Cygnus ROV UTM

Ultrasonic Thickness Gauge

Operating Manual

Covers Instrument Model: M5-ROV-ASCAN
with **SD2D-DCW** Probe

Contents

Revision History.

Issue	Date	Changes
Issue 3	06-Jun-19	SE Mode Measurement Range increased to 55mm, on page 49.
Issue 4	17-Jul-19	Revised depth rating to 3000m (300bar)
Issue 5	04-Oct-19	Included Maximum Surface Contact Temperature to Probe Specifications
Issue 6	03-Nov-20	Updated for change in Probe Connector (CRE). Updated for Serial Interface (RS-232).
Issue 7	06-Jun-22	Change of product name to "Cygnus ROV UTM" Added product registration info.

1. Introduction

Cygnus ROV UTM

The Cygnus ROV UTM – ROV Mountable Thickness Gauges are rugged, compact instruments designed for reliable ultrasonic thickness measurements.

The instrument is pressure rated to a maximum depth of 3000 meters sea water (300 bar). The instrument takes its power from the ROV craft and output thickness measurement data as serial data in RS232 format. The thickness measurement data is viewed top-side using CygLink which can also be used to provide Data Logging facilities and report generation.

Measurements can be displayed in Metric (mm) or Imperial (inch) units; measurement resolution is set to 0.1mm (0.005 inch).

Crystal-controlled Calibration provides stability and accuracy. The thickness measurement can easily be calibrated to a known thickness or to a known Velocity of Sound.

The instruments are able to operate accurately in adverse environmental conditions both underwater and above the sea.

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

Although designed for ease of operation first time users should carefully read this manual to familiarise themselves with the features of the instrument

Register your Gauge

Register your gauge to receive updates on gauge firmware and to register your 3-year warranty.

Registration is quick and easy, go to this web address;

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

Product Registration Link QR

Kit Contents

The Cygnus ROV UTM system is supplied as a complete kit in a transportation case

1	**Cygnus ROV UTM** Subsea Instrumentation Unit	
2	**SD2C-DAW** 2.25 MHz Single Element Delay Line Probe with cable and connector. Fitted in **P50 Probe Handler.**	
3	Patch cable for wiring the Cygnus ROV UTM to the ROV, 0.6m	
4	Test Lead – RS-232 to USB	
5	Test Block 15mm thick in 1080 Mild Steel	
6	USB Flash Drive with **CygLink** Software and Documentation	
7	A Calibration Certificate	
8	Silicon grease for lubricating connectors and O-rings	

Optional Items

1. Fish tail or T-bar manipulator handle.

2.   System Overview

Subsea Instrument

The system is supplied ready to use. All that is required is to make the necessary electrical connections between the subsea unit and the ROV Craft and the top side computer.

There are no controls or display on the subsea instrument unit, operation and calibration is performed at the surface using CygLink software.
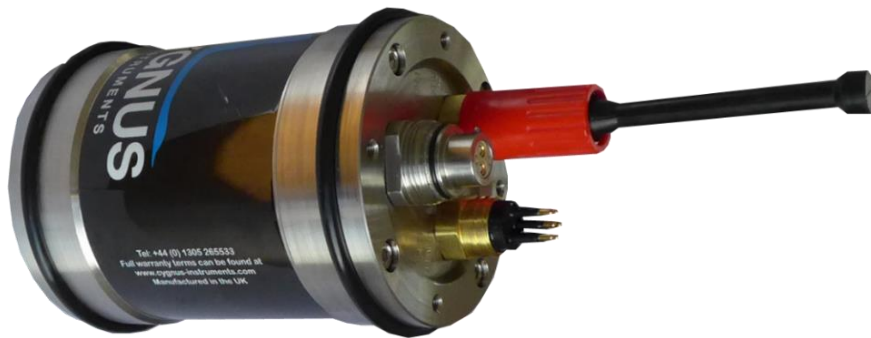
Cygnus ROV UTM Subsea Instrument Unit.

Ultrasonic Probe

The Ultrasonic Probe (model number SD2C-DCW) has a 2.25 MHz ø13mm single element piezo-composite crystal, bonded to a 30mm long Rexolite delay line. The delay line face is ø16mm. The delay line is bonded directly to the active element of the probe and cannot be replaced.

The probe is fully encapsulated internally, double O-Rings seal the delay line in the probe body.

SD2C-DCW Ultrasonic Probe.

The probe is supplied with 5m of cable, protected by an outer reinforced air hose. Each end has a stainless steel bracket which is attached by M5 screws and nuts.

Ultrasonic Probe Cable Mounting Bracket - P50 Probe Handler End.

Ultrasonic Probe Cable Mounting Bracket - Connector End

Connection to the subsea unit is by a multi-pin connector secured by a brass threaded collar.

The instrument is designed only to be used with ultrasonic probes supplied by Cygnus Instruments.

P50 Probe Handler

The 'P50' probe handler is designed to align the ultrasonic probe on to straight pipes from 50mm in diameter up to flat surfaces.

The spring-loaded probe and V shaped block allow the probe to be positioned correctly on a straight pipe and move to accommodate different pipe diameters.

A gimbal allows the probe to move to align on to the straight pipe surface when used with a ROV manipulator arm.

The probe handler can be fitted with a choice of manipulator handles; T Bar or Fishtail.
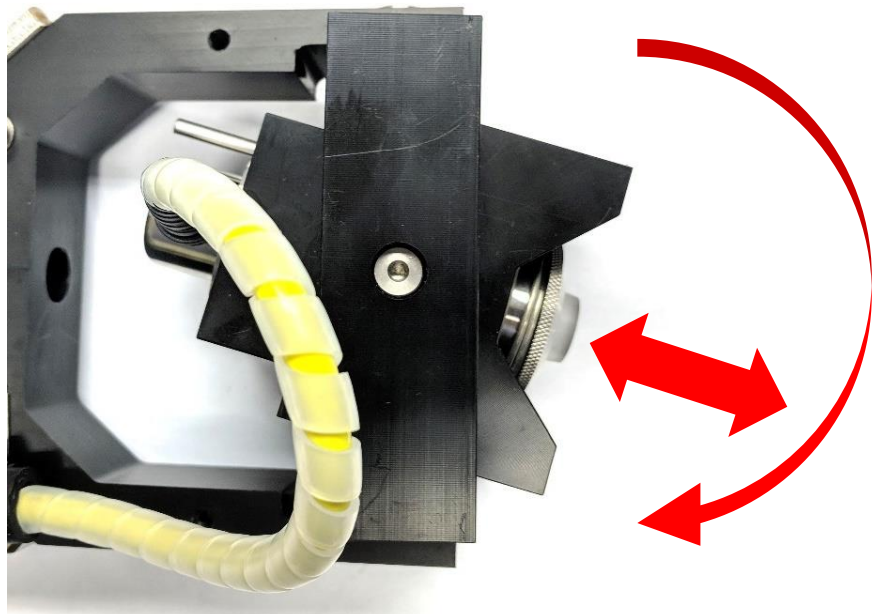
Ultrasonic Probe and P50 Probe Handler.
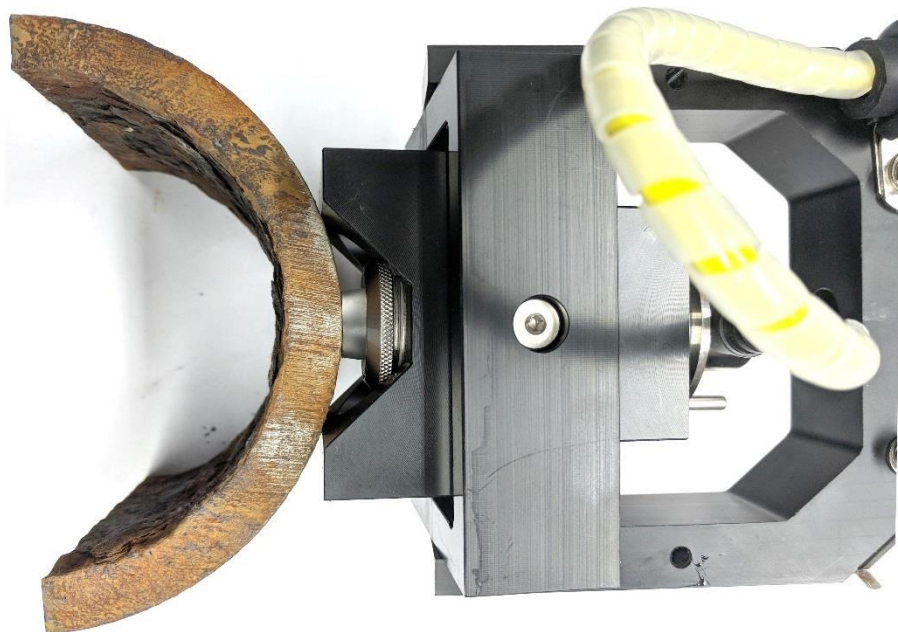
P50 Probe Handler on ø130mm Pipe.

Ultrasonic Probe Alignment on ø130mm Pipe Surface.

Ultrasonic Probe Cable Fitted to the P50 Probe Handler.

3. Connecting the System Together

Subsea Instrument

There are two connectors on the subsea instrument, marked • POWER COMMS • PROBE	
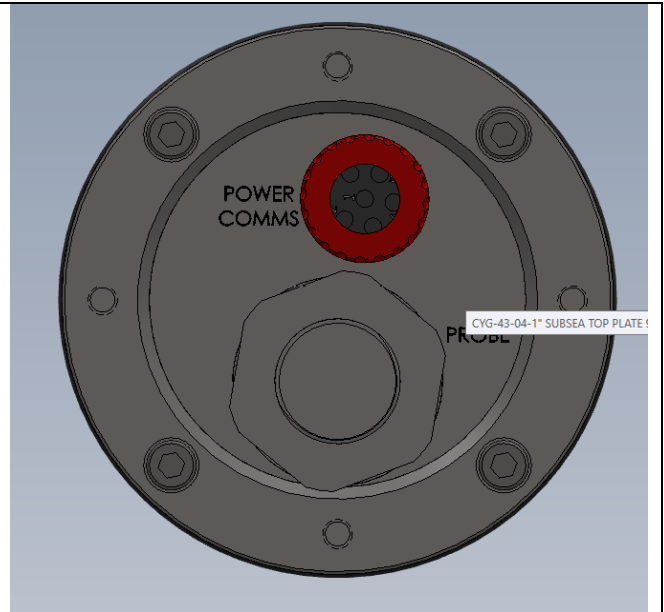
Power and Comms

On the subsea instrument power and comms are connected via the 6-way SubConn© MCBH6M connector marked 'POWER COMMS'.

