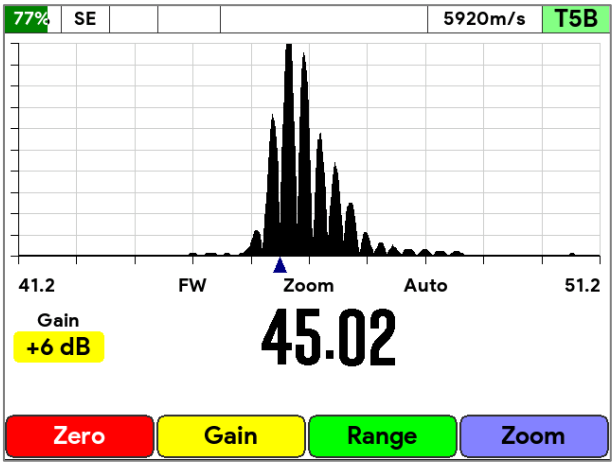


Fig 21. Zoom E1

A-Scan Grid

The A-Scan graph can show a grid for estimating echo positions, there are three grid options – Off, Full and Half.

You can change the A-Scan Range settings from the Menu, see Menu Group - A-Scan on page 85.

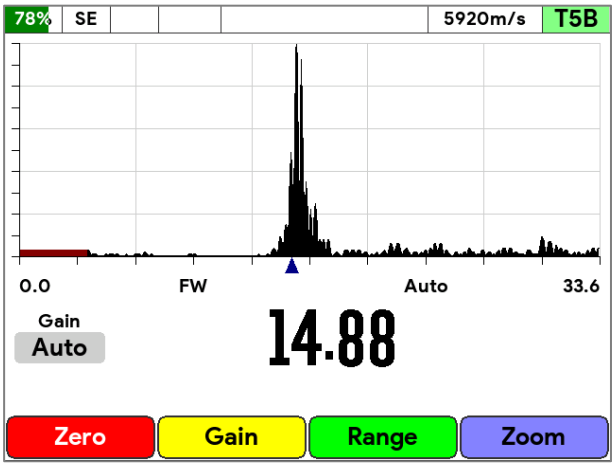


Fig 22. A-Scan Half Grid.

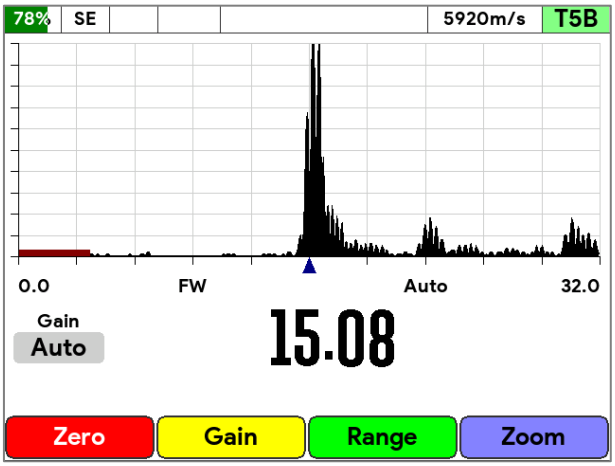


Fig 23. A-Scan Full Grid.

A-Scan Rectification

The A-Scan graph can show a RF or rectified signal independently of the measurement, there are four options.

- RF (No Rectification)
- Full Wave Rectification
- Negative Half Wave Rectification
- Positive Half Wave Rectification

You can change the A-Scan Range settings from the Menu, see Menu Group - A-Scan on page 85.

Changing the Rectification will not affect the measurements, only what is displayed on the A-scan.

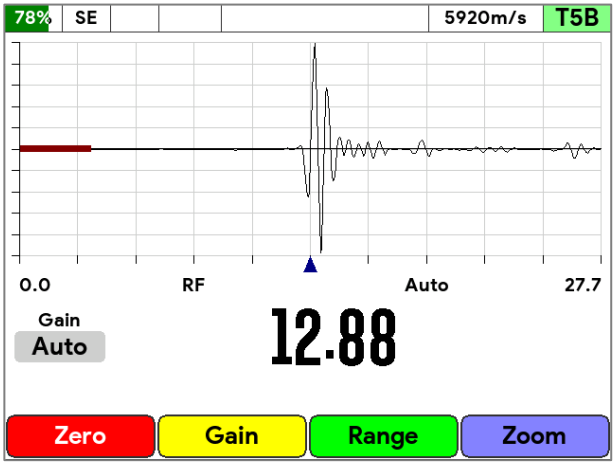


Fig 24. RF Mode, No Rectification.

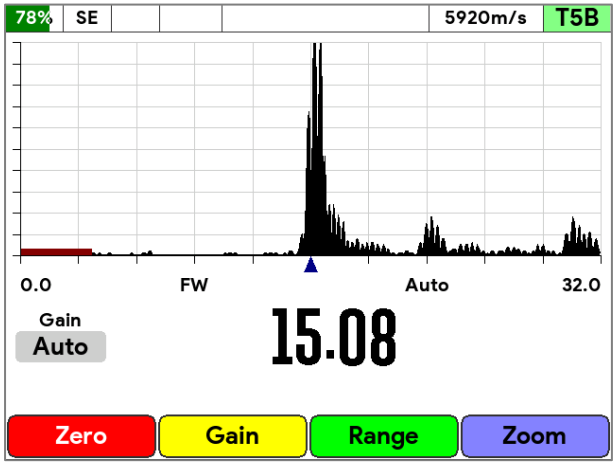


Fig 25. Full Wave Rectification (FW).

Calibration

Why should I Calibrate my Thickness Gauge?

Ultrasonic thickness gauges measure time in order to measure the thickness of the material being tested. It relies on the principal that sound travels through a material at a constant velocity or speed. If you can accurately measure the time it takes to travel through a material, and you know its velocity, then you can calculate its thickness.

$$\text{Thickness} = \frac{\text{time x velocity}}{2}$$

Modern thickness gauges are easily capable of measuring **time** accurately to 10 Nano seconds (0.000,000,01 seconds) so this is considered to be more than sufficiently accurate.

This means the accuracy of any thickness gauge measurement relies principally on the **velocity of sound** value being correct for the material being measured.

There are tables listing the velocity of sound of most common metals and materials, but these velocities are only “typical” values. For example, Mild Steel has a typical velocity of 5920 m/s – but in practice when measuring a variety of mild steel samples, the velocity can range anywhere from 5860 to 5980 m/s.

This means if you want to achieve the most accurate thickness measurements you must calibrate your thickness gauge to a sample of the same material you will be

testing – and a sample that you can accurately measure the thickness of with a Vernier or Micrometer.

Remember - your measurements are only as good as your calibration!

Instructions for calibrating the gauge can be found on page 46.

Calibration Options

The Cygnus 1 Ex gauge is supplied calibrated with a calibration certificate. The Gauge will have been calibrated to measure thickness through steel (grade S355JO) with a velocity of sound of 5920 m/s.

Either a 15mm or 1/2" **Test Block** is supplied with the kit so the Gauge can be quickly checked for correct operation. Note, this test block is not intended to be used for calibration of the Gauge.

The best way to calibrate the Gauge is to Calibrate using a Known Thickness using a sample of the material you intend to measure. This method determines the velocity of sound for the material sample, which will always be more accurate than using a 'general' velocity value. For calibration instructions see page 43.

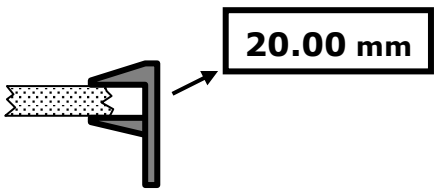
If there is no test sample available, the gauge can be calibrated by setting the Velocity of Sound directly. A table on page 94 at the back of this manual lists common materials and their velocity of sound value. For calibration instructions see page 43.

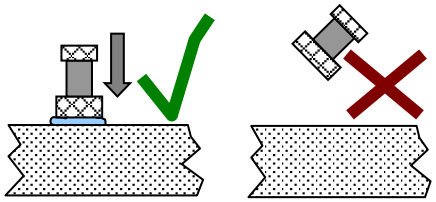
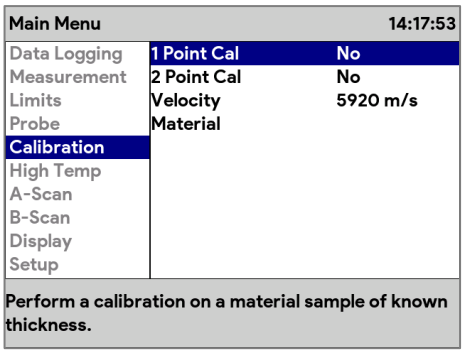
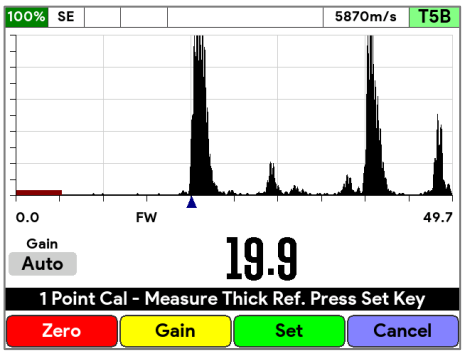
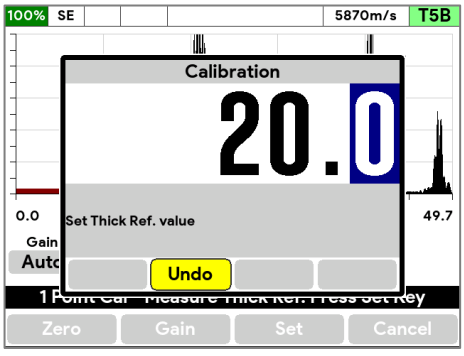
A third method is to leave the Gauge set to its factory-pre-set value for Steel [5920 m/s or 0.2332 in/us], and then use a Conversion Factor from Reading Conversions on page 95.

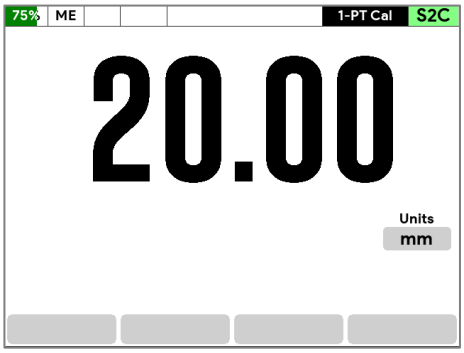
Calibrating to a known thickness (Single or 1 Point)

This method of calibrating the gauge is more accurate than using a standard velocity-of-sound value as the gauge calculates the velocity of sound for the sample material.

You can use this calibration method in all measurement modes.

1.	Accurately measure the thickness of your sample material.	

2.	Place the Probe on the sample and verify the gauge can get a stable thickness value.	
3.	Access the Menu and scroll down to the 'Calibration' group. Then scroll right to the '1 Point Cal' item. Press the √ key to open the '1 Point Cal' function	
4.	Hold the probe firmly on the thick sample to obtain a steady thickness measurement.	
5.	While the thickness value is displayed you can use the up and down ▲▼ navigation keys to adjust the thickness value.	
6.	When you have a stable measurement press the **Set** function key. A dialog box is displayed where you can enter the required thickness measurement. Press the √ key to accept or **X** key to cancel.	

7.	A '1-PT Cal' indication is displayed in the status area. ***1-PT Cal*** *= Single Point Calibration.*	

Two Point Calibration

The Two Point Calibration option is only available in Single Echo and Echo-Echo modes.

Two-point calibration allows the gauge to be calibrated against two reference thicknesses of the same material, one at the minimum (thin) thickness range the other at the maximum (thick) thickness range.

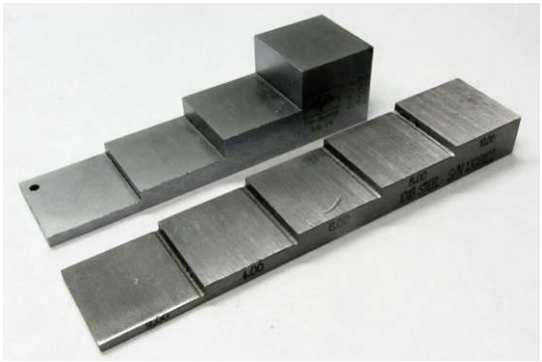
To achieve maximum accuracy in Single Echo mode you must perform a Two Point Calibration – your measurement is only as good as your calibration.

When performing a two-point calibration both sample thicknesses should be made from the same material. The temperature of the sample material should be the close to the temperature of the material to be measured.

The gauge will automatically compensate for v-path error in addition to either single- or two-point calibrations.

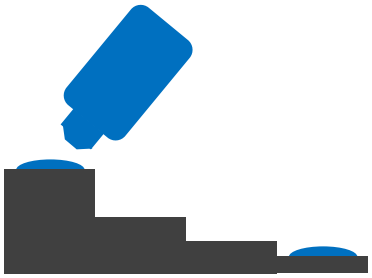
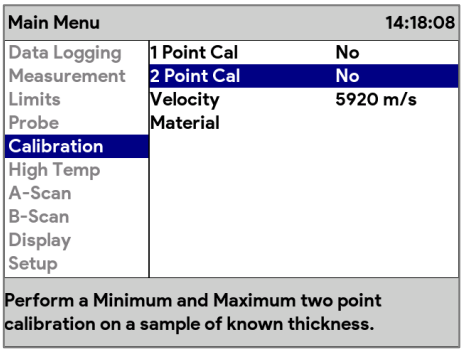
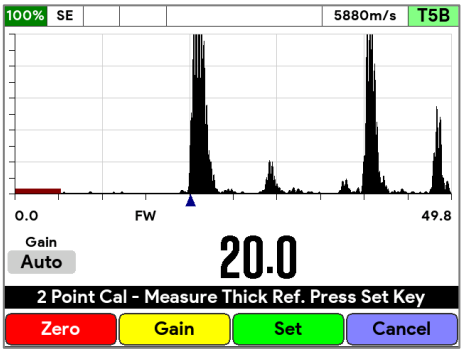
Ladder Step Wedges

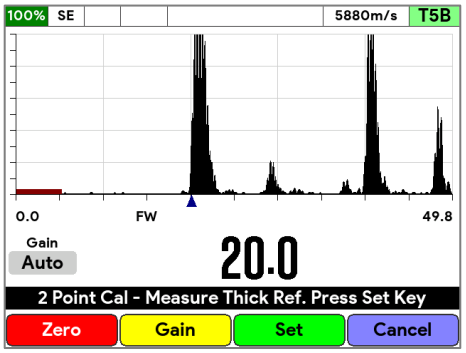
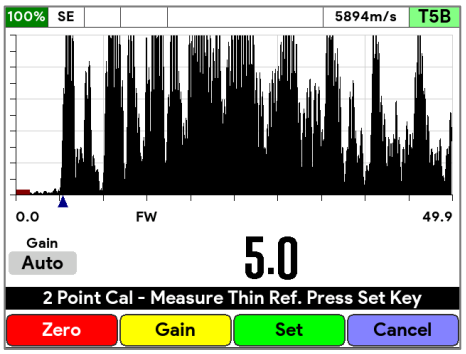
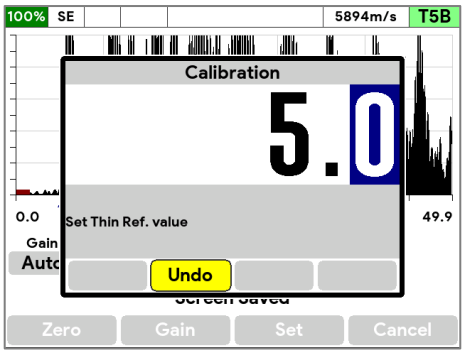
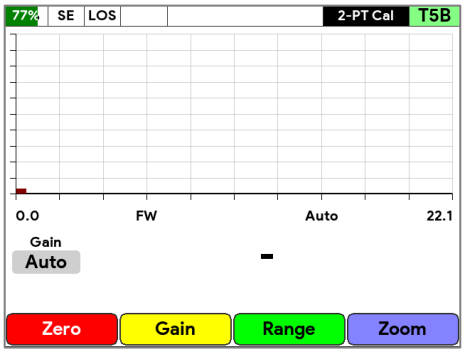
Typically, a Ladder Step Wedge is used to calibrate the probe and gauge for Steel. The ladder step wedge has 4 or 5 different thicknesses typically ranging from 2.5 to 20.0mm (0.1 to 0.5"). You would typically choose to calibrate using the 2.5mm and 20mm thicknesses.



Ladder Step Wedges

Two Point Calibration Procedure

1.	Assuming you have a step wedge of known thicknesses	
2.	Wipe clean the step wedge then add some fresh couplant to the step wedge.	
3.	Place the Probe on the sample and verify the gauge can get a thickness value.	
4.	Access the Menu and scroll down to the 'Calibration' group. Then scroll right to the '**2 Point Cal**' item. Press the √ key to start.	
5.	Start with the **thick** sample – the maximum thickness.	
6.	Hold the probe firmly on the thick sample to obtain a steady thickness measurement. You can use the up and down ▲▼ navigation keys to adjust the thickness to the required value.	

7.	When you have a stable measurement press the **Set** function key A dialog box is displayed where you can enter the required thickness measurement. Press the √ key to accept or **X** key to cancel.	
8.	Next measure the **thin** sample – the minimum thickness.	
9.	Hold the probe firmly on the thin sample to obtain a steady thickness measurement. Use the up and down ▲▼ navigation keys to adjust the thickness to the required value.	
10.	When you have a stable measurement press the **Set** function key A dialog box is displayed where you can enter the required thickness measurement. Press the √ key to accept or **X** key to cancel.	
11.	A '2-PT Cal' indication is displayed in the status area. ***2-PT Cal*** = *Two Point Calibration.*	

Setting the Velocity of Sound

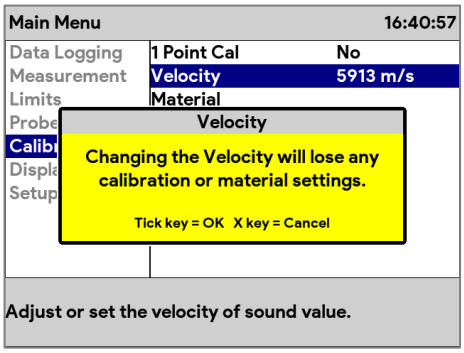
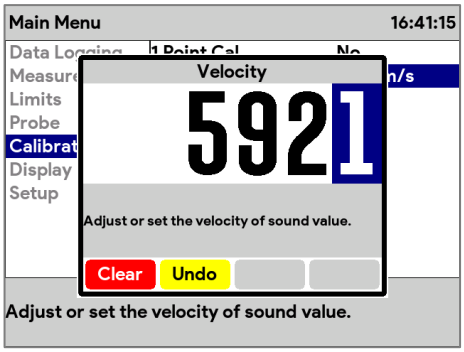
The gauge uses the Velocity of Sound value to calculate the material thickness value. It is therefore important the velocity value is set correctly for the material being measured.

If you perform a Calibration the Velocity of Sound will be set for you during the calibration – so you don't need to adjust it afterwards.

You can manually set the velocity of sound value if required; normally you would do this if.

- You can't perform a calibration.
- You want to use the same velocity setting as last time.
- You want to use a velocity from a material list.

A list of velocity of sound values for common material can be found on page 94.

1.	Access the Menu and scroll down to the **Calibration** group. Then scroll right and select **Velocity**. Press the √ key to set the Velocity	
2.	If there has been a previous Calibration, a message will warn that changing the velocity will alter the calibration. Press the √ key to continue, or **X** to abort.	
3.	Use the up and down ▲▼ navigation keys to adjust the velocity value as required. Use the left and right ◄ ► navigation keys to highlight a digit to change.	

4.	When done press the √ key to save the changes. Or press the **X** key to exit without saving.	

When the velocity has been manually set the value is displayed at the top of the measurement screen in the status area.

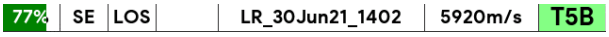


Fig 26. Velocity of Sound value '5920 m/s'

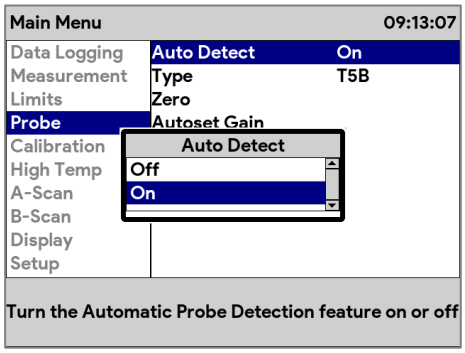
Probe Settings

Setting the Probe Type

The probe type must be set to match the ultrasonic probe connected to the gauge, otherwise the gauge will not function correctly.

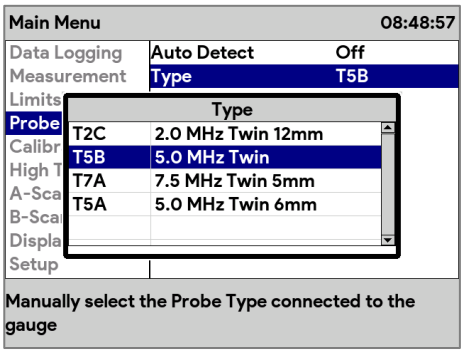
Auto Detect

There is an **Auto Detect** feature that can automatically detect most twin element Cygnus probes when they are connected to the gauge, however this does not work for single element probes.

1.	Access the Menu and scroll down to the **Probe** group. Then scroll right and select **Auto Detect**. Press the √ key to change the setting.	

If Auto Detect can't identify the probe, a list of probes will be displayed so the user can select the correct one from the list.

Manually Setting the Probe Type

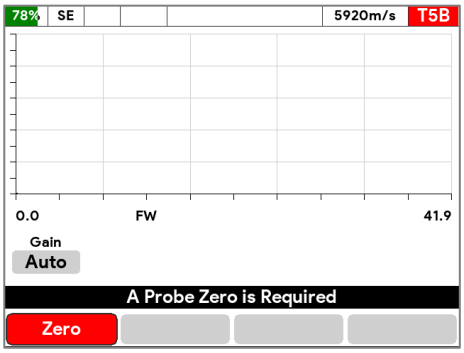
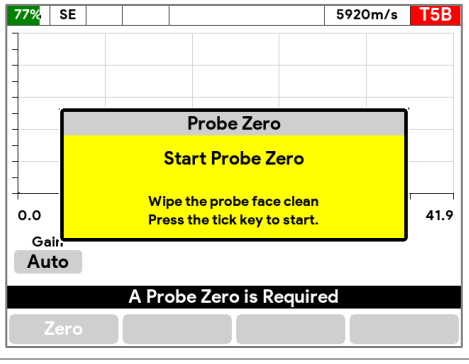
1.	Access the Menu and scroll down to the **Probe** group. Then scroll right and select **Type**. Press the √ key	
2.	Select the Probe from the list and press the √ key to confirm, or X key to cancel.	

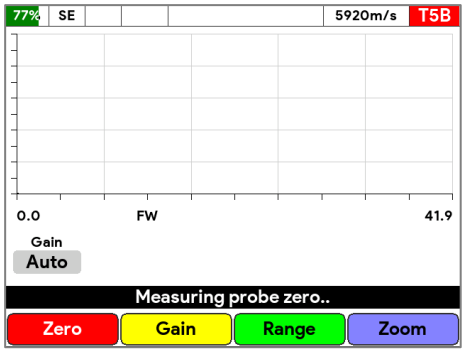
Probe Zeroing (twin element probes)

Twin element probes must be zeroed to compensate for any wear or operating temperature changes. The gauge will always perform a Probe Zero when first turned on or when a twin element probe is connected.

If the probe gets significantly warmer during use this can cause a shift in the zero position and thus introduce small errors in the thickness measurement. Typically, a 20°C (68°F) change in temperature the measurements can shift by 0.1 mm (0.04”).

It is recommended to frequently perform a Probe Zero especially if conditions such as temperature are changing.

1.	“A Probe Zero is Required” message is shown when a probe is connected. Press the **Zero** function key to begin.	
2.	Wipe clean the face of the probe. Press the √ key to start. The gauge measures the probe zero point. This takes a few seconds.	

3.	"Measuring probe zero" message is displayed, followed by the probe zero time in nanoseconds.	
4.	If the Probe Zero fails a message will be displayed. • Check the probe has not been unplugged or the cable is damaged/faulty. • The probe face must be clean and in the air. • Are you using a non-Cygnus probe?	

Probe Gain Auto-Setting

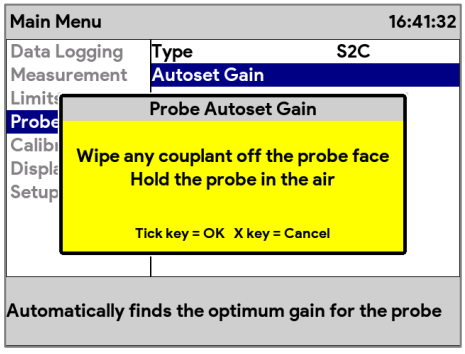
The probe gain can be auto-set by the gauge to allow for sensitivity variations in the probe. This ensures the optimal gain settings are used for the probe.

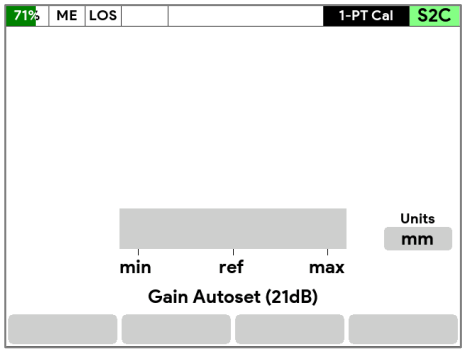
It is important that Probes have their gain set using this function otherwise they may not perform correctly.

You can perform a **Autoset Gain** function at any time.

Single Element Probes

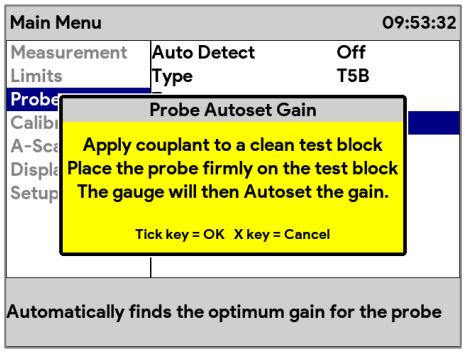
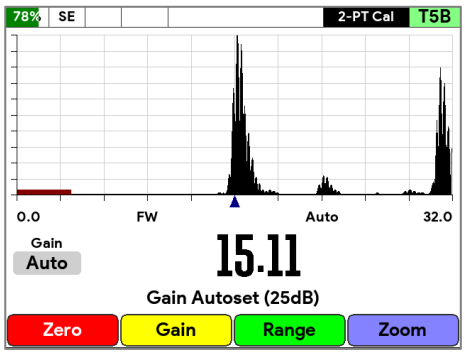
The gain is optimised when the probe is uncoupled and "in the air".

1.	From the Menu, select **Probe**, then **Autoset Gain**	
2.	Follow the instructions wiping clean the probe face, then press the √ key to start.	

3.	The gauge finds an optimal gain value, and this is displayed in the status message area.	

Twin Element Probes

The gain is optimised when the probe is placed on the Test Block supplied with the kit.

1.	From the Menu, select **Probe**, then **Autoset Gain**	
2.	Follow the instructions, adding couplant to the Test Block, then press the √ key to start.	
3.	The gauge finds an optimal gain value, and this is displayed in the status message area.	

High Temperature Measurement

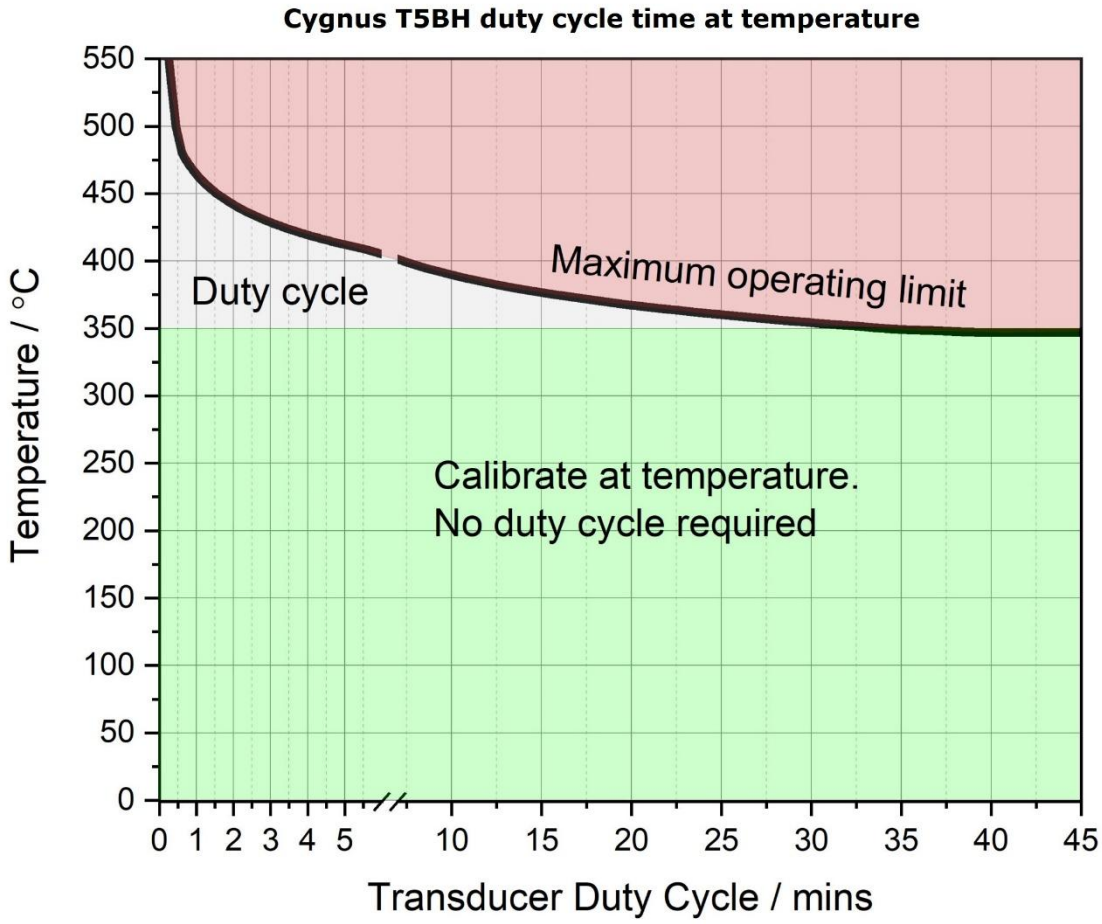
The T5BH High Temperature Probe

The Cygnus **T5BH** probe is suitable for measuring surface temperatures up to 550°C (1022°F) when used with a suitable high temperature couplant. This probe has been developed with Ionix Advanced Technologies® and has been Ex certified for use with the Cygnus 1 Ex gauge. The probe is supplied with a probe cable with a glass-fibre outer braid to protect the cable.

Temperature Range

The **T5BH** High Temperature Probe can withstand temperatures up to 550°C (1022°F) providing suitable cooling cycles are observed. The graph below shows the temperature area (in green) where continuous measurement is possible, the probe should never be operated in the red area otherwise permanent damage to the probe will occur.

- Up to 350°C (662°F) – Continuous probe to hot surface contact okay.
- Over 350°C (662°F) – Intermittent probe to hot surface contact required.



Velocity Change Compensation

When taking thickness measurements of metal at elevated temperatures the velocity of sound for the metal will increase as the temperature increases, this will introduce an error in the thickness measurement and must be compensated for using a simple general formula.

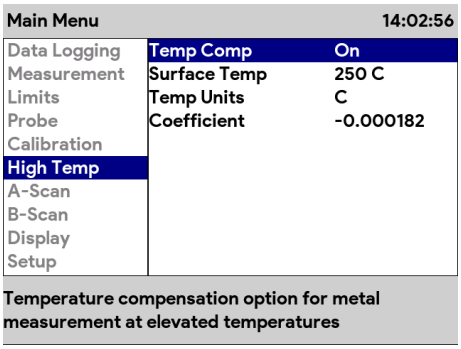
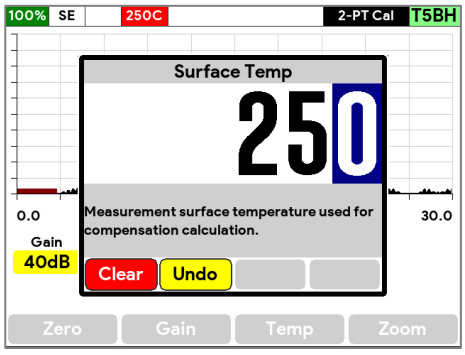
Reduce 1% per 55°C (100°F) rise in temperature.