Power must be connected to a clean DC Power Supply on the ROV, typically 12 to 24V DC is used.

The Comms link is connected to a channel on the ROV multiplexer. This must be configured for RS-232, 115200 Baud, 8 Data Bits.

The MCBH6M (mates with MCIL6F).

The picture below is shown looking into the bulkead connector.

Pin No.	Colour	Description	Pinout
1	Black	Ground	
2	White	12-24V DC Input	
3	Red	RS-232 TXD	
4	Green	RS-232 RXD	
5	Orange	*No connect*	
6	Blue	*No connect*	

Connecting the Ultrasonic Probe

The ultrasonic probe is connected to the subsea instrument using the threaded connector marked 'PROBE'. There is a slot to ensure correct alignment before the connector can be mated.
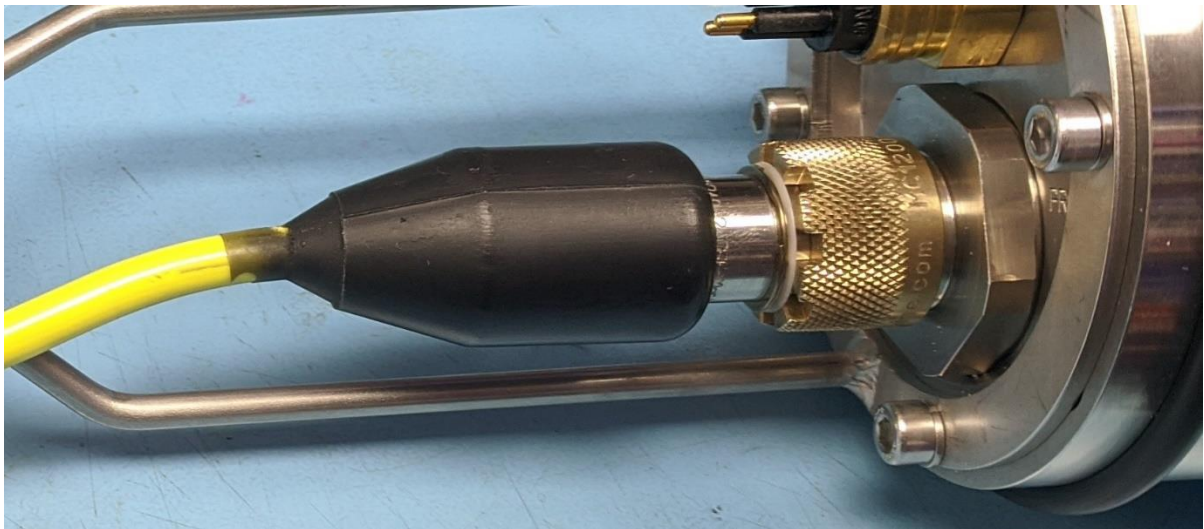
Ultrasonic Probe Connectors, Mated.

⚠	**Ensure the brass knurled Screw Collar is tight, and the connector is fully mated.** **There should be no movement between the connector parts when correctly mated.**

Securing the Cables

The system is supplied with a Cable Support Cage which is used to secure the probe cable bracket and cable-tie the power and comms cable. The cable support cage is bolted to the top of the subsea enclosure using four M5 cap-head screws.

There are two alignment marks on the top of the subsea enclosure and cable support cage to ensure it is fitted in the right position.
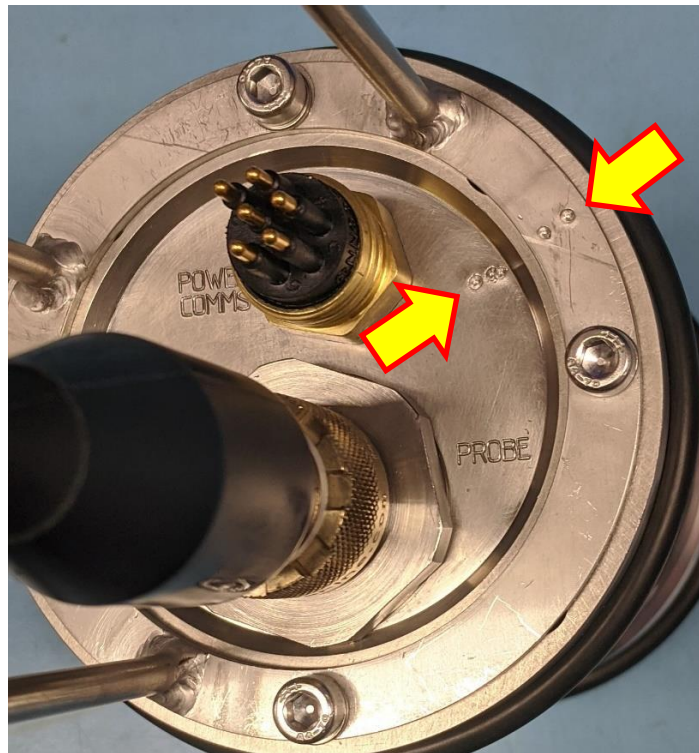
Alignment Marks (arrowed)
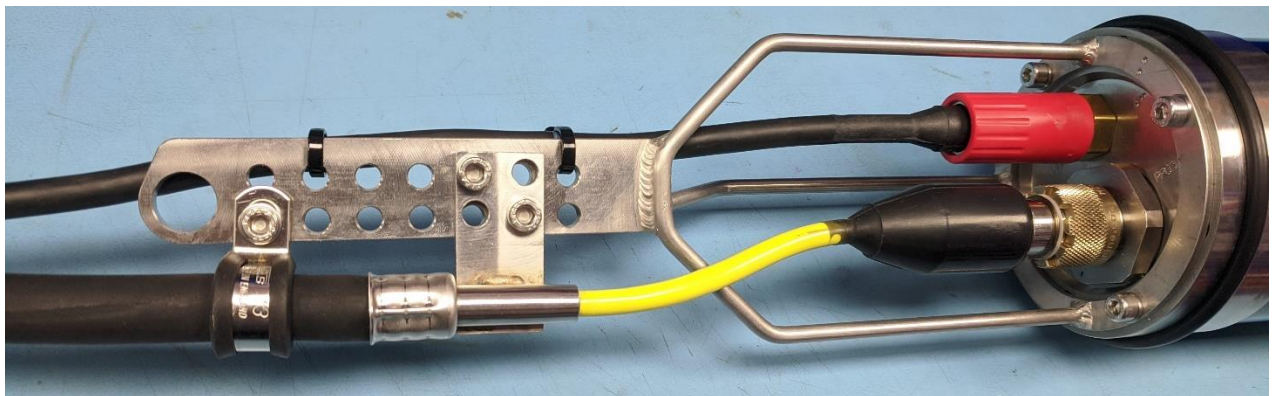
Cable Support Cage with Cables Fitted and Secured.

Connecting Topside

At the surface, the RS-232 Comms link should be wired from the multiplexer port to the RS-232 to USB converter lead. There are three connections; TXD, RXD and Ground. You must connect the ground.

The RS-232 to USB converter is then plugged into the computer that will run the CygLink program.

4. System Operation

On the deck before launching the ROV

Before launching the ROV, test the system is operating and you can take a thickness measurement using the 15mm Test Block from the kit. Hold the test block against the probe face and use couplant gel to ultrasonically couple the test block to the probe.

If necessary, **Calibrate** the system so the measurement is correct. Otherwise set the velocity of sound to 5920m/s for steel.

See Calibrating to a Known Thickness on page 34

When operating the system with the probe **out of water** you will get a standing reading of around 9.7mm in SE Mode. This is normal and will disappear once the ultrasonic probe is submerged in water.
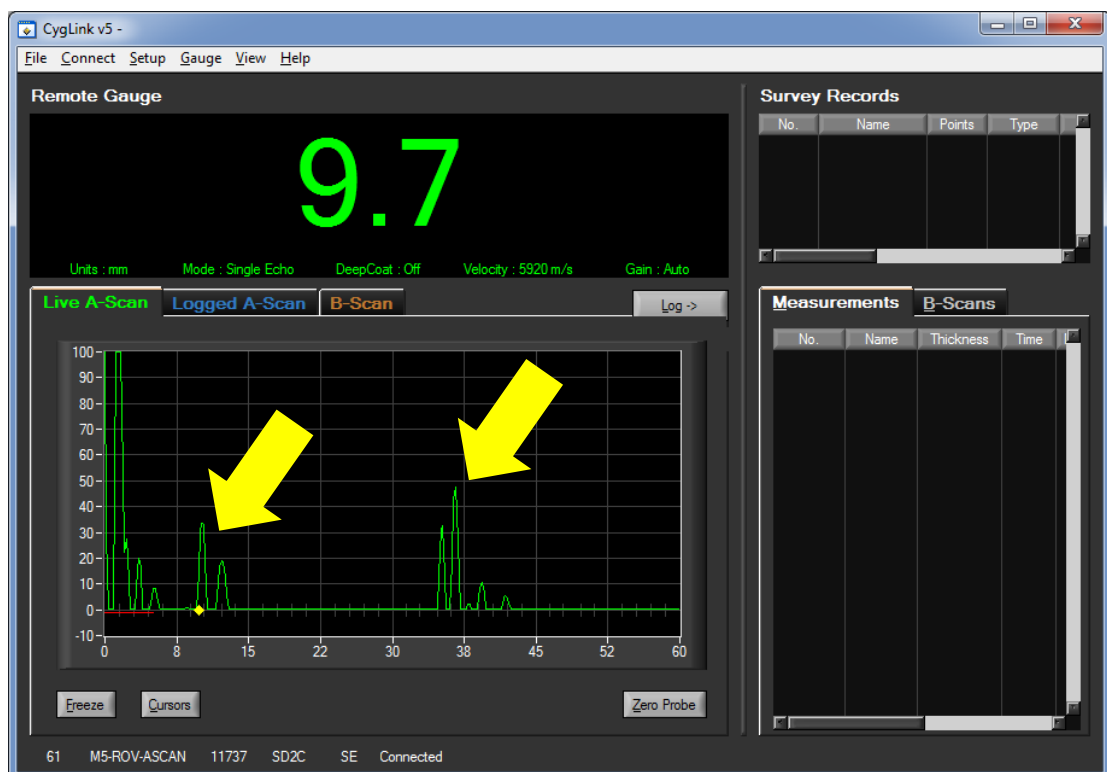
Delay Line Reflections when Probe in Air.

Taking Thickness Measurements Subsea

Surface Preparation

Water jetting the surface to SA1 is recommended.

The instrument will not measure through barnacles or similar hard encrustations. You must therefore remove any hard marine growth before attempting a thickness measurement.

Thin layers of green algae over paint don't need to be removed.

If there is loose rust (rusticles) or de-lamination of the metal surface you will need to remove these loose outer layers with a scraping tool.

Zeroing the Probe

As the pressure increases with depth the delay line will compress and this will shift the interface echo (zero point) as the length of the delay line decreases. To compensate for this, before attempting measurements perform a Probe Zero measurement.

> ⚠ Always perform a Probe Zero before attempting thickness measurements.

See Zeroing the Probe on page 35.

Probe Alignment

To have any chance of getting a good measurement the ultrasonic probe must be positioned correctly on the surface of the object being surveyed.

⚠	The probe MUST BE perpendicular to the surface in both axes, otherwise the ultrasound will not reflect back to the probe.

The P50 Probe Handler will assist in aligning the probe with the surface but the ROV's position and the manipulator arm position are critical in helping to align the probe correctly.
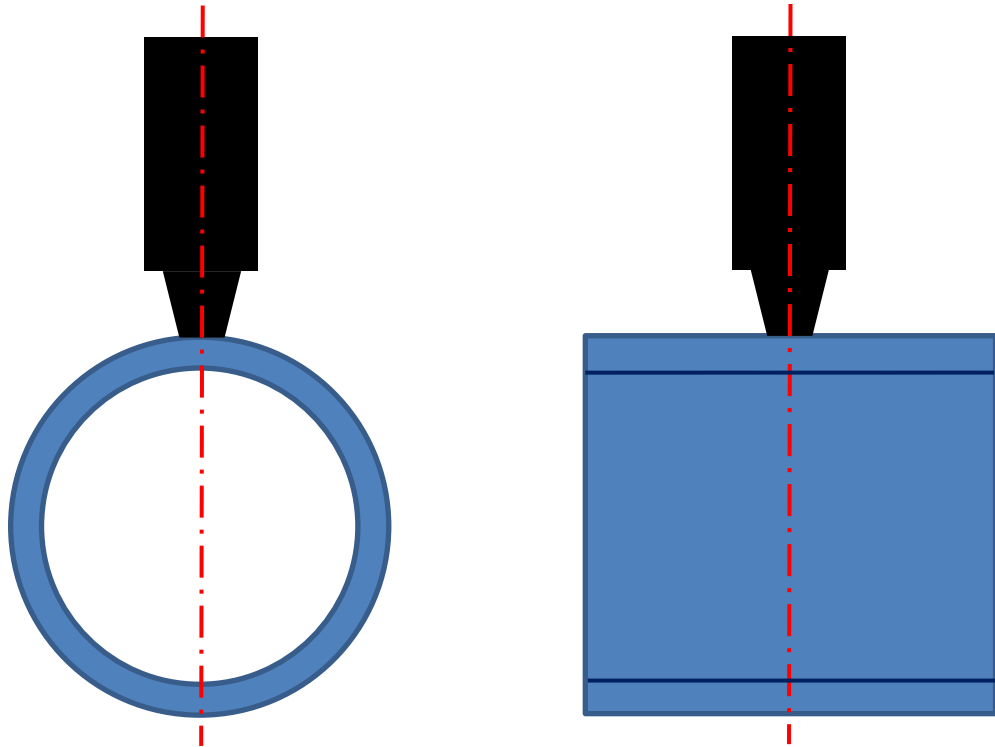
The Probe Must Be Aligned Perpendicular in Both Axes.

Start CygLink Topside

Run the Cygnus **CygLink** program from its desktop shortcut. To Connect to the Subsea Instrument, from the menu select;

Connect -> Connect to Gauge

Taking Measurements

For best results set the Measuring Mode to **Auto SE/EE/ME**, see Measure Mode on page 30. This will let the instrument decide the best measurement to make.

The ROV operator should position the ultrasonic probe on the measurement surface, when CygLink is running it will continuously update the screen with the A-Scan and display a measurement if it can get one.

The probe handler should be moved/re-positioned until an acceptable measurement has been obtained.
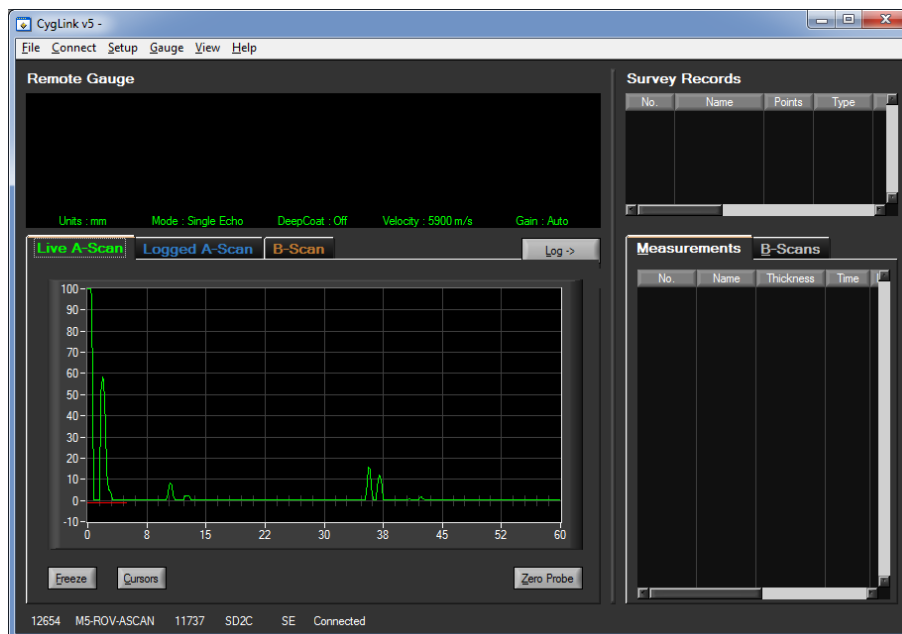
No Measurement.

The screens shown below show a valid measurement of 12.0mm and the A-Scan graph shows a signal marked with a single yellow diamond to indicate the SE measurement point.
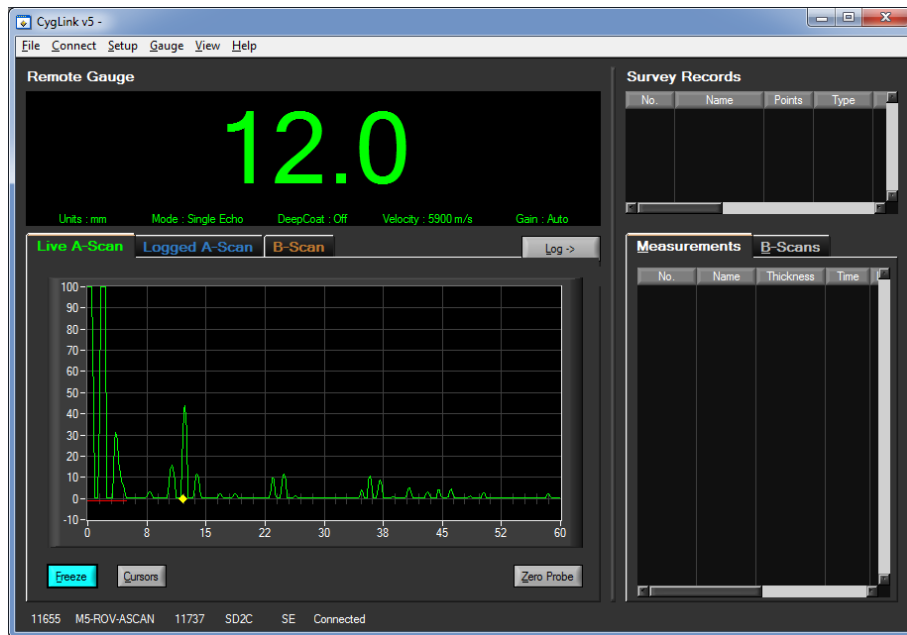
Valid SE Measurement of 12.0mm.
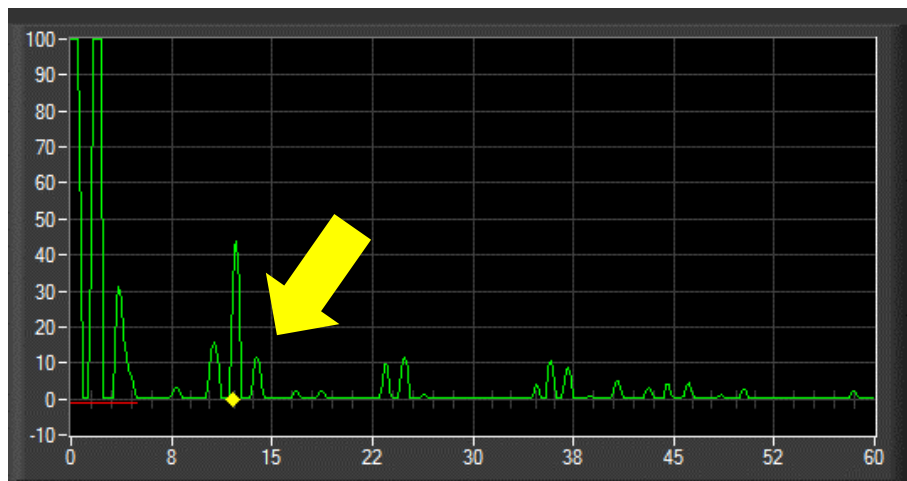
A single yellow diamond marks the Measurement Point in SE Mode.