Temperature Compensation Feature

The gauge has a facility to apply this correction based on the surface temperature measured. The user inputs the surface temperature of the sample being measured and the gauge will calculate and apply the correction factor to the thickness measurements.

Excerpt from ASME V Art 23 UT;

> *"A rule of thumb often used is as follows:*
>
> *The apparent thickness reading obtained from steel walls having elevated temperatures is high (too thick) by a factor of about **1% per 55°C (100°F)**. Thus, if the instrument was calibrated on a piece of similar material at 20°C (68°F), and if the reading was obtained with a surface temperature of 460°C (860°F), the apparent reading should be reduced by 8%.*
>
> ***This correction is an average one for many types of steel**. Other corrections would have to be determined empirically for other materials."*

1.	From the Menu, select **High Temp** to display the settings	
2.	Set **Temp Comp** to On Set the **Surface Temp** You can also change the temperature units between C and F You can edit the compensation coefficient should you need to.	
3.	On the measurement screen, A-Scan display, when **Temp Comp** is on, the green function key can be used to enter the Surface Temperature. Note this is displayed on red at the top of the screen.	

Taking Measurements at High Temperatures

A basic procedure for talking high temperature measurements follows, this should only be used as a guide as the operator should have the required training and experience to perform high temperature measurement.

1. Wear the appropriate PPE.
2. Clear the test area ready for the UT probe.
3. Set the Measurement Hold function to Min so the gauge will track and record the minimum thickness value.
4. Temperature Compensation mode can be used as this will adjust the measurements for the temperature of the material being measured. Temperature Compensation also enables manual gain to ensure that the gain can be adjusted sufficiently to obtain satisfactory measurements.
5. Set the Temperature Compensation temperature.
6. Enable manual gain control so you can adjust the gain as required.
7. Make sure the Update Rate is set to its fastest setting.
8. Take a few sample measurements to heat up the probe and then re-Zero the probe whilst hot to ensure accuracy.
9. Display the A-Scan screen.
10. Place the couplant on the probe face.
11. Place the probe firmly on the hot surface, observe the A-Scan and measurement then adjust the gain if required - you may need a few attempts to get this right.
12. Be careful not to set the gain too high otherwise you will get erratic readings when the couplant is sitting on the probe face. Generally a gain value between 40dB to 50dB is sufficient.
13. The Measurement Hold function will automatically record the Minimum thickness – you can Reset this before each measurement by pressing the red X key
14. When you get a good measurement – you can log the held value by pressing the green Tick key (if a record is open)

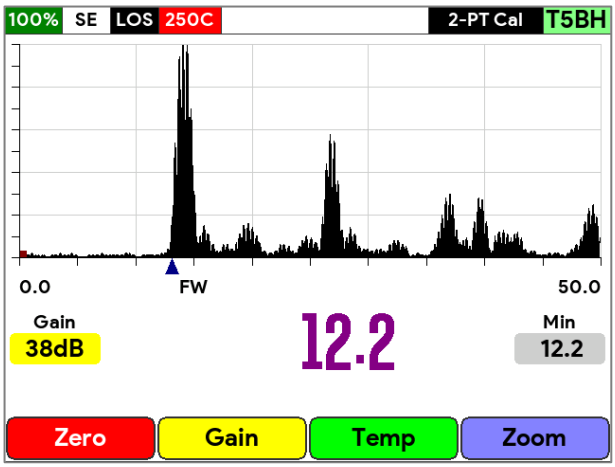


Fig 27. A high temperature measurement using the Measurement Hold function.

Tips for High Temperature Measurements

- Clean off old couplant otherwise it can form a barrier to ultrasound when it gets cooked on.
- Apply fresh couplant to the probe face and immediately place on the hot surface.
- Zero the probe frequently.
- Set a fast update rate of 16Hz or 32Hz.
- Measurement can be brief – use the Min Hold function.
- Trying to measure surfaces over 300C is very challenging.
- Watch these videos and learn more about High Temperature measurements!



YouTube – *Holloway Engineering, High Temperature UT Thickness*
https://www.youtube.com/watch?v=P-IUUt0EIe8
YouTube – *Ionix Advanced Technologies*
https://www.youtube.com/@ionixadvancedtechnologies9998/featured

High Temperature Couplant

Cygnus recommend HiTempco couplant from Echo Ultrasonics (www.echoultrasonics.com). HiTempco can be used for measurements up to 412°C (775°F).

Datalogging

Overview

The Datalogger feature allows the user to log thickness measurements in a structured record which can be saved to a file, then later sent to a Windows® computer for analysis and report generation.

Records can be created, saved, closed and re-opened to continue datalogging at any time.

Records are saved as files in the gauges file system, each record is one file.

Datalogger Variants

Data logging is available in two levels of functionality depending on the gauge variant;

Datalogging Basic

- Linear Records
- Comments

Datalogging Advanced

- Linear, Grid 2D and Multipoint Records
- Comments
- Radial Points
- Templates

Record Types

There are four types of Record that can be created.

Linear	Simple one-dimensional list of measurement points.
Grid 2D	Two-dimension grid of measurement points.
Multipoint	Three-dimension arrangement of measurement points. Level – Y dimension Position – X dimension Point – Z dimension (1..12 points)
Template	A record created from a Template. Templates set the structure of a record so measurements can be logging into this predefined structure.

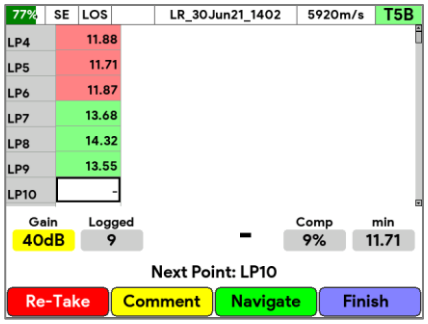


Fig 28. A Linear Record

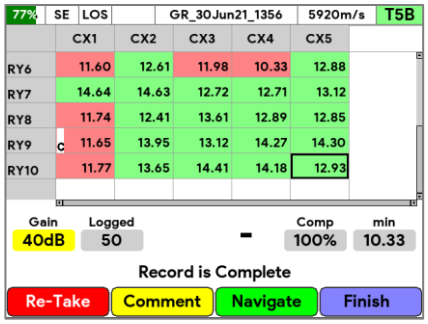


Fig 29. A Grid-2D Record

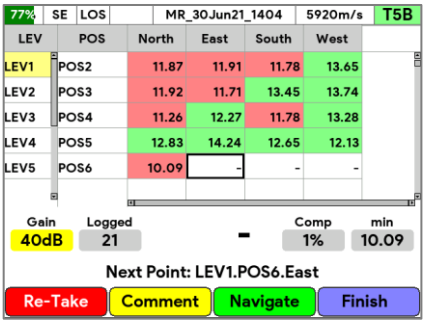
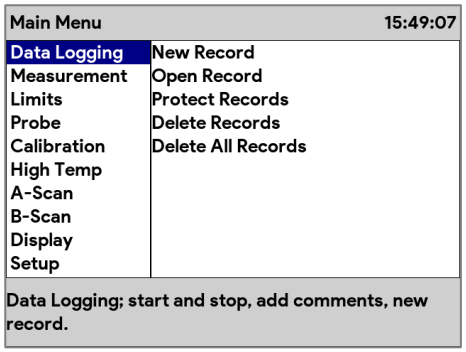
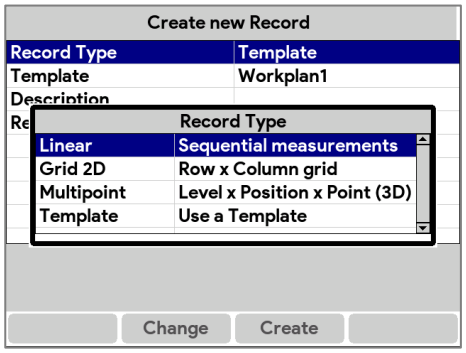
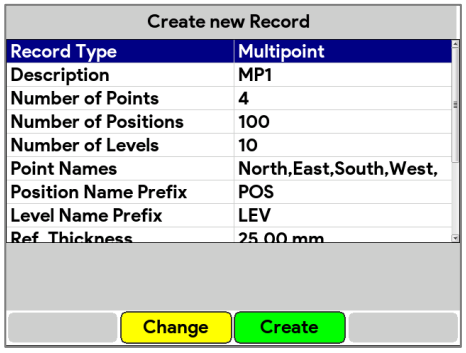


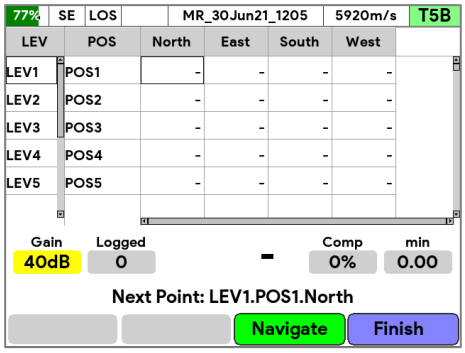
Fig 30. A Multipoint Record

Datalogger Features

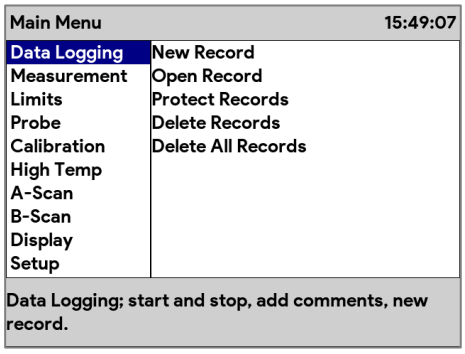
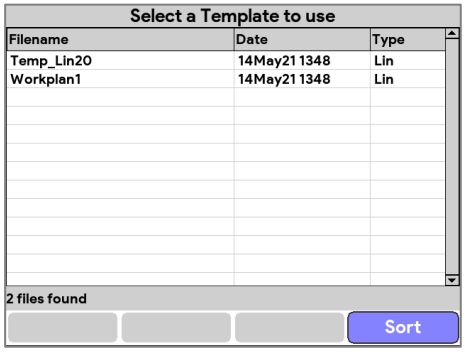
- Each record can have a maximum of 10,000 measurement points.
- Each measurement point includes a A-Scan ‘snapshot’.
- Comments can be attached to any measurement point.
- Minimum and Reference thickness limits can be specified in a record.
- Radial Points can be added to any Linear or Grid measurement point.
- You can start logging measurements from any location in the record.
- Grid records can have a ‘grid patten’ specified.

Creating a New Record

1.	From the Menu, select **Data Logging**, then **New Record.** Press the √ key to start.	
2.	Select the Type of Record you want to create.	
3.	Set the parameters for the new record in the list displayed. *Use the **Change** function key to edit a parameter.*	

4.	When all the parameters have been set, press the **Create** function key to create the new record and start logging.	

Creating a New Record using a Template

1.	From the Menu, select **Data Logging**, then **New Record.** Press the √ key to start.	
2.	Select **Template** as the Record Type.	
3.	Select the Template you want to use.	
4.	When all the parameters have been set, press the **Create** function key to create the new record and start logging.	

Record Names

When a new record is created, it is given a default record-name (and thus filename) based on the record type and the time and date.

Linear Record = LR_01Jan21_1200
Grid Record = GR_01Jan21_1200
Multipoint Record = MR_01Jan21_1200

Templated Record = TR_01Jan21_1200

You can set your own record-name when you create the record, just scroll down to the **Record Name** field in the new record parameters.

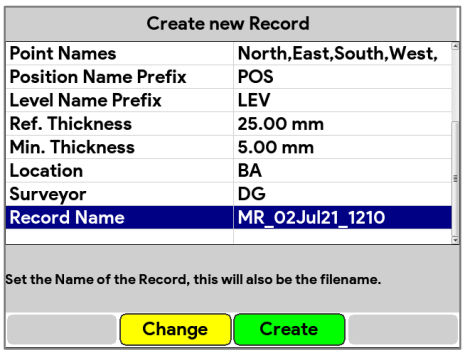


Fig 31. Record Name parameter.

Reference and Minimum Thicknesses

Each record can have an optional Reference and Minimum thickness value applied to it. When logging thickness measurements these limits are used to colour the measurement values and in the case of the minimum limit alert the user if the measurement is under that limit by way of a red colour highlight.

1. **Ref. Thickness** – This is the Reference Thickness value for the whole record. If you are surveying steel that was 12mm thick when new, then this would be your reference thickness.
2. **Min. Thickness** – This is the Minimum Thickness value for the whole record. If you take any measurements under this value, they will be coloured Red to highlight them.

Grid Record Patterns

Grid records have a choice of 16 pattern describing how to move the cursor around the grid as measurements are taken.

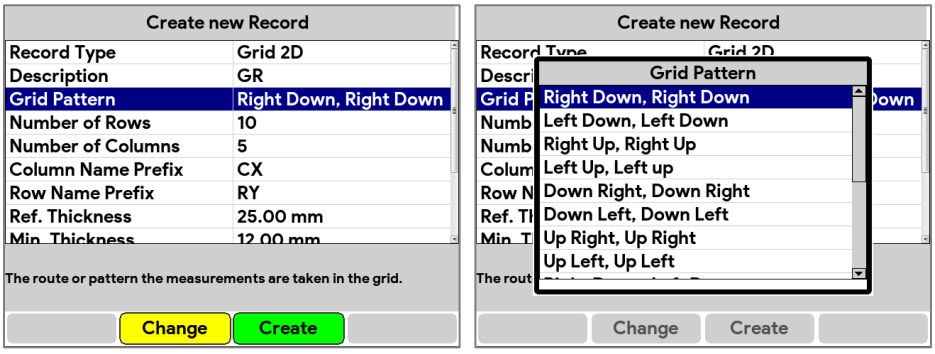


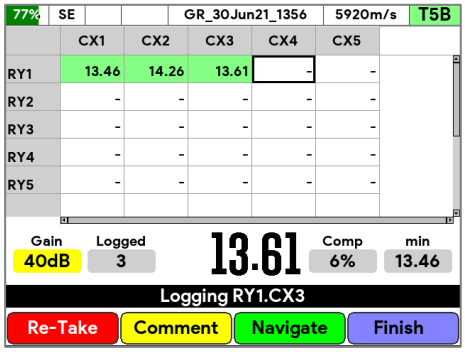
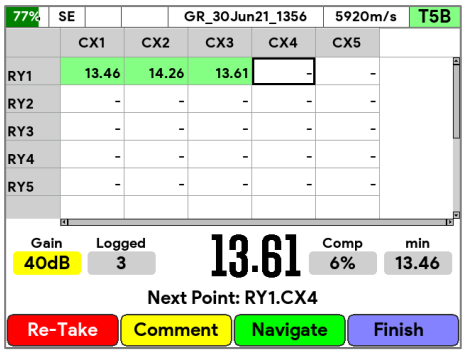
Fig 32. Grid Record and Grid Patterns.

Example Patterns

Right Down, Right Down	This is a **Horizontal** Measurement pattern. First move **right** across the columns, then move **down** to the next row. Repeat.
Up Left, Up Left	This is a **Vertical** Measurement pattern. First move **up** through the rows, then move **left** to the next column. Repeat.
Down Right, Up Right	This is a **Vertical-S** Measurement pattern. First move **down** through the rows, then move **right** to the next column. Then move back **up** through the rows, then move **right** again to the next column. Repeat.