The screen shown below show a valid measurement of 21.7mm and the A-Scan graph shows a signal marked with two yellow diamonds to indicate the EE measurement points.
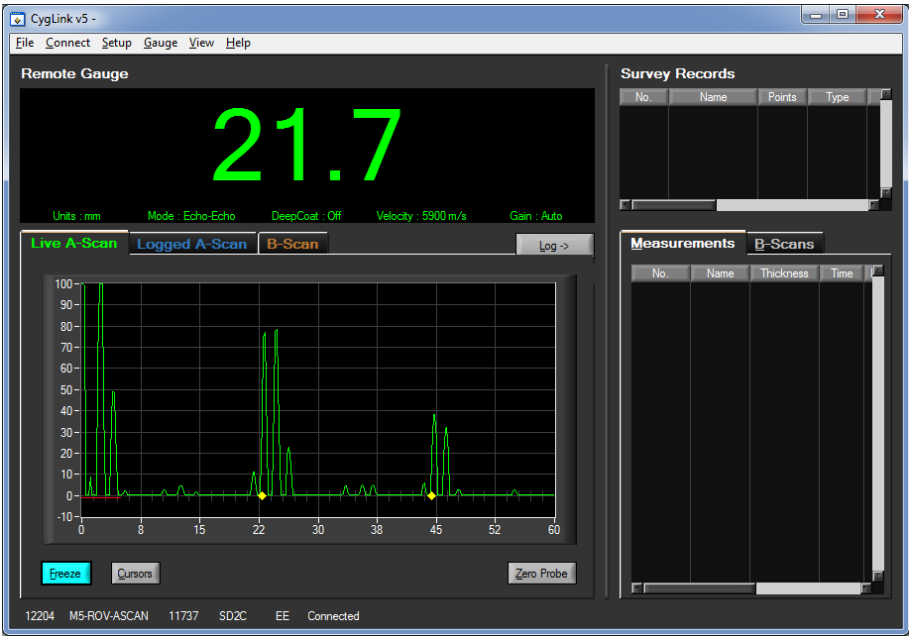
Valid EE Measurement of 21.7mm.

The screen shown below show a valid measurement of 11.4mm and the A-Scan graph shows a signal marked with three yellow diamonds to indicate the ME measurement points.
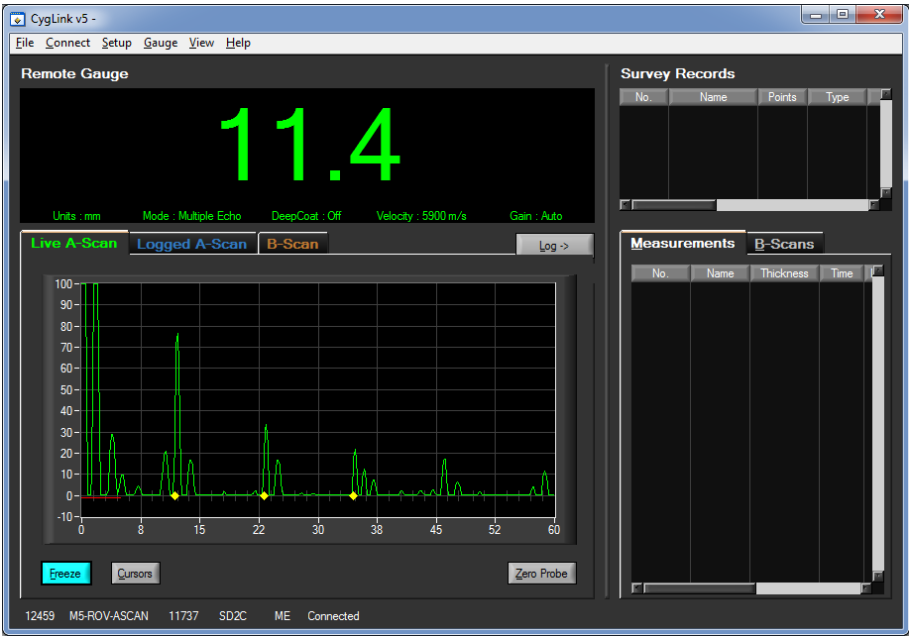
Valid ME Measurement of 11.4mm.

Logging Measurements

You can Log a measurement at any time by clicking the **Log** button, the displayed measurement and A-Scan will be saved in to the current survey.
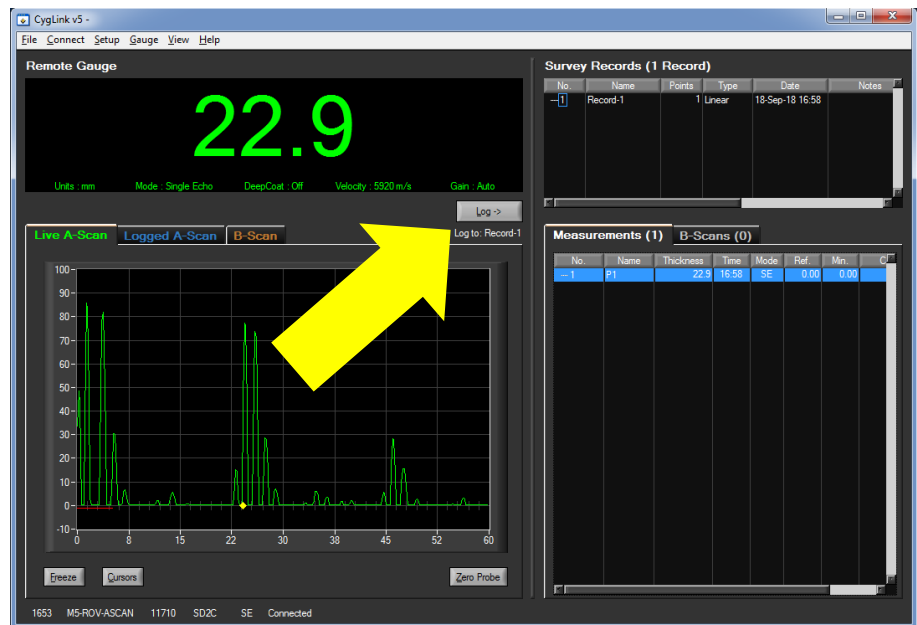
Logging a Measurement.

You can view a logged measurement at any time by double clicking on the measurement in the Measurements tab on the right.

Remember to **Save** the **Survey** and your logged measurements.

Manual Gain Control

For the experienced UT operator there is a **Manual Gain** control feature that allows the operator to adjust the gain value in dB.

This can be useful when obtaining a thickness measurement is difficult in Auto gain mode.

When used in conjunction with the **Cursors** and variable **A-Scan Range** this is similar to using a basic Flaw Detector.
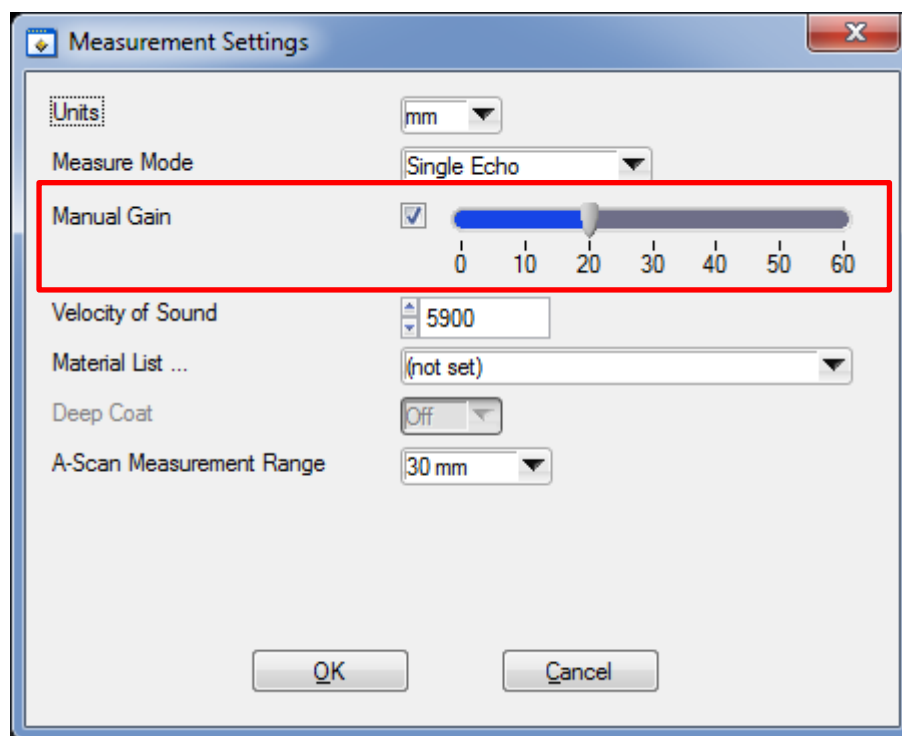
Manual Gain Setting in dB.

Using the Cursors to make Direct Measurements

There are two measurement cursors that can be displayed by clicking the **Cursors** button under the A-Scan graph.