Logging Measurements

Manual Logging

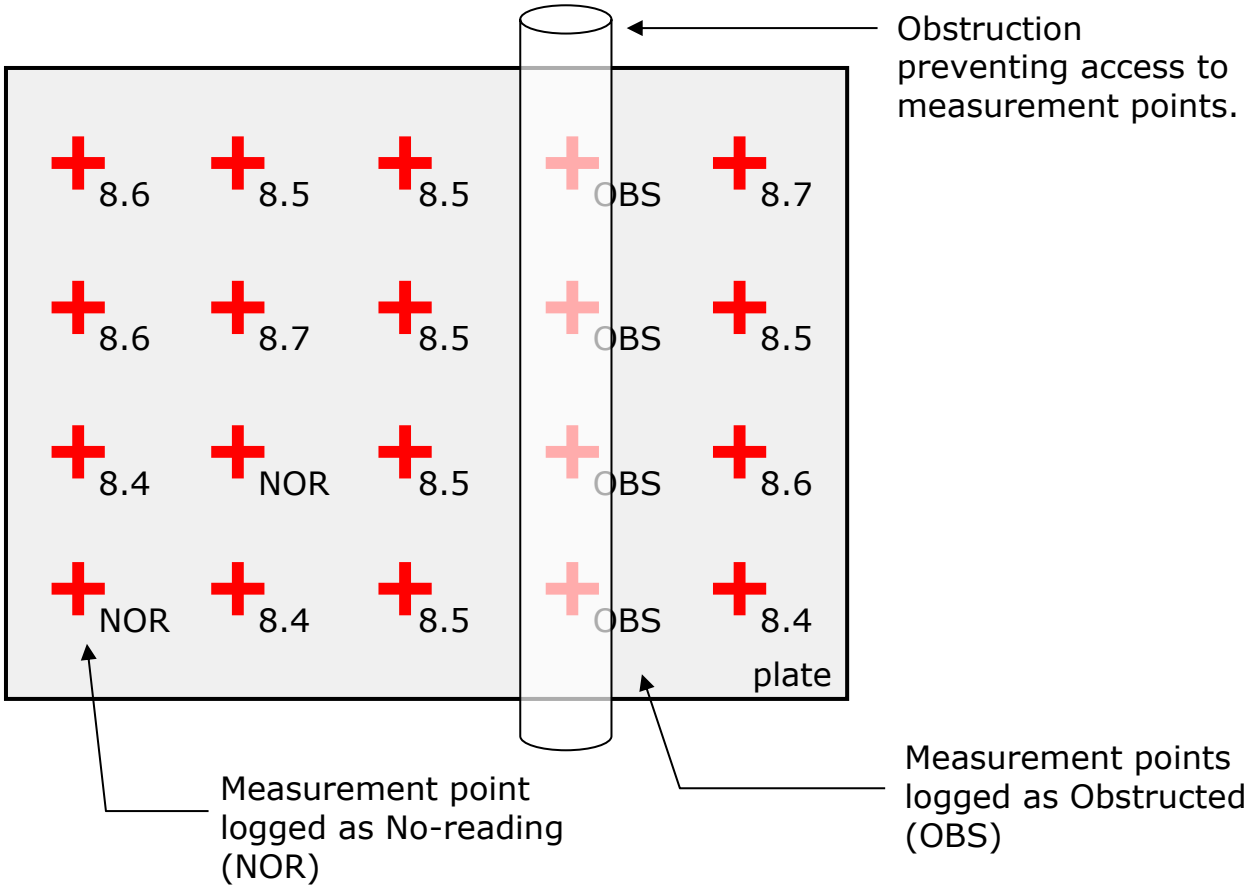
1.	To log a thickness measurement, press the √ key once in any measurement screen except the B-Scan screen. The status message will show a "**Logging..**" message	
2.	The logging position will advance one place, ready for the next measurement. Grid-2D records follow the grid pattern set.	

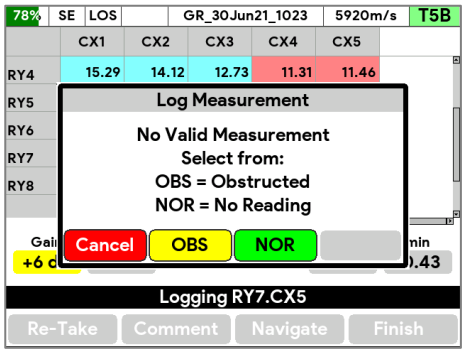
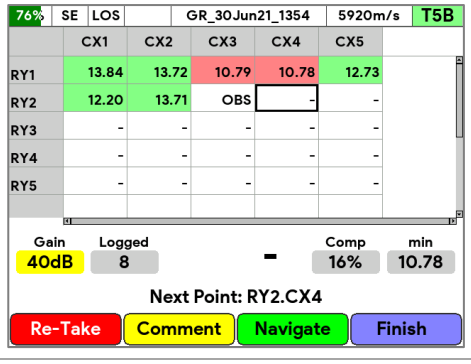
Auto-Logging Feature

When the Auto-Log feature is turned on, a stable thickness measurement will be logged when the measurement is maintained for 2 seconds.

Logging Obstructed (OBS) Measurements

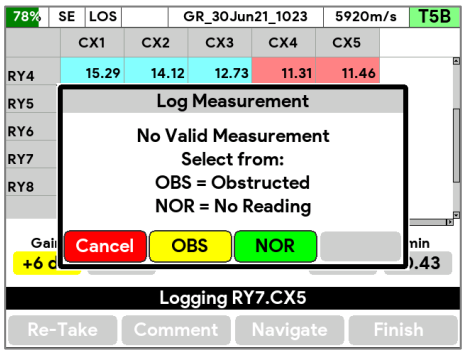
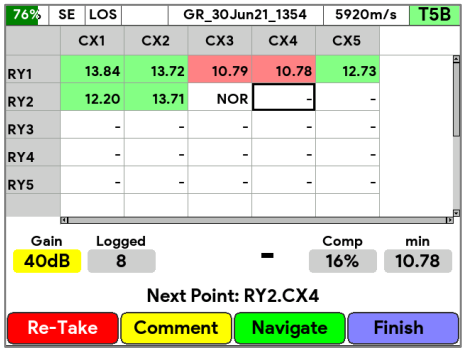
When you can't physically access a thickness measurement location, but need to record something in the record, you can choose to log a OBS (Obstructed) measurement.



1.	In a measurement screen, make sure there is no thickness measurement displayed – **LOS** is displayed - the probe is in air and its face is clean. Press the √ key to log. Select the **OBS** function key to log an obstructed point.	
2.	The point is marked with a **OBS**.	

Logging No-Reading (NOR) Points

When you can't get a thickness measurement at the current location, but need to record something in the record, you can choose to log a NOR (No Reading) measurement.

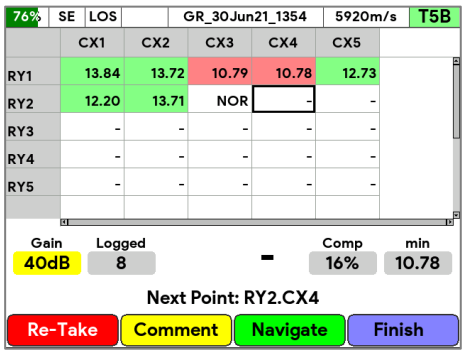
1.	In a measurement screen and have no thickness measurement value displayed. Press the √ key to log. Select the **NOR** function key to log an obstructed point.	
2.	The point is marked with a **NOR**.	

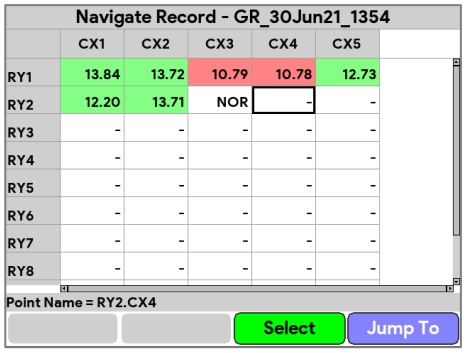
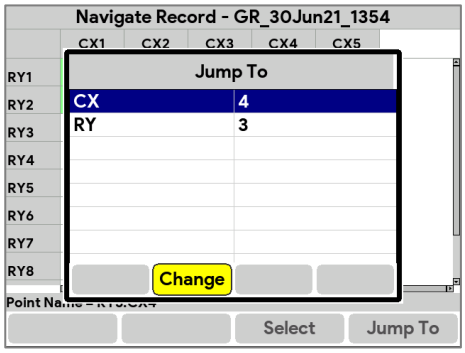
Navigating, Re-taking and Deleting

You can navigate to any point in the open record to,

- Continue logging from that point.
- Delete that measurement point.
- Re-take the last measurement point.

Navigating to a Specific Point

1.	Press the **Navigate** function key from the Datalogging measurement screen. Or, from the Menu, select **Data Logging**, then **Navigate**, then press the √ key.	

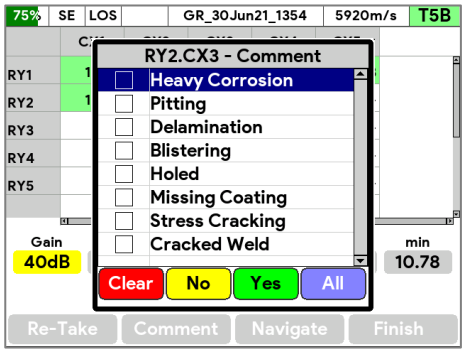
2.	Use the ◄►▲▼ navigation keys to highlight the required measurement point	
3.	You can also press the **Jump To** function key to specify a specific coordinate in the record. Pressing the √ key to jump to the coordinates entered.	
4.	Press the √ key or **Select** function key to save and exit or press the **X** key to cancel.	

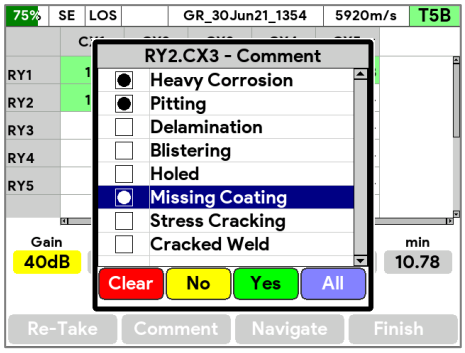
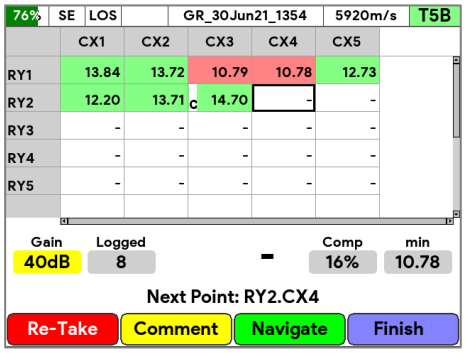
Adding Comments

There are eight 'text' comments that can be assigned to thickness measurement points. These comments can be edited from the Setup menu group, see Menu Group - Setup on page 87.

By having a list of pre-set comments, the user can quickly add comments by just selected the ones that are appropriate, this also standardises the information you want recording.

You can add a selection of Comments to any measurement point in the open record.

1.	In the Datalogging measurement screen, after logging a thickness measurement, press the **Comment** function key.	

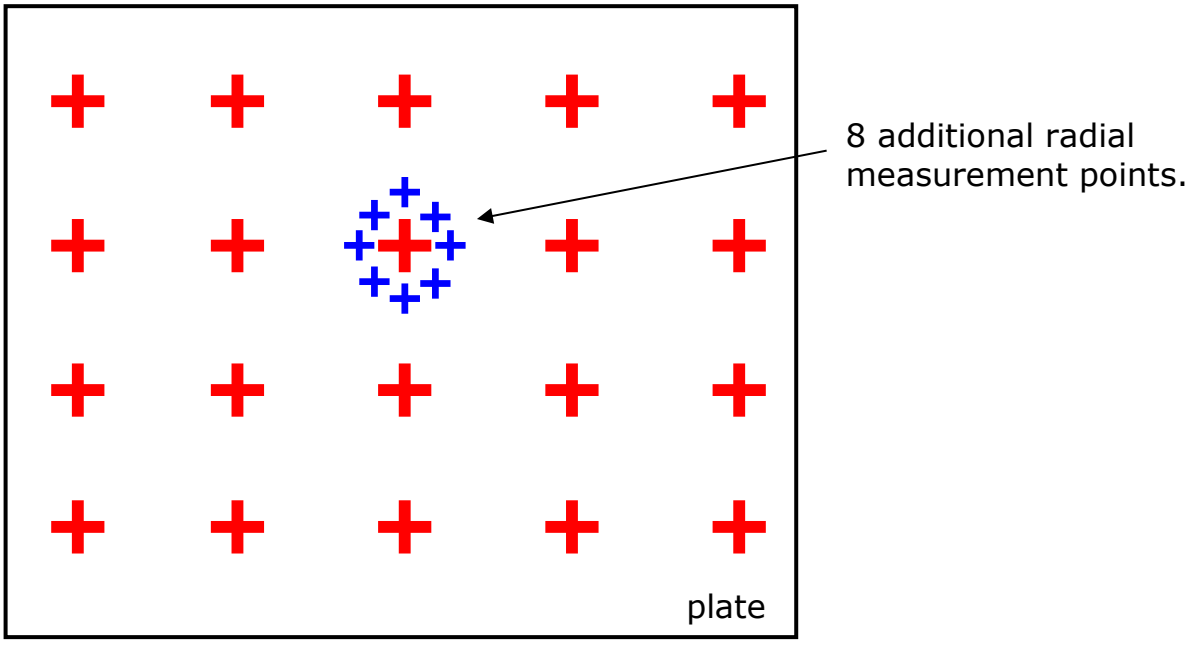
2.	Use the up and down ▲▼ navigation keys to highlight the required comments, using the function keys to select/clear as required.	
3.	Measurement points with comments have a small **c** in the lower left part of the measurement cell.	

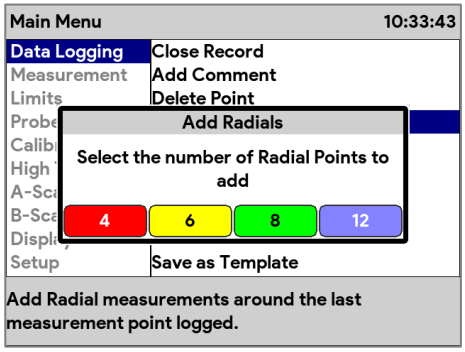
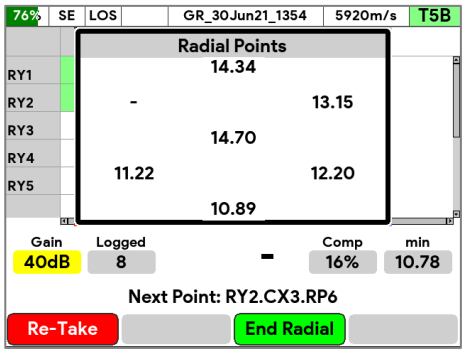
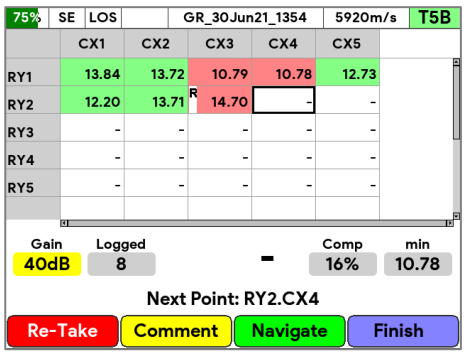
Adding Radial Points

Both Linear and Grid Records can have a set of Radial Points added to any thickness measurement to further detail an area of interest or heavy corrosion. You can add up to 12 additional thickness measurements 'around' the principal measurement in a 'clock-face' pattern.

- If you delete or re-take a measurement that has Radial Points, its radial points will be deleted.
- Radial Point values will be included when calculating the "minimum" thickness value in the whole record.

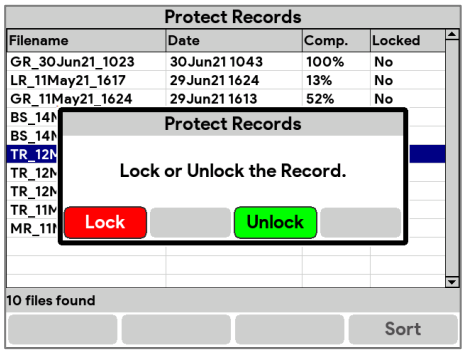
For example, when logging thickness measurements on a pipe, tank or plate it is sometimes necessary to add additional measurement points radially around a badly corroded or thin area to detail the extent of the thinning or corrosion.



1.	After logging a measurement, from the Menu select **Data Logging**, then **Radial Points**, then press the √ key. Next select the number of Radial Point to add.	
2.	Log the Radial Point measurements 'around' the parent measurement location.	
3.	Measurement points with Radial Points have a small R in the upper left part of the measurement cell.	

Protecting Records

You can protect a datalogger record to prevent any further changes being made to it. Records can be locked or unlocked, when records are created, they are un-locked so you can log measurement into them, when you have finished a record you can lock it to prevent any accidental changes or deletion.

1.	First close any Open record. *Menu - **Data Logging, Close Record.***	
2.	From the Menu select **Data Logging**, then **Protect Record**, then press the √ key.	
3.	Use the up and down ▲▼ navigation keys to select the records to lock or un-lock. Press the √ key to choose to lock or unlock the record.	

Protecting Records with User Access

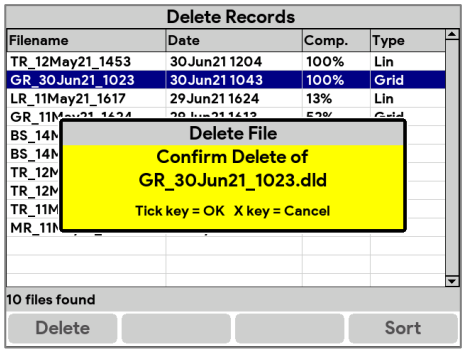
When the User Access feature is enabled, only Users with Level 1 access can lock and unlock records.

Deleting Records

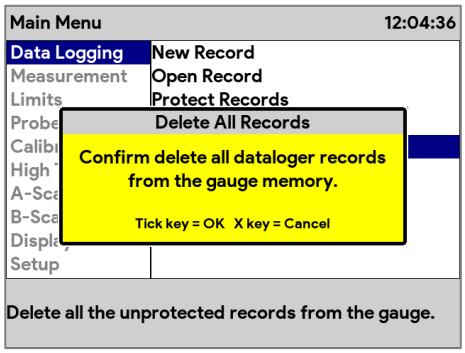
You can delete datalogger records from the gauge, either by selecting individual records, or by deleting all the records in one go. Only un-protected records can be deleted.

Deleting Individual Records

1.	First close any Open record. *Menu - **Data Logging, Close Record.***	
2.	From the Menu select **Data Logging**, then **Delete Record**, then press the √ key.	

3.	Select the record to delete, then press the **Delete** function key. You will be prompted to conform the deletion – press the √ key to confirm or the **X** key to cancel.	

Deleting All Records

1.	First close any Open record.	
2.	From the Menu select **Data Logging**, then **Delete All Records**, then press the √ key.	
3.	You will be prompted twice to conform the deletion of all the records – each time press the √ key to confirm or the **X** key to cancel.	

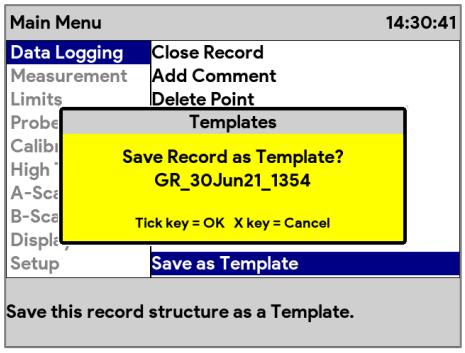
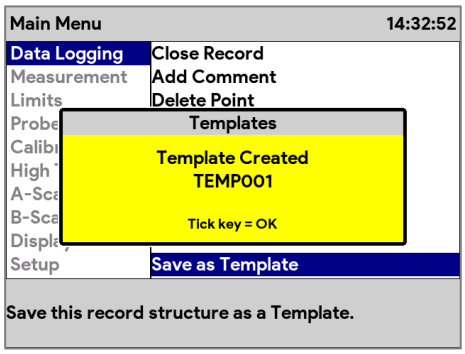
Using Templates

Templates are used to create datalogger record structure in new records, ready for logging measurement into. You can use templates for logging common parts or objects.

- Templates only contain structure, no thickness measurements.
- Templates can be created on the gauge by saving a record as a template.
- Templates can be created in CygLink on a Windows® computer and sent to the gauge.

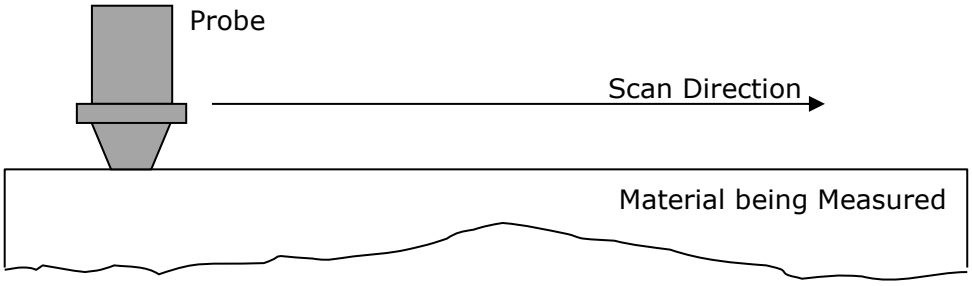
Creating a Template from a Record

1.	Prepare the current record by ensuring all the record parameters are as required.	

2.	From the Menu, select **Data Logging**, then **Save a Template**, then press the √ key.	
3.	Give the template a meaningful name so you can identify it easily.	

B-Scans

The **B-Scan** feature can be used to take a series of continuous thickness measurements and display the results graphically to represent a cross section through the material.



The results of the scan include a minimum thickness value. A cursor can also be positioned to pinpoint individual thickness measurements and log these to a data logger record if required. The B-Scan data is saved to a file in the gauges file system.

For the best results the probe must remain in continuous contact with the surface and be moved at a constant rate – in practice however this can be tricky to achieve especially on rough surfaces.

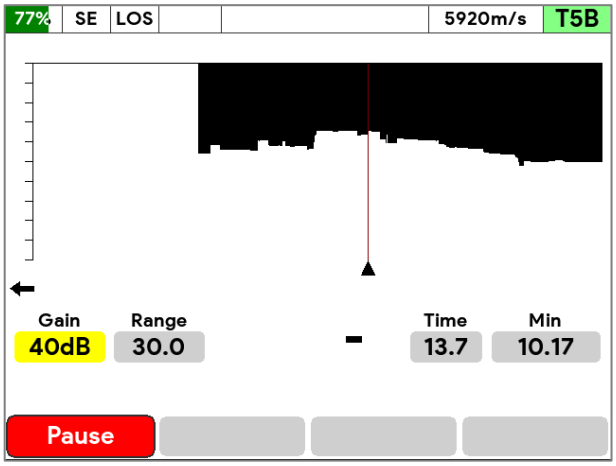
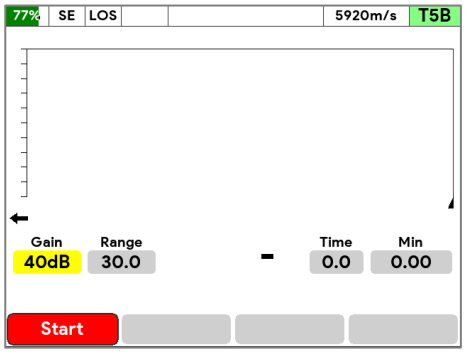


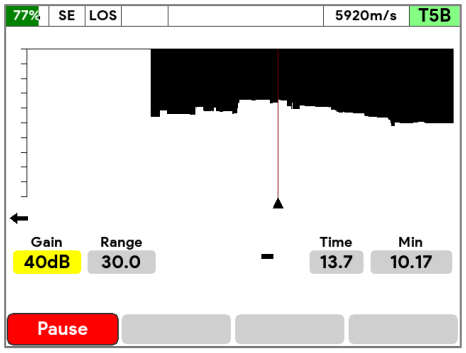
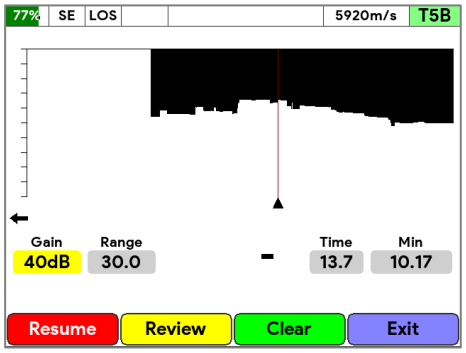
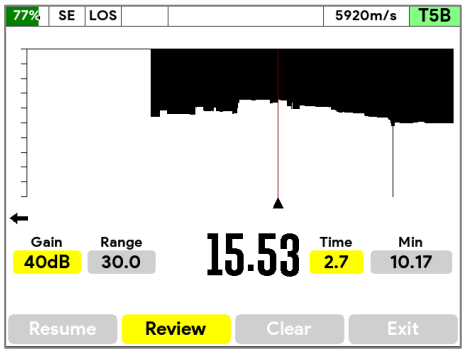
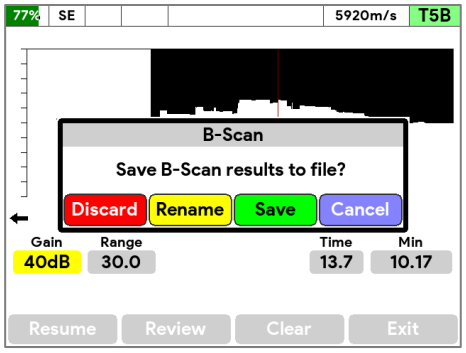
Fig 33. B-Scan Example.

- B-Scans can be auto-paused when the ultrasound signal is lost – LOS Mode.
- B-Scans have a measurement Scan Range to scale the Y axis.
- B-Scans have an optional Scan Length to scale the X axis.
- B-Scans can operate at 32Hz rate and hold up to 5,000 measurement points.
- The minimum thickness point in the scan is marked with a red line.
- B-Scans can be saved to a file.
- B-Scans can be exported to a datalogger record.
- B-Scans can be reviewed on screen to find thickness measurements.

Performing a Scan

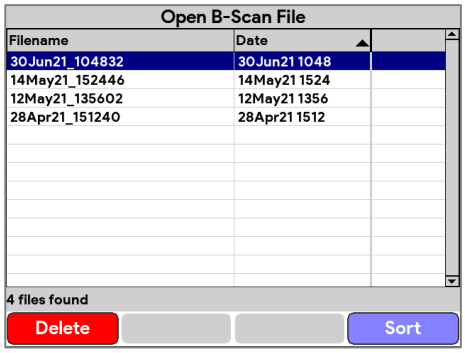
Before starting a scan, setup the probe and measurement options so you are able to take spot thickness measurements as required. Next set any of the B-Scan menu options as required.

1.	To start a new B-Scan, navigate to the B-Scan measurement screen, then press the **Start** function key.	

2.	Place the probe and start measuring, carefully moving the probe across the surface at a constant speed. The scan trace will start to build.	
3.	Lifting the probe off the surface will pause the scan (if LOS Mode is set to Pause). You can press the **Clear** function key to clear the scan data and start again.	
4.	Pressing the **Review** function key will allow a cursor to be moved across the trace using the navigation keys, the thickness measurement at the cursor point will be displayed. Press the **Review** function key to exit review mode.	
5.	Pressing the **Exit** function key will prompt to discard, rename or save the B-Scan data.	

Loading a B-Scan

You can load a B-Scan file and review the scan data.

1.	From the Menu, select **B-Scan**, then **Open B-Scan File**, then press the √ key. Select the B-Scan, then press the √ key.	

Manual Measurement Mode

For the advanced user, the gauge can take measurements using conventional Gates which can be manually configured to suit the application. The gain can also be manually controlled, including a time-controlled gain-increase slope.

- There are two Gates A and B
- Each gate has a Start, Width, Level and Peak/Flank mode.
- Measurements can be from Gate A (SE or EE), or Gate A & B (EE).
- The gain can be a static value, or a dynamic time-controlled increasing gain with a configurable start position.

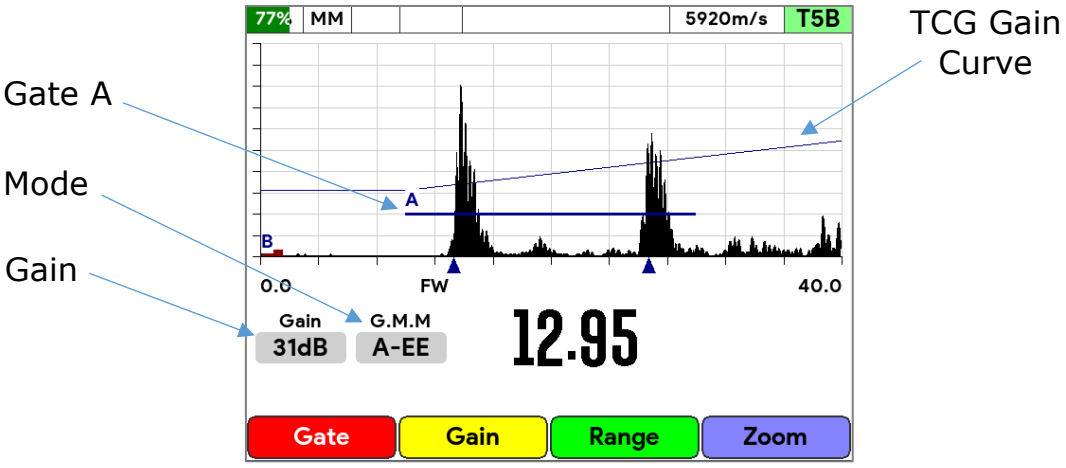
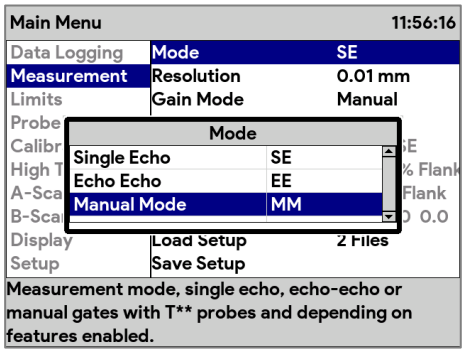
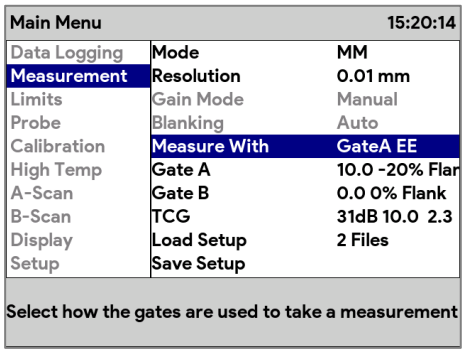
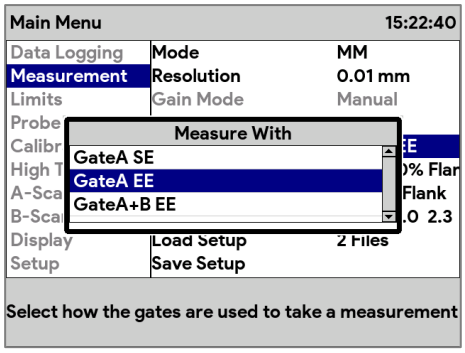


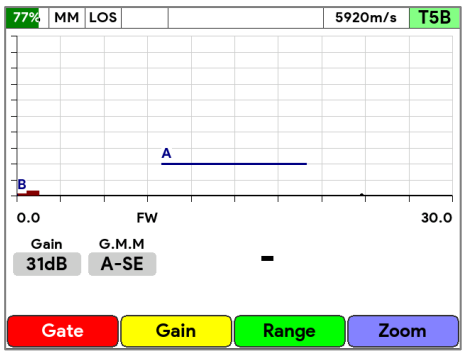
Fig 34. Manual Measuring Mode – Gate A EE.

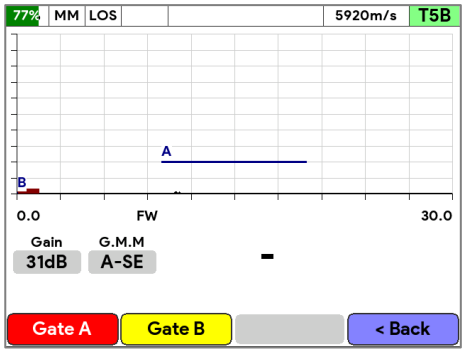
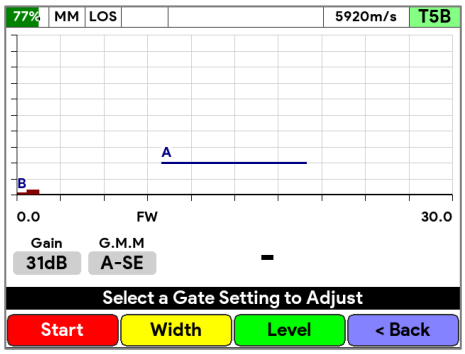
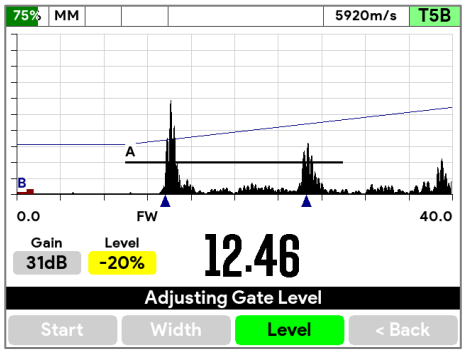
Enabling Manual Measuring Mode

1.	From the Menu, select **Measurement**, then **Mode**, then press the √ key. Select the **Manual Mode** then press the √ key.	
2.	The measurement menu now allows selection of the manual mode features.	
3.	The **Measure With** setting sets how the thickness measurement will be taken. GateA SE = SE measurement using Gate A GateA EE = EE measurement using Gate A GateAB EE = EE measurement using Gate A & B	

Adjusting Gates

You can adjust the Gate setting either from the Menu or using the function keys on the A-Scan measurement screen. When using the function keys, you can dynamically adjust the Gate settings and observe on the A-Scan.