You can drag each cursor to make direct measurements from the A-Scan graph. The cursor values (in thickness units) are displayed as;

- c1 = Cursor 1 Value (yellow)
- c2 = Cursor 2 Value (blue)
- d = Cursor 2 – Cursor 1 (difference between)

You can Log any cursor measurement into the Survey by clicking the **Log** button next to the cursor values.
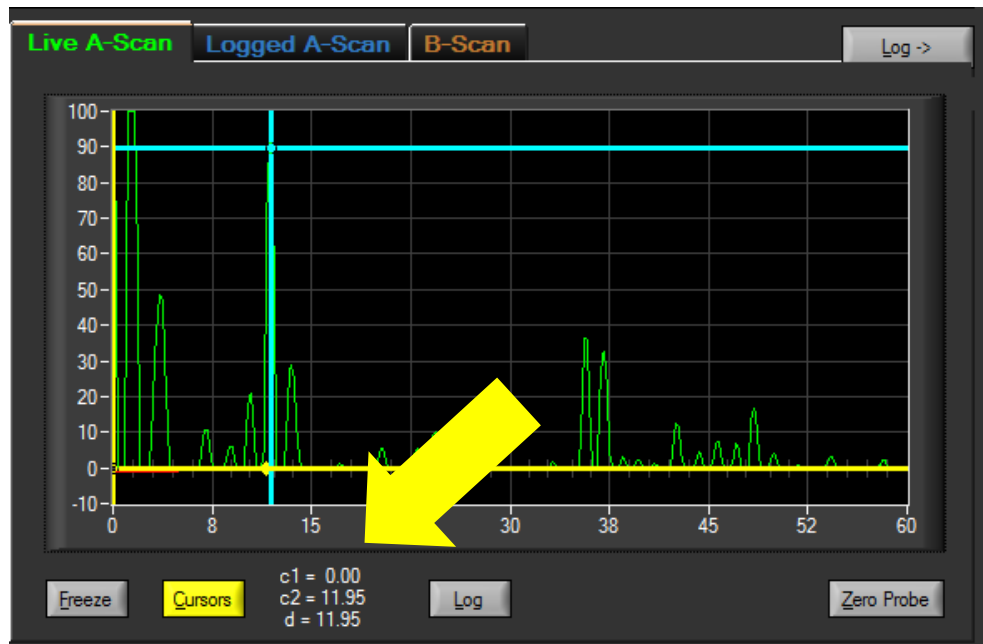
Using the Cursors to Make a Measurement directly off the A-Scan.

Using the Display Freeze

You can freeze the display, thickness value and A-Scan graph, at any time by clicking the **Freeze** button. To un-freeze just click the button again.

When the display is frozen you can use the cursors to make direct measurements and log these into the survey.
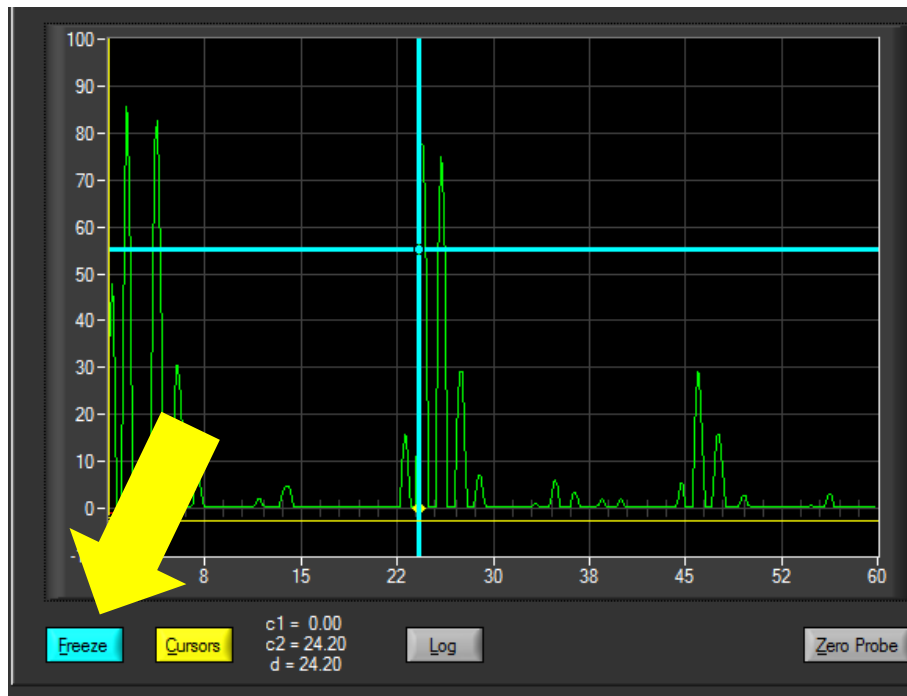
Frozen A-Scan Graph.

5. Measurement Modes

The Measure Mode determines how the instrument uses the ultrasound signals to get a thickness measurement. There are three measurement modes used in this instrument;

- **Single Echo Mode**
- **Echo-Echo Mode**
- **Multiple Echo Mode**

Single Echo Mode (SE)

Single Echo Mode (ISO 16809 Mode 2) measures from the interface echo (F) and the 1st back-wall echo (E1).
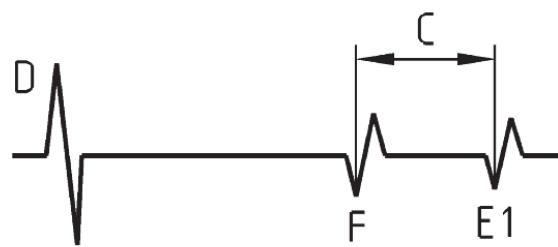
Mode 2

D	*transmission pulse*
F	*interface echo (delay line face)*
E1 to E3	*back-wall echoes*
C	*sound path travel time (thickness)*

Advantages:
- Good performance on corrosion
- Will almost always get a measurement

Disadvantages
- Does not ignore surface coatings
- Performance poor on thin material

Echo-Echo Mode (EE)

Echo-Echo Mode (ISO 16809 Mode 3) measures from the 1st back-wall echo (E1) to the 2nd back-wall echo (E2).
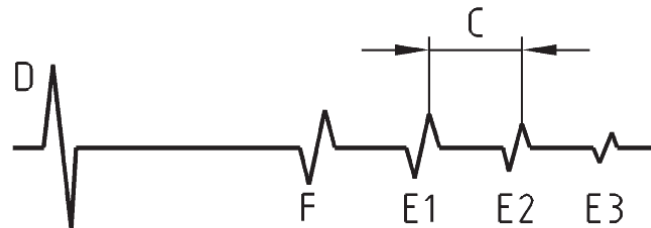
Mode 3

Advantages:
- Ignores surface coatings up to 1mm thick
- Better measurement accuracy

Disadvantages
- Not good on heavy corrosion
- Can sometime give a 'double' measurement

Multiple Echo Mode (ME)

Multiple Echo mode measures between the 1st back-wall echo (E1) and the 3rd back-wall echo (E3) and checks that E2 is exactly half we between E1 and E3.
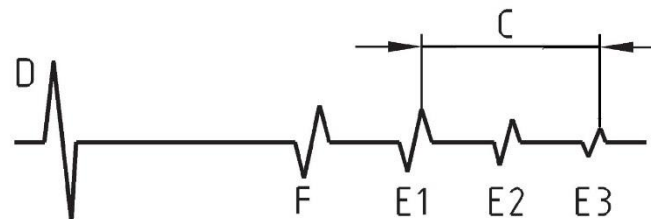
Mode 3

Advantages:
- Ignores surface coatings up to 1mm thick
- Best measurement accuracy

Disadvantages

- Not good on heavy corrosion
- Can be difficult to get a measurement

Auto EE/SE/ME Mode

This mode lets the instruments decide the best measurement mode to use. First it will try to get a ME measurement, then try to get an EE measurement then finally try to get an SE Measurement.

See Measure Mode on page 30.

6. Measurement Settings in CygLink

The measurement settings panel in CygLink has all the settings that control how the system measures thickness.

In CygLink from the menu bar select **Setup -> Measurement Settings**, this will display the screen below.
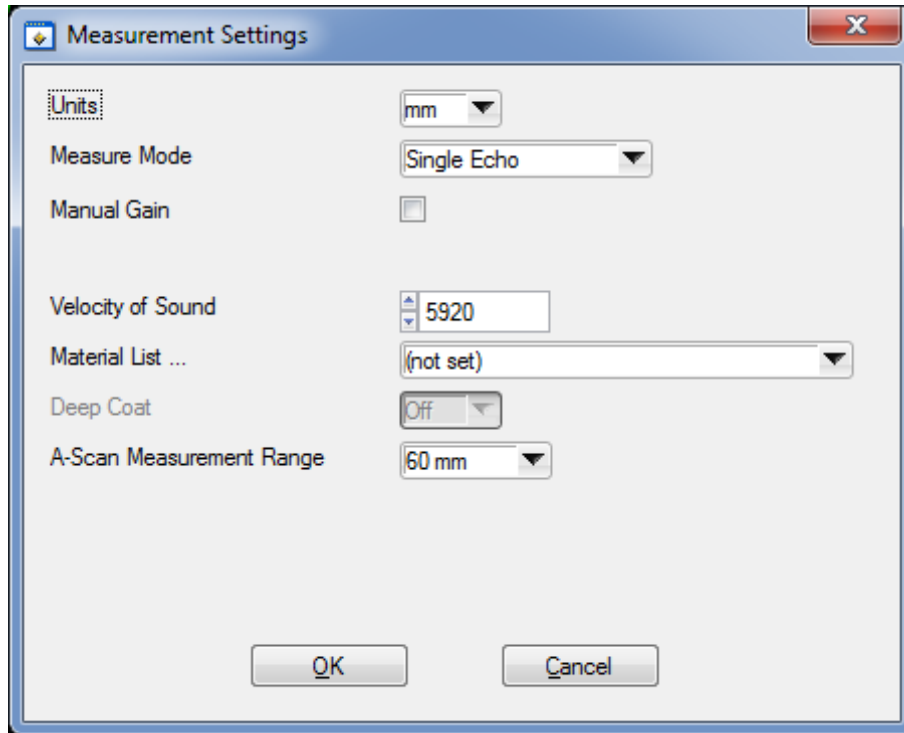
Measurement Settings Panel.

The subsea instrument is updated with the new values after the **Ok** button is pressed.

Units

The choices are mm or inches.

Measure Mode

The choices are;

- Single Echo

- Echo-Echo
- Multiple Echo
- Auto SE/EE/ME

See Measurement Modes on page 27.

Manual Gain

When the tick-box is un-checked the Gain is set **Automatically** by the subsea instrument. This is the default and recommended setting.

When the tick-box is checked the gain is set **Manually** by the operator, a slider control is displayed that adjusts the gain value as required. The subsea instrument is updated with the new gain value after the **Ok** button is pressed.

Manual Gain Control.

Velocity of Sound and Material List

One of these two settings are used by the gauge in determining the flight time of the sound wave in the material being measured. The speed at which sound travels in the material being measured.

Measurement range for A-Scan Range

The X-axis of the A-scan graph is ideally set to show the best number of return echoes in the material being measured. The gauge can automatically adjust the A-scan range using the thickness measurement, or you can manually set the range to suit the material thickness you expect to measure.

You can choose from the following A-Scan range values;

- AUTO   The gauge automatically adjusts the A-scan range
- 15 mm (0.6")
- 30 mm (1.2")
- 60 mm (2.4")

7. Calibration and Zero

Why should I Calibrate?

Ultrasonic thickness gauges measure time in order to measure the thickness of the material being tested. The rely 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;

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

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

There are tables listing the velocity 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.
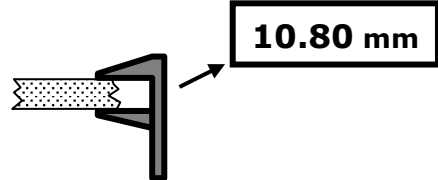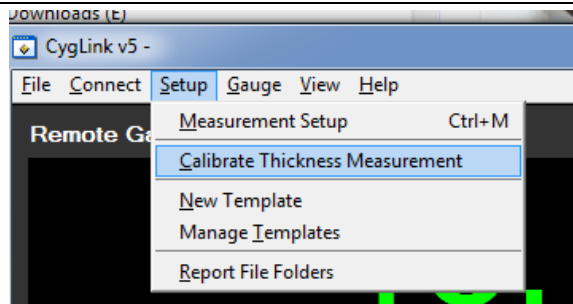
This means if you want to achieve the most accurate thickness measurements you must calibrate your instrument to a sample of the same material you will be testing – and a sample that you can accurately measure its thickness with a Vernier or Micrometer.
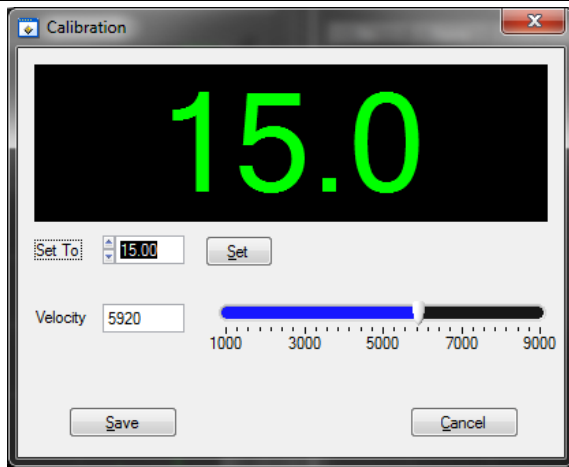
Your measurements are only as good as your calibration

Instructions on calibrating the instrument can be found on pages 34.

Calibrating to a Known Thickness

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

Calibrating to a Known Thickness		
1	Accurately measure the thickness of your sample material. Or use the supplied 15mm test block.	**10.80 mm**
2	Apply some couplant to the sample or test block. Hold the sample against the front of the probe. You must hold sample against the front of the probe during calibration.	
4	From the Cyglink menu select **Setup** -> **Calibrate Thickness Measurement**	

Calibrating to a Known Thickness		
5	Either set the material thickness in the "Set To" and press Set or adjust the velocity if the material velocity is known.	
6	Close the window by pressing **Save** once calibration is complete.	

Zeroing the Probe

The ultrasonic probe must be zeroed before attempting measurements to compensate for pressure changes at depth, wear or operating temperature changes. The instrumnet will always perform a Probe Zero when first turned on or when a probe is connected.

⚠	Always perform a Probe Zero before attempting thickness measurements.

In CygLink select **Gauge** from the top menu and then **Probe Zero**, click **Start** to measure the probe zero.

Or you can click the **Zero Probe** button on the main screen.
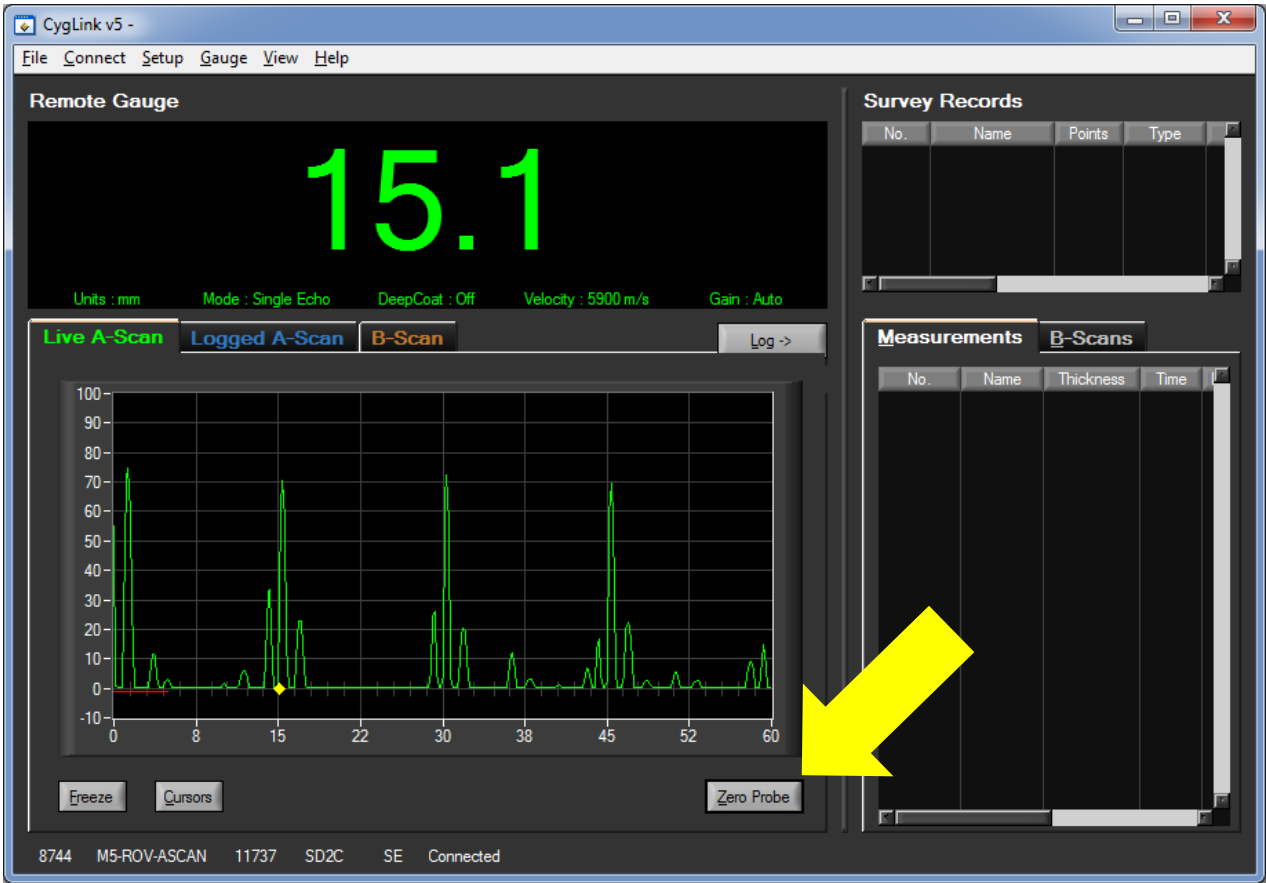
Zero Probe button.

8. CygLink

Installing CygLink

CygLink V5 is supplied with the kit on a USB Flash Drive, or it can be downloaded from the Cygnus Instruments website. If you want to make sure you are installing the latest version, then downloading from the website is the best option.

Requirements

To install and run CygLink the computer must:

1. Be running Windows 10 or a newer version
2. Have sufficient resources for Microsoft .NET Framework installation
3. We recommend a screen resolution of 1280 x 720 or greater
4. We recommend at least 1GB of memory

Upgrading

You can check the Cygnus Instruments website for the latest version of CygLink V5.

Installing

If you downloaded the CygLink installer file from the Cygnus website then this is a single self-extracting ZIP file.

Simple double-click the 'setup' or 'CygLink…' exe file to start installation. You will need to agree to the license terms and conditions. There are no options to select so installation is straight forward. You will also need to accept the End User Licence Agreement in order to complete the installation and a summary of its terms is provided at the start.

COM Port Numbers

CygLink should automatically find the COM port number assigned to the USB converter when you click "connect" so you don't need to search for the port number Windows has assigned.

Setting the COM Port Manually

If CygLink fails to locate the correct COM port number you can set in manually from the **File** -> **Communications Options** menu item. Just tick the **Manual Setup** box and select the correct COM port number.