1.	To adjust a Gate, in the A-Scan measurement screen press the **Gate** function key.	

2.	Select the **Gate A** or **Gate B** function key.	
3.	Use the function keys to select and adjust a Gate setting. Start = Start Position Width = Gate Width Level = Gate Level in % Back = Back to Gate select.	
4.	Here the Gate Level has been selected and the up and down ▲▼ navigation keys can be used to adjust the Level value. Ending by pressing the **Level** function key again to end the adjustment mode.	

Gate Modes

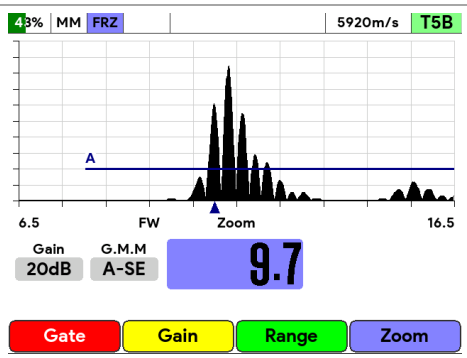
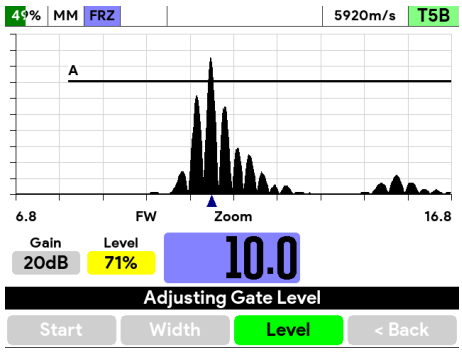
You can select from three different Gate modes,

- Flank — the Gate time is taken from the Flank of the Signal
- Peak — the Gate time is taken from the Peak of the Signal
- First-Peak — the Gate time is taken from the First-Peak of the Signal

The Gate time is used for the thickness measurement calculation.

Dynamic Freeze Mode

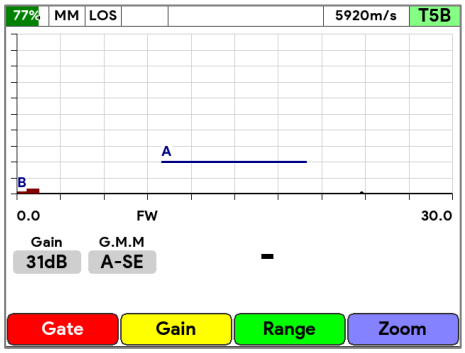
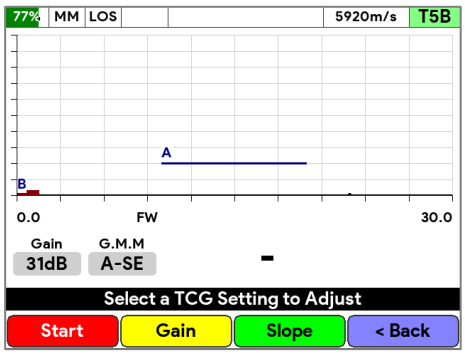
If you Freeze the measurement in Manual Mode, the frozen UT signal is re-processed continuously so you can make changes to the Gate settings and see the effect this has on measurements. This is called **Dynamic Freeze** mode.

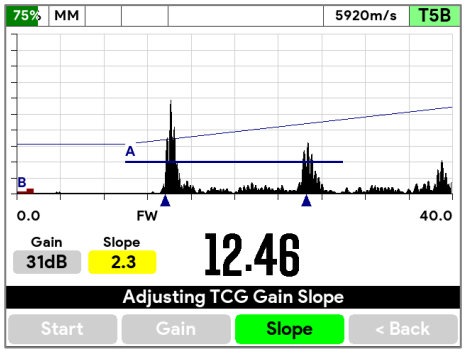
1.	The Gate Level is set to 20% The signal is then Frozen.	
2.	The Gate Level is now adjusted to 71%, and the Gate Trigger point now moves as its triggers by a later ½ cycle. The measurement value increases to 10.0mm.	

Note. You cannot adjust the Gain Values and expect to see a change in signal in Dynamic Freeze mode, as changes to Gain require a new UT signal to be fed through the pulser-receiver circuit.

Adjusting Gain and TCG

You can adjust the Gain and TCG settings either from the Menu or using the function keys on the A-Scan measurement screen. When using the function keys, you can dynamically adjust the Gain settings and observe on the A-Scan.

1.	To adjust a Gain, in the A-Scan measurement screen press the **Gain** function key.	
2.	Use the function keys to select and adjust a Gain setting. Start = TCG Slope Start Position Gain = Gain id dB Slope = Gain Slope in dB/us Back = Back to Gate select.	

3.	Here the Gain Slope has been selected and the up and down ▲▼ navigation keys can be used to adjust the Slope value. Ending by pressing the **Slope** function key again to end the adjustment mode.	

Measurement Hold Function

The gauge can keep track of thickness measurements so when the probe is removed from the measurement surface, and LOS (Loss of Signal) is detected, the tracked measurement is displayed.

You can choose to track and hold,

- The **Last** measurement
- The **Minimum** measurement
- The **Maximum** measurement

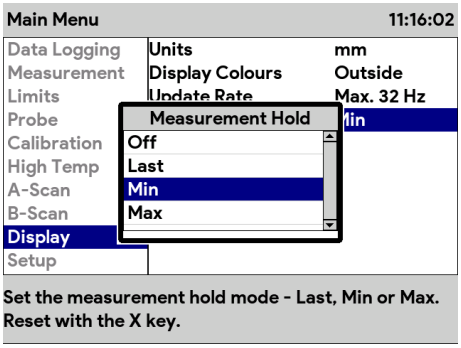
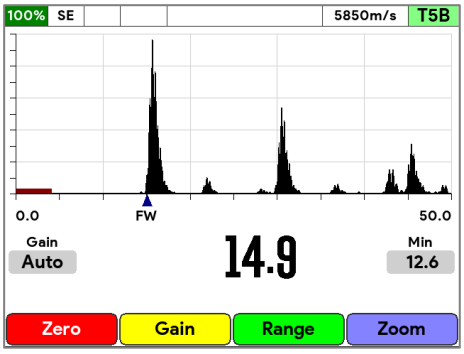
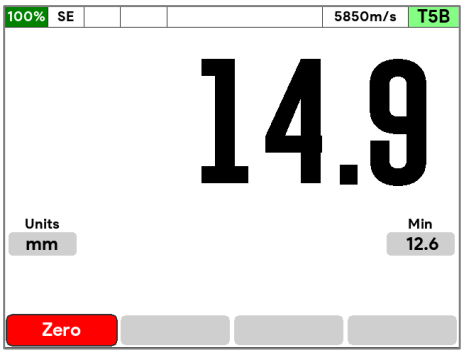
The Minimum mode will track the lowest thickness measurement since reset.

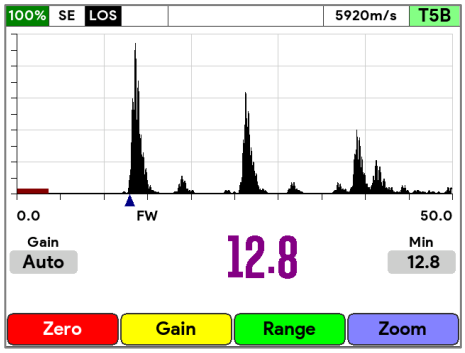
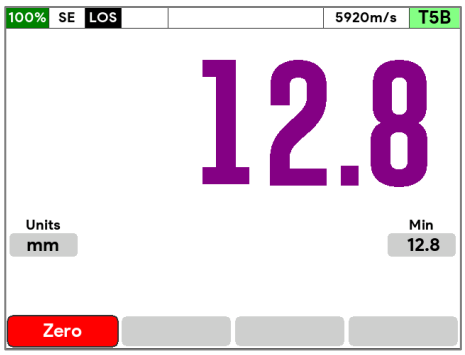
The Maximum mode will track the highest thickness measurement since reset.

This feature is useful when,

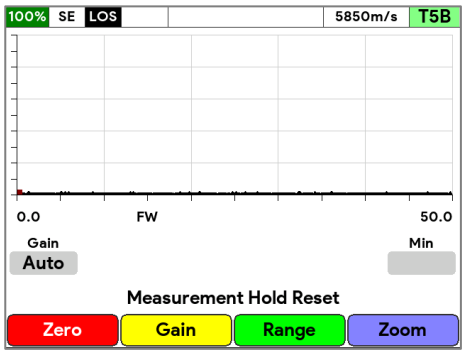
- Scanning an area for Minimum or Maximum values.
- High Temperature measurement when you need to capture the minimum thickness before the couplant breaks down.
- You want the last measurement to remain displayed so you can record it.

Setting the Measurement Hold Function

1.	From the Menu, select **Display**, then **Measurement Hold**, then press the √ key. Select the require **Measurement Hold** then press the √ key.	
2.	The main screen (Basic and A-Scan) will show the selected measurement hold value next to the thickness measurement. In the examples on the right the Measurement Hold = Minimum and a "**Min**" value is shown. When Measurement Hold = Maximum a "**Max**" value is shown. When Measurement Hold = Last a "**Last**" value is shown.	 Hold Minimum Mode 

3.	When there are no measurements (LOS is shown) the **Held** measurement value (and its A-Scan) will be displayed. The thickness value colour will be **Magenta** to signal this is a Held value.	 Held Value Displayed 

Resetting a Held Measurement

1.	To **Reset** a held value, press the red X key in any measurement screen. The message "*Measurement Hold Reset*" will be briefly shown.	

Measurement Setups

You can save a complete measurement setup to a file stored on the gauge. This measurement setup file can then be loaded back in to restore that setup. The measurement setup saves the following.

- Probe Type
- Measurement Mode
- Resolution
- Deep Coat
- Limits

- A-Scan Setup
- B-Scan Setup
- High Temp Setup
- Calibration and Velocity Setup
- Gain Settings
- Gate and TCG Settings

You can save and load measurement setups from the Measurement menu.

User Access

The Cygnus 1 Ex gauge has a User Access feature that can be used to prevent access to certain features depending on the access level of the current user.

You can create a list of Users, each with an access level, and each with a unique PIN number. There are three access levels.

- Level 1 = Lowest
- Level 2
- Level 3 = Highest

The following table shows what access level is required to access a feature.

Feature	Level 1	Level 2	Level 3
Probe Menu	√	√	√
Measurement Menu	√	√	√
Datalogging	√	√	√
B-Scan	√	√	√
A-Scan Menu	√	√	√
Material List	√	√	√
Limits Menu	√	√	√
Display Menu	√	√	√
Calibration & Velocity Changes	-	√	√
Datalogging - Delete	-	√	√
Datalogging - Save as Template	-	√	√
B-Scan - Delete	-	√	√
Measurement - Manual Mode	-	√	√
Measurement - Manual Gain	-	√	√

Feature	Level 1	Level 2	Level 3
Setup Menu	-	-	√

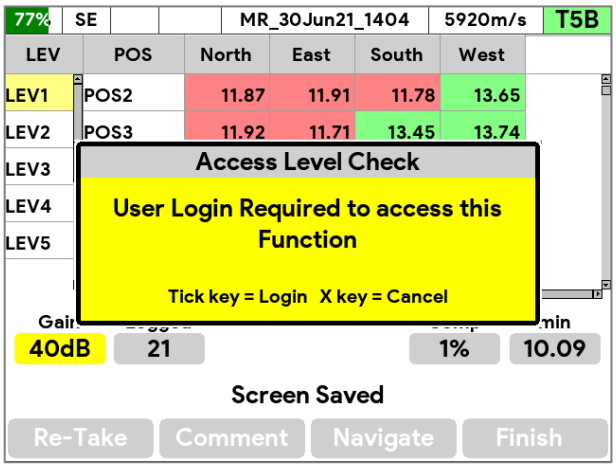


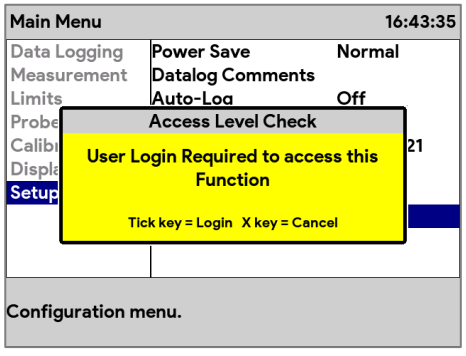
Fig 35. Example of User Login to Access a Datalogging Function.

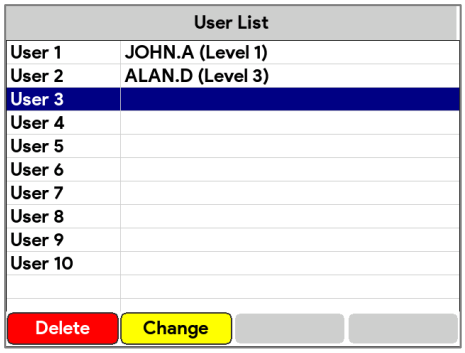
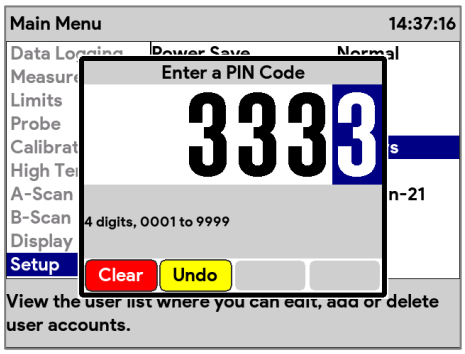
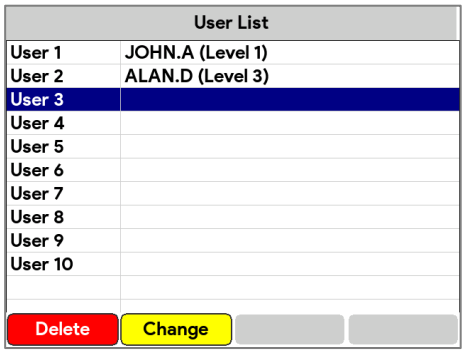
When user access is enabled, the gauge can still take thickness measurement without a User being logged in, but any settings can't be changed.

To access a protected feature, the gauge prompts for a User to login. Once logged in the user can access all features their access level permits. They will be automatically logged out when the gauge has been idle and goes into power-save state or if the gauge is turned off.

Adding Users

Users are added from the Setup menu, under the User List item. When the user list is empty and Admin login will be required, the default Admin PIN number is "1305", this is fixed and cannot be changed as it provides a backdoor way-in should you forget a PIN number.

1.	From the Menu, select **Setup**, then **User List**, then press the √ key. Select and enter the **Admin** PIN or a Level 3 access User PIN number.	

2.	You can then select a User slot, there are 10 in total. Press the **Delete** or **Select** function key as required.	
3.	When entering a new User, you will need to select; a **Name**, an **Access Level**, and a unique 4-digit **PIN code**.	
4.	Finally press the √ key to save your changes, or the **X** key to cancel.	

Gauge Menu

Menu Operation

All the gauge's features and settings can be accessed via the Menu, to display the Menu just press the **Menu** key from any measurement screen.

The menu is split into two columns, the left column are the Groups, the right column are the selected Group's Items.

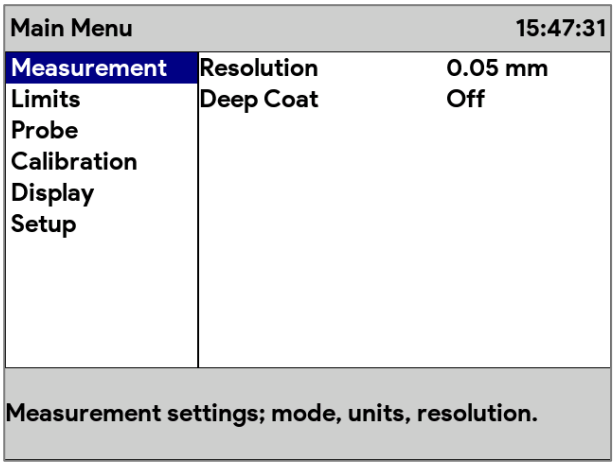


Fig 36. Menu – Basic Features Gauge

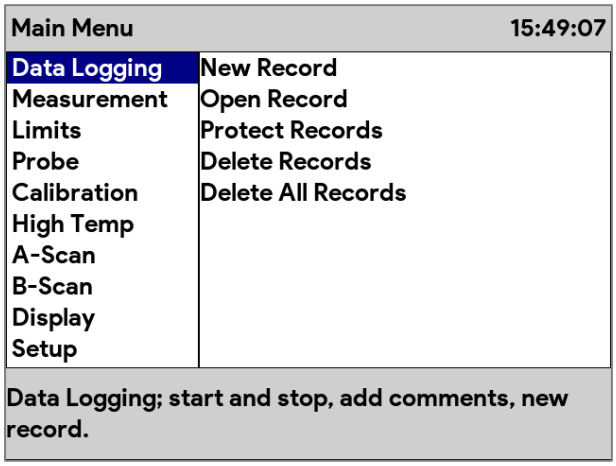


Fig 37. Menu – All Features Gauge

- Use the up and down ▲▼ navigation keys to select an item.
- Use the left and right ◄ ► navigation keys to go between a Group and its Items.
- Press the √ key to select an Item.
- Press the **X** key to cancel.
- Press the **Menu** key to exit the menu.

Menu Group - Datalogging

No Record is Open

New Record	Creates a New datalogging record, choosing from various options like record type.
Open Record	Select and Open an existing datalogging record.
Protect Record	Select and Protect a datalogging record.
Delete Record	Select and Delete a datalogging record.
Delete All Records	Delete all the datalogging records from the file system. You will be prompted twice to confirm the deletion.

A Record is Open

Close Record	Close the current datalogging record.
Add Comment	Add a Comment to a specific measurement point in the current datalogging record. Navigate through the record to select the measurement point.
Delete Point	Delete a specific measurement point in the current datalogging record. Navigate through the record to select the measurement point.

Add Radials	Add Radial Points to the last measurement point in the current datalogging record. *Only possible in Linear and Grid-2D Record.*
Navigate	Navigate through the record to select the location for the next measurement point.
Review	Navigate through the record to select measurement points to review. You can review the Measurement, A-Scan, Comments and Radial Points.
Location	Set the location name for the record info.
Surveyor	Set the surveyor's name for the record info.
Record Info	View information about the current datalogging record. Some fields can be edited.
Save as Template	Save the current datalogging record as a Template which can then be used to create new records.

Menu Group - Measurement

Mode	Select the measurement mode.
Resolution	Select the thickness value resolution. ME Measurement mode = 0.1mm/0.05mm SE/EE Measurement modes = 0.1mm/0.05mm/0.01mm
Deep Coat	Deep Coat enables measurement through thick coatings over 3mm thick. (ME Measurement mode only)
Gain Mode	Selects between Automatic and Manual gain control. (SE and EE Measurement modes only)
Blanking	Select between Automatic and Manual start blanking. (SE and EE Measurement modes only)
Load Setup	Load a measurement setup from a file.
Save Setup	Save a measurement setup from a file.

Measurement group items when the Manual Mode Measurement feature is enabled.

Measure With	Selects which Gate/Gates are used for thickness measurements. GateA SE = SE measurement using Gate A GateA EE = EE measurement using Gate A GateAB EE = EE measurement using Gate A & B

Gate A	Gate A setup – Start, Width, Level, Flank/Peak/First-Peak.
Gate B	Gate B setup – Start, Width, Level, Flank/Peak/First-Peak.
TCG	Time Controlled Gain settings – Gain, Slope, Start.

Menu Group - Limits

Limits	Turn the Limits feature On or Off.
Maximum	Set the Maximum thickness value, or set to zero when not required.
Reference	Set the Reference thickness value.
Minimum	Set the Minimum thickness value.

Menu Group - Probe

Auto Detect	Turn the Auto Probe Detect feature On or Off.
Type	Select the Probe Type, if Auto Detect is off or the probe can't be detected.
Zero	Start a Probe Zero measurement.
Autoset Gain	Start an Autoset Probe Gain measurement.

Menu Group - Calibration

1 Point Cal	Start a Single Point Calibration.
2 Point Cal	Start a Two Point Calibration.
Velocity	Set the Velocity of Sound value.
Material	Set the velocity of sound using a Material from a list of materials. *The material list is stored as a plain text file in the gauge's User directory and can be modified to provide custom material lists.*

Menu Group - High Temp

Enable	Set the High Temperature Compensation feature On or Off.
Surface Temp	Set the surface temperature for compensation.
Temp Units	Select between C and F units for surface temperature.

Coefficient	Sets the temperature compensation coefficient value. *The default values for steel is "-0.000182", equal to -1% per 55C rise in temperature.* *So, -0.000182 = (-1%/55C)/100%*

Menu Group - A-Scan

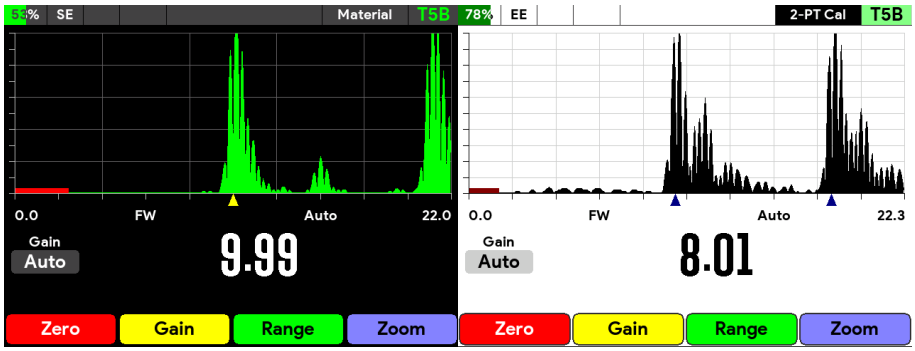
Auto Range	Set the A-Scan Auto-Range feature On or Off.
Zoom	Set the A-Scan Zoom mode.
Range	Set the A-Scan graph X axis range.
Rectification	Set the A-Scan Rectification mode. RF = no rectification FW = full-wave rectification. +HW = positive half-wave rectification. -HW = negative half -wave rectification.
Grid	Set the A-Scan Grid mode. Off = No grid lines. Half = grid lines at 1/5^{ths} Full = grid lines at 1/10^{ths}
Fill	Sets if the rectified A-Scan signal is filled down to the y=0 baseline. Non = No fill. Below = Fill down to the baseline.

Menu Group - B-Scan

Save to Datalogger	Saves the current B-Scan data to a new Linear Datalogger Record. This can take some time if there are lots of B-Scan points.
Scan Range	Set the Thickness Range for the B-Scan graph. This is the vertical height of the B-Scan graph, the Y axis.
Scan Length	Sets a length of a scan so an estimation of position can be made. This expects the scan to made at a constant speed.
Scan Direction	Sets the scan direction as shown on the B-Scan graph. Left = Scanning to the Left Right = Scanning to the Right

LOS Mode	Sets what the B-Scan should do when the ultrasound signal is lost (LOS = Loss of Signal). Pause = pause the B-Scan Continue = continue the B-Scan, logging zero thickness.
Open B-Scan File	Select a B-Scan file to open and review the scan data.
Delete B-Scan Files	Select B-Scan files to delete from the file system.

Menu Group - Display

Units	Select between mm and Inch units.
Display Colours	Select between Indoor and Outdoor colour schemes. Indoor = Black background. Outdoor = White background.  Fig 38. Indoor and Outdoor Display Colours
Update Rate	Set the display Update Rate, depending on the measurement mode and gauge variant, this can be set between 4, 8, 16 and 32 Hz (Fast Update Rate).
Measurement Hold	Hold Options are, Off – measurements are not held. Last – the last measurement is held. Min – the minimum measurement is held. Max – the maximum measurement is held. When active the (last/min/max) thickness measurement value will be displayed when the probe is removed from the specimen surface (LOS). *The default value = Off.*
Brightness	Sets the display backlight brightness from 1 to 5 (low to high.) *The default value = 2*

Menu Group - Setup

Power Save	Sets the Power Saving Timer. When the gauge is Idle, not taking measurements or being used, to save battery power the screen brightness is reduced and eventually the gauge is turned off. Short = 2 minutes to Auto Turn Off Normal = 5 minutes to Auto Turn Off Long = 20 minutes to Auto Turn Off
Bluetooth	Turns the Bluetooth connection On or Off. Bluetooth can be used to make a connection to a Windows® computer for transferring data to CygLink.
Datalog Comments	Edit the list of Datalogger Comments.
Auto-Log	Turn the Auto-Log feature On or Off. Auto-Log will automatically log a stable thickness measurement after a period of time if the measurement is maintained.
User List	Edit the list of Users and set Access Levels and PIN Codes.
Set Time	Set the Time.
Set Date	Set the Date.
Gauge Info	Displays information about the gauge. Gauge Variant Serial Number Firmware Versions File System Space Feature Code Run Time Battery Status
Enable Features	Enter in an Update Code to change the gauge variant or enable additional gauge features.
Config	Access gauge configuration settings. This is protected by an Admin level password. Gauge ID Probe Gain Values Languages
Battery Discharge	This feature can be used to quickly discharge a battery to prepare for safe air transport. IATA require Li-Ion batteries to have a State-of-Charge no more than 30% for air transport.

Section 5 - Information

Cleaning

- Clean the instrument using mild detergent and a cloth.
- **DO NOT use solvents such as Isopropyl / Alcohol.**
- **DO NOT use abrasives.**
- **DO NOT use excessive liquid** – *the gauge body is not IP67 sealed if the battery has been removed.*

Display Area

Due to the nature of the material used to electromagnetically shield, and provide antistatic protection to the display area, it is possible some small dots may be visible when the instrument is turned off – this is normal and does not affect the operation in any way.

Maintenance

There are no regular maintenance procedures for this equipment.

As part of an annual measurement calibration and service, Cygnus Instruments will also inspect this equipment to ensure Ex safety has not been compromised.

For the user - the instrument body, the battery and the ultrasonic probes must be inspected for damage before use. Do not take the equipment in to an explosive atmosphere if any part is damaged or there are signs the equipment has been tampered with.

Repairs

There are no user repairable parts inside the instrument. All the electronics are contained inside a single encapsulated module. To ensure Ex compliance all repairs must be carried out by Cygnus Instruments.



The Cygnus 1 Ex kit is covered by a full manufacturers no-quibble 1 year warranty, this can be extended to 3 years at no extra cost by registering your product on the Cygnus Website.

If your equipment develops a fault or is damaged, you must return it to an authorised Cygnus Instruments service centre for inspection and repair. Details of service centres can be found on the Cygnus Instruments website.

Part Numbers

This table lists all the parts of the Cygnus 1 Ex product kit that have been approved for use as part of the Ex-Certificates.

Item	Part Number (ATEX/IECEx/UKEX)
Cygnus 1 Ex Instrument Body	060-1005
Cygnus 1 Ex Battery Pack	060-1003
Cygnus 1 Ex USB Interface	060-1002
Cygnus 1 Ex Battery Charger (UK/EU/USA Plugs)	060-1006
Cygnus 1 Ex Standard Probes	
S2C-EX	060-1200
S3C-EX	060-1202
S5A-EX	060-1203
T2C-EX	060-1205
T5B-EX	060-1206
T5A-EX	060-1207
T7A-EX	060-1208
Cygnus 1 Ex Right-Angle Probes	
S2C-EX	060-1209
S3C-EX	060-1210
S5A-EX	060-1211
T2C-EX	060-1212
T5B-EX	060-1213
Cygnus 1 Ex High Temperature Probes	
T5BH-EX	060-1222
Probe Cable for T5BH-EX	060-1220

Updating your Gauge

As part of our policy of ongoing development and product improvement Cygnus may issue firmware updates for your model of gauge. The firmware on the gauge can be easily updated by the user using update software downloaded from the Cygnus website.

Before updating your gauge note the model and serial number of the gauge (Menu -> Setup -> Gauge Info). You can then check on the Cygnus website if your gauge has the latest firmware version, and if not proceed to download the update software.

You can check for the latest gauge firmware on the Cygnus website [http://www.cygnus-instruments.com]. Navigate to **Support** -> **Downloads** -> **Technical Software** and look for a PDF document called 'Cygnus 1 Ex Firmware Version Info' view this document to find the latest version for your gauge along with any changes made. *Note you may need to create an account to access this section of the website.*

Update Software

To update a gauge, you must first download and install the 'Cygnus M5-EX Gauge Updater' software utility. This is available from the Cygnus website in the **Support** -> **Downloads** -> **Technical Software** section. There is a PDF document with instructions available.

Technical Specifications

Cygnus 1 Ex Technical Specifications	
General Attributes	
Size	135 mm x 270 mm x 80 mm (W x H x D)
Weight	Gauge with Battery 1 Kg
Power Supply	Rechargeable, Removable Battery Pack
Power Rating	2W
Probe Sockets	Single Dual-Coaxial Connector
Operating Temperature Range	-0°C to +50°C
Storage Temperature Range	-10°C to +65°C
Battery Operation Time	Approximately 6-8 hrs of continuous measurement with fully charged battery pack.
Battery Voltage Range	Min 7.2 V dc, Max 8.4 V dc

Cygnus 1 Ex Technical Specifications			
Battery Type	Lithium-Ion		
Low Battery Indication	Battery level indication on display with low battery warning message.		
PRF	Automatic, 4Hz to 100 Hz *depending on probe type and measurement mode*		
Monitor Outputs	N/A		
Through Coating Measurements	Multiple-Echo mode with Single element 0° probe; • Through coating measurement for coatings up to 3 mm thick as standard depending on coating velocity. • Deep Coat mode provides ability to measure through thicker coatings depending on coating material. Echo-Echo mode with Twin element probe; • Through coating measurement for coatings up to 1 mm thick as standard depending on coating velocity.		
Materials	Sound velocity from 1000 m/s to 9000 m/s [0.0390 in/us to 0.3543 in/us]		
Measurement Ranges (in steel)	Single element 0° probes in Multiple Echo mode;		
	S2C probe	3.0 to 250 mm	[0.120 in. to 10.00 in.]
	S3C probe	2.0 to 150 mm	[0.080 in. to 6.000 in.]
	S5A probes	1.0 to 50 mm	[0.040 in. to 2.000 in.]
	Twin element probes in Single Echo mode;		
	T2C probe	2.5 to 250 mm	[0.098 in. to 10.00 in.]
	T5B probe	1.5 to 200 mm	[0.059 in. to 7.900 in.]
	T5A probe	1.0 to 150 mm	[0.039 in. to 6.000 in.]
	T7A probe	0.8 to 50 mm	[0.031 in. to 2.000 in.]
	Twin element probes in Echo-Echo mode;		
	T2C probe	5.0 to 50 mm	[0.200 in. to 2.000 in.]
	T5B probe	4.0 to 50 mm	[0.160 in. to 2.000 in.]
	T5A probe	2.0 to 50 mm	[0.080 in. to 2.000 in.]
	T7A probe	2.0 to 25 mm	[0.080 in. to 1.000 in.]
Probe Zero	Twin element probes are zeroed in the air without the need of a zero block. The user is prompted to zero the probe at power up and after a probe change. Single element probes in multiple echo mode do not need to be zeroed.		
Measurement Modes	Single Echo mode with Twin element probe. Measures thickness using the time from the delay line (zero point) to the first back-wall echo. (UT Mode 2)		

Cygnus 1 Ex Technical Specifications			
	Echo-Echo mode with Twin element probe. Measures thickness using the time between the first and second back-wall echoes. (UT Mode 3) Multiple Echo using Single element probe. Uses three matched and verified back-wall echoes to determine the material thickness and ignore surface coatings.		
Measurement Technology	Zero-crossing detection with interpolation.		
Resolution	Single Echo and Echo-Echo measurement modes;		
	Low	0.1 mm	[0.005”]
	High	0.01 mm	[0.001”]
	Multiple Echo measurement modes;		
	Low (measurement > 120 mm)	0.1 mm	[0.005”]
	Medium (measurement < 120 mm)	0.05 mm	[0.002”]
Accuracy	±0.1 mm (±0.004”) or 0.1% of thickness measurement whichever is the greatest.		
Display			
Type of Display	Sunlight readable, colour TFT display with LED Backlight.		
Display Size	VGA 640 x 320 Pixels 3.5 Inch, 70mm x 52mm.		
Display Information	Digital Thickness Value. A-Scan. B-Scan. Logged Measurements. Settings. Battery Level.		
Transmitter			
Shape of Pulse	Square		
Pulse Energy : Voltage (peak-to-peak)	40 V p-p		
Pulse Energy : Rise Time	3 ns (max)		
Pulse Energy : Pulse Duration	S2C : 220 ns S3C : 100 ns S5A : 67ns T2C : 220 ns T5A : 100 ns T5B : 100 ns T5BH : 100 ns T7A : 67 ns		
Receiver			
Gain Control	Automatic Gain Control depending on probe and measurement mode (default). Manual Gain control option in 1dB steps from 20 to 70 dB		
Frequency Range	1.0 MHz to 10.0 MHz (-6dB)		
Other Information			
Data Output and Storage	Data stored on internal flash memory device. Data output via serial data or Bluetooth connection to computer.		