Finding your COM Port Number

With the USB-RS232 Converter plugged into your computer, open Windows Device Manager – to do this press the Windows® key and the '**R**' key together, then type "**devmgmt.msc**" into the prompt followed by enter key. In the **Ports** section, look for the USB Serial Port entry. Remember the COM number listed as this will need to be selected within CygLink's settings menu.
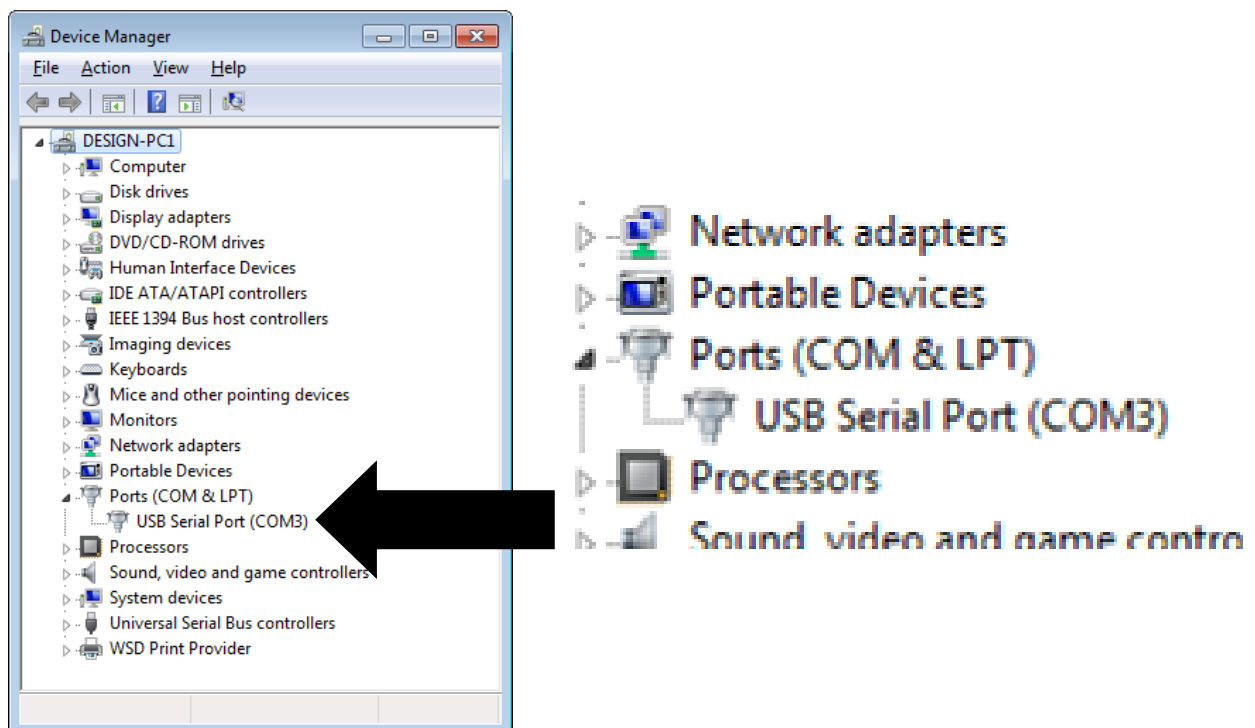
Windows® Device Manager

Connecting to the Instrument

First time USB Connection

When you first connect the gauge to the computers USB port Windows will search for a suitable driver, you may notice this message from the taskbar;
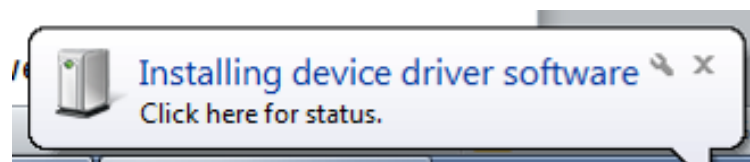
If you click the message you should see the driver installation process;
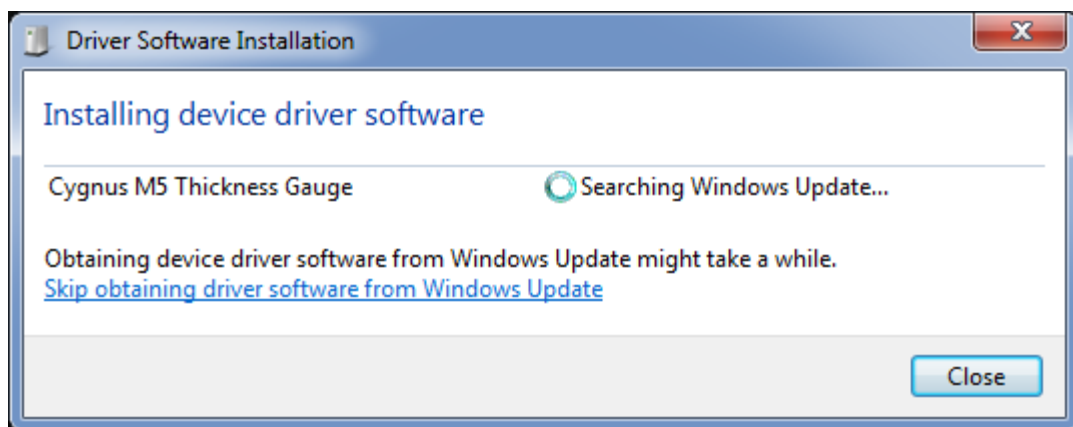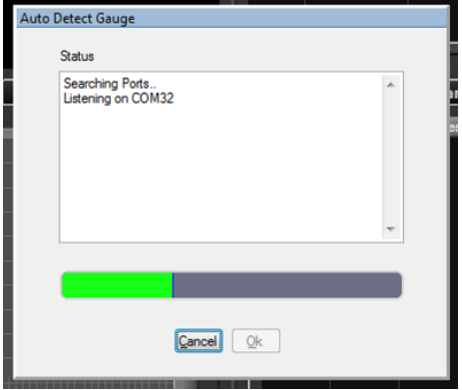
You can 'Skip' this process, but otherwise let it proceed and eventually you should see the following message;
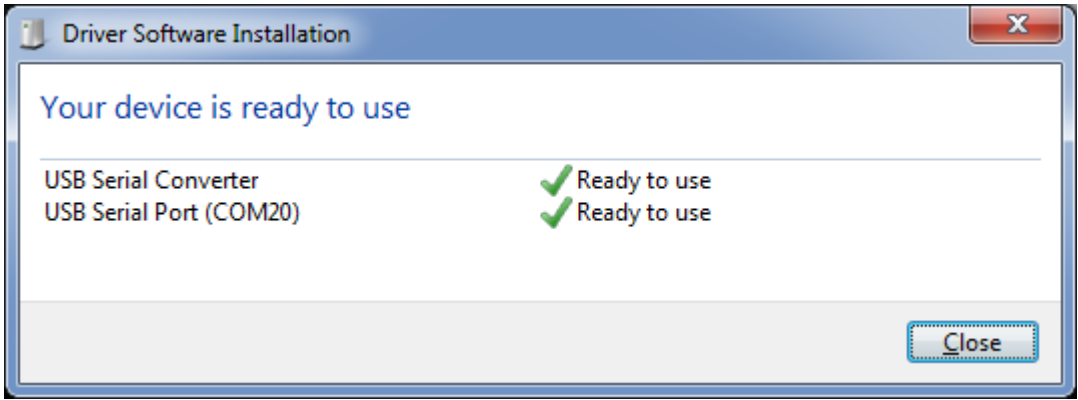
Connecting the Instrument to CygLink for the First Time
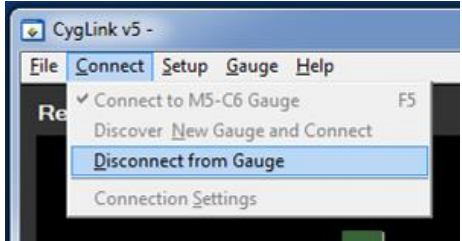
1.	Turn on the system power	
2.	Run CygLink V5	
3.	From the Menu click; **Connect** └ **Discover new Gauge and Connect**	

4.	CygLink will search all the available Com ports listening for a Cygnus gauge. If a instrument is detected, then it will connect and save these settings for next time.	
5.	When connected you should see details of the gauge in the status bar at the bottom and 'Connected' 	
6.	If the connection is ever lost the status bar will show 'Lost Connection' then 'Disconnected'. 	

Connecting to the Instrument Afterwards

1.	Once you have discovered the instrument the connection settings will be stored for next time, so to connect next time simply click from the menu; **Connect** └ **Connect to M5-ROV-ASCAN Gauge**	

Disconnecting from the Gauge

1.	To disconnect from the instrument simply click from the menu; **Connect** └ **Disconnect from Gauge**	

Manual Connection Settings

If you need to manually set the connection settings then select the **Connection Settings** option from the **Connect** menu, here you can specify the COM Port number, gauge type and baud rate.

CygLink Surveys and Data Logging

CygLink have the facility to store logged thickness measurements in a single Survey file. These measurements are organised into Survey Groups, each Survey Groups can contain any number of thickness measurements. The whole Survey can be saved to a single file which can be emailed, or it can be turned into a PDF paper report and also emailed or printed out.

Survey   1 Survey
   Groups   (1 to many groups)
     Measurements   (1 to many measurements)
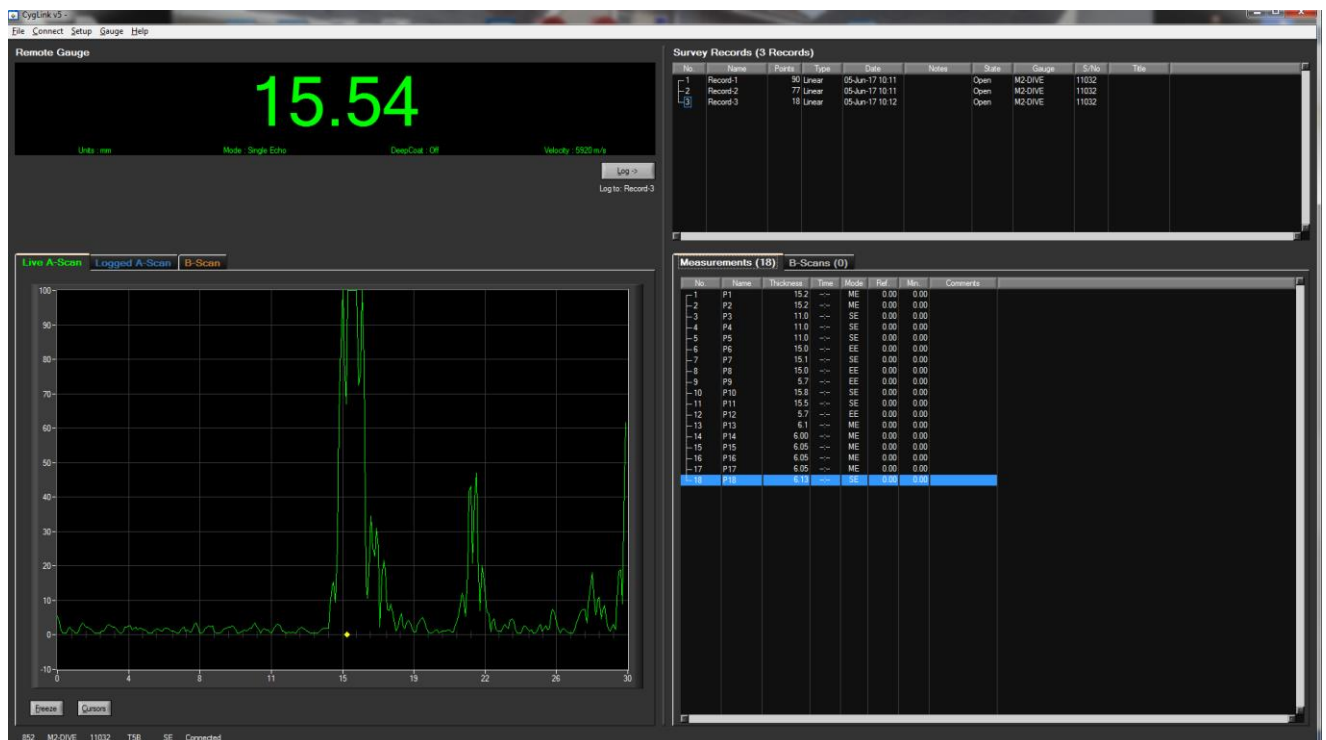
CygLink Main Screen with a Survey Group with Measurements.