Cygnus 1 Ex Technical Specifications	
Data Connector	Lemo-1 RS-422 to USB Interface Module with Ex Barrier.
Data Logger	Maximum number of measurement points per Record : 10000 Data stored on internal flash memory device, capacity 127MB.
Cross-Section B-Scan Function	4, 8, 16 or 32 Hz *depending on probe type and measurement mode.* Maximum number of points 5,000
Calibration setting storage	Calibration Data stored to Internal Flash Memory
Calibration Mechanisms	Not required for Multiple Echo mode. Automatic V-path correction for twin element probes. Option of two-point calibration for twin element probes.
Display & Recall Facilities	N/A
Display Response Time	32 Hz
Printer Output	N/A
Bluetooth	Class 1.5, v4.0 EDR. 10.5dBm TX Power. SPP/RFCOM Profile.
Environmental Rating	IP67 (Water immersion 1 metre depth for 30 minutes) Pollution Degree 3 (Electrical equipment in industrial areas)
Compliance	CE ATEX UKEX - UKCA IECEx
Designed for Standards Reference	BS EN ISO 16831 ISO 16809 2nd Edition 2017 ISO 9712 5th Edition 2021 EN 14127:2011

Specifications are subject to change for product improvement.

Table of Sound Velocities

Velocities will vary according to the precise grade and processing conditions of the material being measured.

This table is included as a guide only.
Wherever possible, the Gauge should always be calibrated on the material under test.

These Velocities are given in good faith and are believed to be accurate within the limits described above.
No liability is accepted for errors.

Velocities given are the compressional wave velocity c_l.

Material	**Velocity of Sound (V)**	

	m/s	in/us	Conversion Factor (f)
Aluminium (alloyed)	6380	0.2512	1.078
Aluminium (2014)	6320	0.2488	1.068
Aluminium (2024 T4)	6370	0.2508	1.076
Aluminium (2117 T4)	6500	0.2559	1.098
Brass (CuZn40)	4400	0.1732	0.743
Brass (Naval)	4330	0.1705	0.731
Brass (CuZn30)	4700	0.1850	0.794
Copper	4700 - 5000	0.1850 – 0.1969	0.794 – 0.845
Core Ten	5920	0.2331	1.000
Grey Cast Iron	4600	0.1811	0.777
Inconel	5700	0.2244	0.963
Lead	2150	0.0846	0.363
Monel	5400	0.2126	0.912
Nickel	5630	0.2217	0.951
Phosphor Bronze	3530	0.1390	0.596
Mild Steel	5920	0.2331	1.000
Tool Steel	5870	0.2311	0.992
Stainless Steel 302	5660	0.2228	0.956
Stainless Steel 347	5790	0.2279	0.978
Stainless Steel 304	5664	0.2229	0.956
Stainless Steel 314	5715	0.2250	0.965
Stainless Steel 316	5750	0.1163	0.971
Tin	3320	0.1307	0.561
Titanium	6100 - 6230	0.2402 – 0.2453	1.030 – 1.052
Tungsten Carbide	6660	0.2622	1.125

Reading Conversions

If only a few measurements are to be taken on a material other than Steel, it may be easier to leave the calibration set for Steel and merely convert the readings by multiplying by the **Conversion Factor** for the material being measured.

This method avoids unnecessary recalibration.

Example.

The Gauge is calibrated for Steel [5920 m/s], but the reading is being taken on Copper [4700 m/s] :

$T = t \times V_{COPPER} / V_{STEEL}$
$= t \times 4700 / 5920$
$= t \times 0.794$

thus : $\mathbf{T = t \times f}$ [where: $f = V_{COPPER} / V_{STEEL}$]

where : **T = true thickness of Copper being measured**
t = actual reading obtained
f = Conversion Factor (from table)
V_{COPPER} = Sound Velocity in Copper : 4700 m/s
V_{STEEL} = Sound Velocity in Steel : 5920 m/s

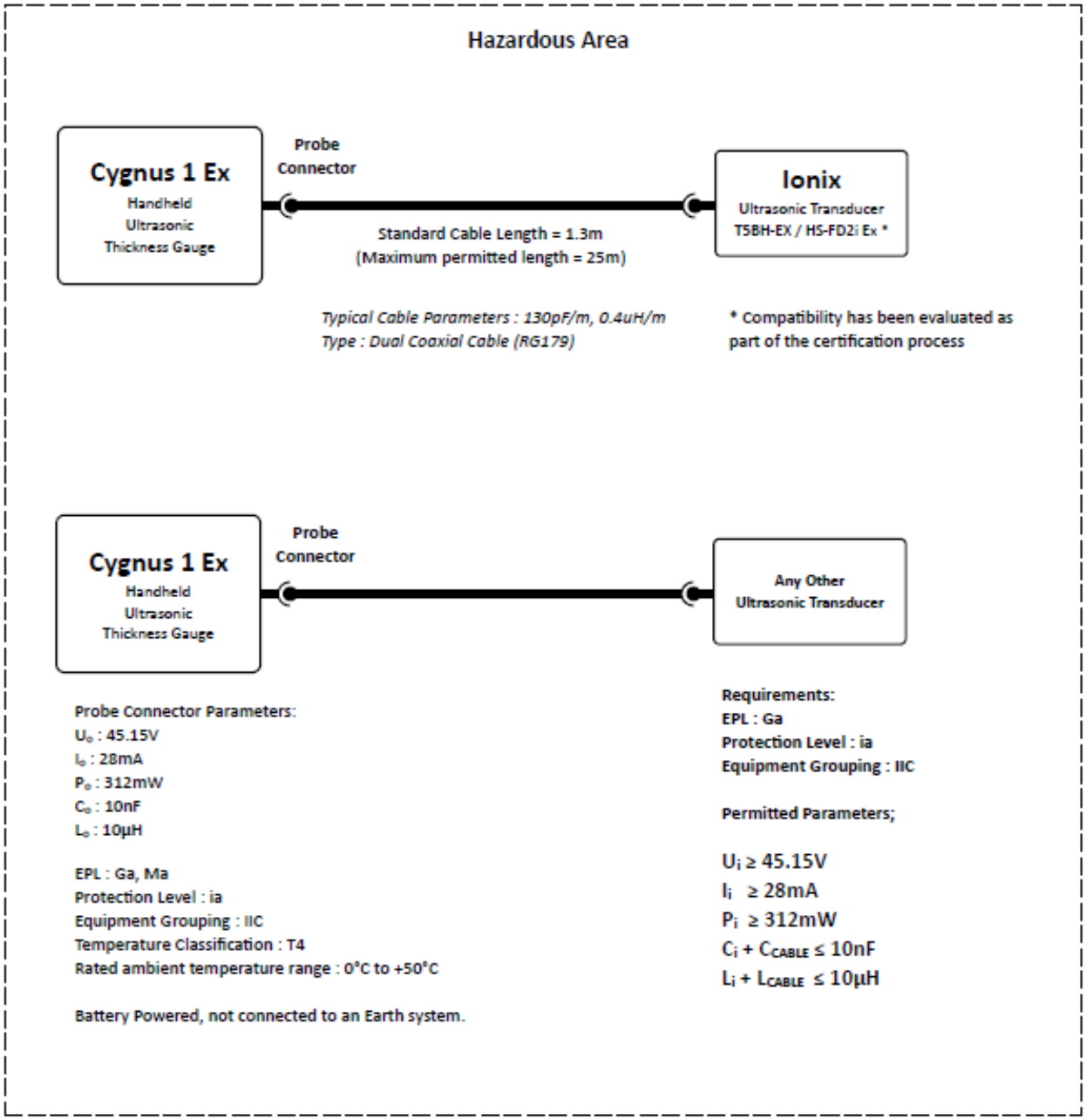
The **Conversion Factor f**: is given for various materials in the Table of Sound Velocities

Descriptive System Document

Descriptive System Document

In accordance with IEC 60079-25

Manufacturer	Cygnus Instruments Ltd. Dorchester, England. DT1 1PW
Ex Equipment	Cygnus 1 Ex
Document Ref.	DSD001 Issue 3
Date	May 2023
Author	David George

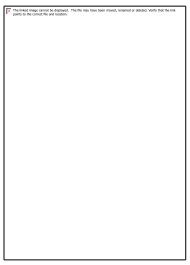


Typical Block Diagram for Ex/IS Descriptive System Document

Recycling and Disposal (EC Countries)

The WEEE Directive (Waste Electrical and Electronic Equipment 2002/96.EC) has been put into place to ensure that products are recycled using best available treatment, recovery and recycling techniques to ensure human health and high environmental protection.

The Gauge has been designed and manufactured with high quality materials and components which can be recycled and reused. It may contain hazardous substances that could impact health and the environment. In order to avoid the dissemination of those substances in our environment and to diminish the pressure on natural resources we encourage you to dispose of this product correctly.



DO NOT dispose of this product with general household waste.

DO dispose of the complete product including cables, plugs and accessories in the designed WEEE collection facilities.

This product may also be returned to the agent or manufacturer who supplied it for safe end-of-life disposal.

Cygnus Instruments Ltd registration number for The WEEE Directive is WEE/HE1274RU.

Warranty Information

Terms of Warranty

1. Product Registration

1.1 Cygnus Instruments Ltd. ("Cygnus") collaborates with all its resale partners, but resale of Cygnus products ("Products") by the Customer risks loss of traceability to end users of the Products. Manufacturer's support for the Products, including but not limited to firmware updates or product recall requirements, can only be provided by Cygnus with contact details of the end user, since support communication cannot be guaranteed via a resale partner or any other third party. **Cygnus guarantees provision of proactive support and transfer of warranties for the Products to end users of the Products who register their Products at: https://cygnus-instruments.com/service/product-registration/**

1.2 Cygnus stipulates that Product Registration as set out in paragraph 1.1 is a mandatory requirement for the Cygnus 1 Ex Ultrasonic Thickness Gauge in accordance with manufacturer responsibilities under the ATEX/IECEx/UKEX certification requirements.

1.3 All information relating to an individual person provided to Cygnus will remain confidential and protected under privacy policy terms found at: https://cygnus-instruments.com/privacy-policy/

2. Warranty

2.1 Subject to paragraph 3.2 and the following provisions, Cygnus warrants that:

2.1.1 the Products manufactured by it will correspond with their specification and be free from defects in material and workmanship for a standard period of **three (3) years** from the date of purchase from Cygnus;

2.1.2 except for batteries, probes, leads, microphones, telescopic extensions, which are warranted for six (6) months;

2.1.3 in the case of Products or equipment manufactured by a third party, Cygnus shall assign to the Customer the benefit of any warranty, guarantee or indemnity given by the company supplying the goods to Cygnus;

2.1.4 except for consumables, which are not warranted at all;

2.1.5 in the case of Equipment Service, the service will be provided using reasonable care and skill;

2.1.6 in the case of bespoke Products or which have (at the request of or by agreement with the Customer) been modified by Cygnus prior to sale, Cygnus warrants (subject as aforesaid) that any design or engineering services carried out by Cygnus will be supplied with reasonable care and skill.

2.2 The warranties referred to above are given by Cygnus, who shall, at its option, repair, replace or refund the price of the defective Products in full, provided:

2.2.1 the Customer gives notice in Writing during the warranty period within a reasonable time of discovery that some or all of the Products do not comply with the warranty set out in paragraph 2.1;

2.2.2 the Customer returns such Products to Cygnus' place of business at the Customer's cost;

2.2.3 Cygnus is given a reasonable opportunity of examining such Products.

2.3 Cygnus shall be under no liability for the Products' failure to comply with the warranties if:

2.3.1 any defect in the Products arises from any drawing, design, specification information or instructions supplied by the Customer, or arises from their late arrival or non-arrival, or any other fault of the Customer;

2.3.2 the Customer integrates into any system, alters, modifies or repairs such Products without the prior written consent of Cygnus;

2.3.3 the defect arises because the Customer failed to follow Cygnus oral or written instructions as to the storage, installation, calibration, integration into a system, commissioning, use or maintenance of the Products or (if there are no such instructions) good trade practice;

2.3.4 the defect arises as a result of fair wear and tear, wilful damage, negligence, or abnormal working conditions;

2.3.5 the total price for the Products has not been paid by the due date for payment.

2.4 The warranty in this section 2 is the only warranty provided by Cygnus to the Customer in relation to the Products. All other statements, conditions, representations, warranties, whether express or implied, including any implied warranty of fitness for any particular purpose or satisfactory quality, are expressly excluded.

3. Products returned immediately after receipt

3.1 The Customer shall inspect the Products, or any instalment of the Products, immediately upon receipt. If the Products are damaged or do not comply with the warranty in paragraph 2.1, the Customer shall:

3.1.1 provide Cygnus with details of the problem with the Products in Writing; and

3.1.2 store the Products until it receives Cygnus' Written instructions in relation to the Products.

3.2 Cygnus' only liability and the Customer's sole right and remedy in respect of Products which at the time of delivery are damaged or do not meet the warranty in section 2 shall be at Cygnus' option either the supply of replacement Products (or the part in question) or a refund of the price paid (or a proportionate part of the price) to Cygnus in respect of such Products, in which case Cygnus shall have no further liability to the Customer. For the avoidance of doubt, Cygnus shall not be liable to the Customer for any damage to the Products , which occurs after the time of delivery, however the Customer may make a claim in respect of any such damage under the appropriate insurance policy.

4. Liabilities

4.1 Subject as expressly provided in these terms or in Cygnus' Terms of Sale, and except where the Products are sold to a person dealing as a consumer (within the meaning of the Unfair Contract Terms Act 1977), all warranties, conditions or other terms implied by statute or common law are excluded to the fullest extent permitted by law.

4.2 Except in respect of death or personal injury caused by Cygnus' negligence or liability for defective Products under the Consumer Protection Act 1987 Cygnus shall not be liable to the Customer by reason of any representation (unless fraudulent), or any implied warranty, condition or other term, or any duty at common law, or under the express terms of the Contract for purchase of the Products, for loss of profit or for any indirect, special or consequential loss or damage, costs, expenses or other claims for compensation whatsoever (whether caused by the negligence of Cygnus, its employees or agents or otherwise) which arise out of or in connection with the supply of the Products (including any delay in supplying or any failure to supply the Products in accordance with the Contract or at all) or their use or resale by the Customer. The entire liability of Cygnus under or in connection with the Products shall not exceed the price of the Products, except as expressly provided in these terms.

Revision History

Issue	Date	Notes
A	30-Jun-2021	First Draft.
B	22-Sep-2021	Added section for "Cleaning The Instrument".
C	03-Oct-2021	For NRTL Certification - Added statement about protective features in "Important Notice" section.
D	23-Nov-2021	Added T7A-EX Probe.
E	10-Jan-2022	Added NRTL Marking Info and Standards List. Added new NRTL Part Numbers.
1	15-Aug-2022	Added MET-US Listing Number. Added product registration information.
2	05-Sep-2022	Revised variant names.
3	15-Nov-2022	Updated Cygnus Contact QR Codes.
4	15-May-2023	Added Output Limiting Parameters for probe connector. Added T5BH Probe and High Temp measurement section. Updated Warranty Section.
5	12-Oct-2023	For Firmware Version 1.2.1310 onwards. Updated High Temp measurement section. Updated Calibration section.

Issue	Date	Notes
		Added new Measurement Hold features
6	31-Jan-2024	For Firmware Version 1.2.1317 onwards. Removed NRTL, MET-US Listing Information.
7	02-Sep-2024	For IECEX/ATEX/UKEX Ex Certificates Issue 3 - Updated for IEC 60079-11 7th Edition. - Marking revised to add "II 2 D, Ex ib IIIB T100 Db" T5BH Max Temp Revised to 550°C and added details of safe operating temperatures.
8	01-Nov-2025	C1Ex Gauge Firmware > **CB Version 1.3.1346** > UB Version 2.1364
9	26-Oct-2026	BS EN 15317 has been changed to BS EN ISO 16831.

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