You can Save, Open or Create new Surveys from the File menu;
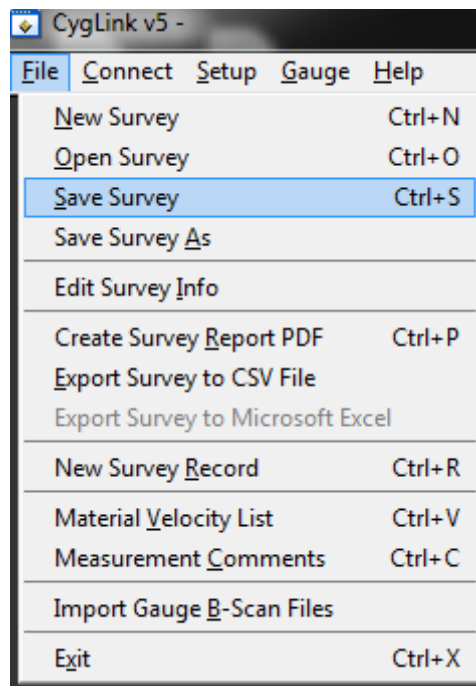
File Menu.

Editing the Survey Details
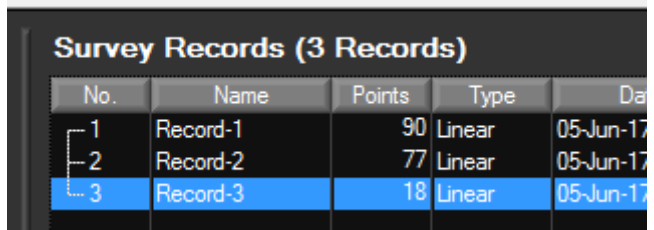
The Survey contains all the Groups and is used to save all the data. You can also add details to the Survey that will be printed at the beginning of the PDF report. To create or edit the Survey details click **File** -> **Edit Survey Info**.

Survey Details Screen.

Editing the Survey Group Details

To view and edit the survey Group details right click on the records number and select properties.

To create a new Survey Group select in the File menu **New Survey Record.** File in the details as needed and press **Save**.
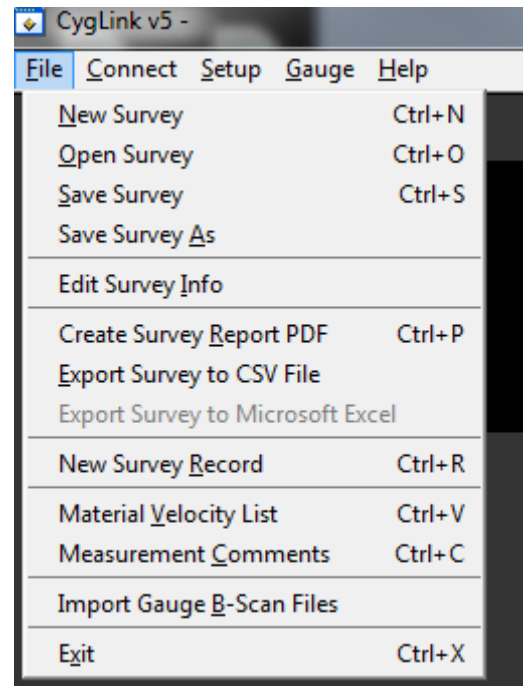
Producing a Survey Report Document

A PDF report can be produced containing all the Groups and thickness measurements in the Survey, grouped by each Survey Group. From the **File** menu select **Create Survey Report PDF**. You will be prompted for a filename first for the report first.

Once the export process is complete, your report will automatically be displayed in your installed PDF viewer. The export may take a few seconds, depending on the number of logged measurements.

Logging Measurements Directly in CygLink

You can use CygLink to log the displayed topside thickness measurements into a Survey so they can be presented in the Survey report.

Clicking the **Log** button next to the thickness measurement will create a new record and add a measurement into the group.

Reference and Minimum Thickness Criteria

You can set a Reference Thickness and Minimum Thickness for each survey Group right clicking on the records number and select properties. This will be applied to all measurements in the Group.

The Reference Thickness is the thickness of metal when new.

The Minimum Thickness is the minimum thickness – any measurement below this will be highlighted Red on the screen and in the survey report.

Pre-Set Measurement Comments List

You can add up to 8 short text comments that can then be used to append to a thickness measurement. To setup your comments click **File** -> **Measurement Comments**.
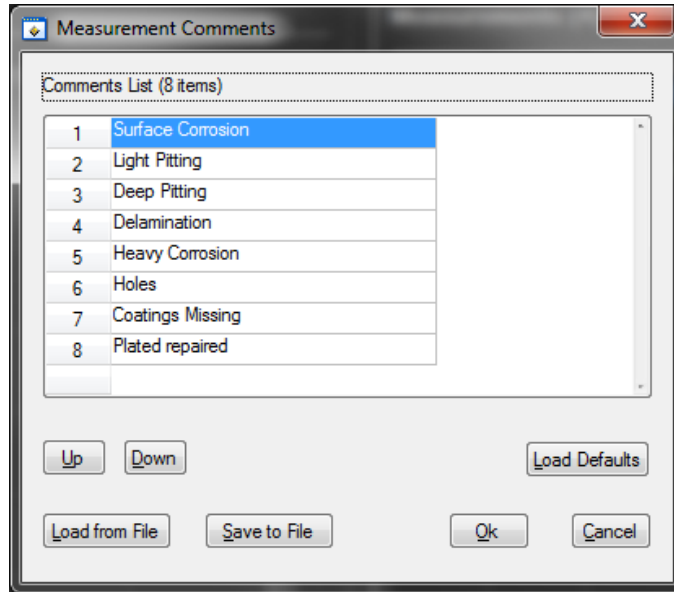
Measurement Comments Screen.

Adding Comments or Notes to a Measurement

You can add your own quick text Notes to any logged thickness measurement, just select the measurement point in the list and right click to display more options.

Click **Add Note** to type in a brief text note.
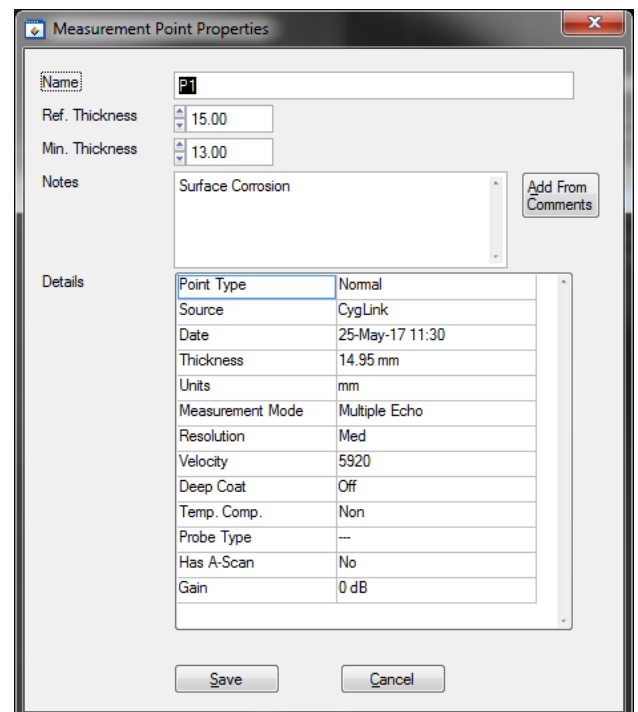
To Change the COM Port number assigned by Windows®

Depending on a variety of factors, Windows® may sometimes assign a COM Port number that is too high or unusual to be easily remembered. You may change the number assigned to the port by following these steps:

Opening Device Manager

Each version of Windows has a slightly different procedure for opening Device Manager. The most direct route is to press ⊞ + R, type "devmgmt.msc" and press Enter.

1. Select the "**USB Serial Port**" device and right click to display its context menu, Click "**Properties**".
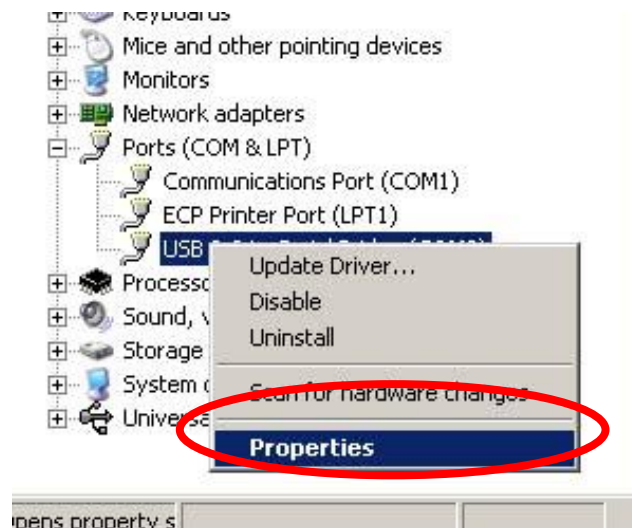
2. On the Properties form select the "**Port Settings**" tab, then click the "**Advanced**" button.
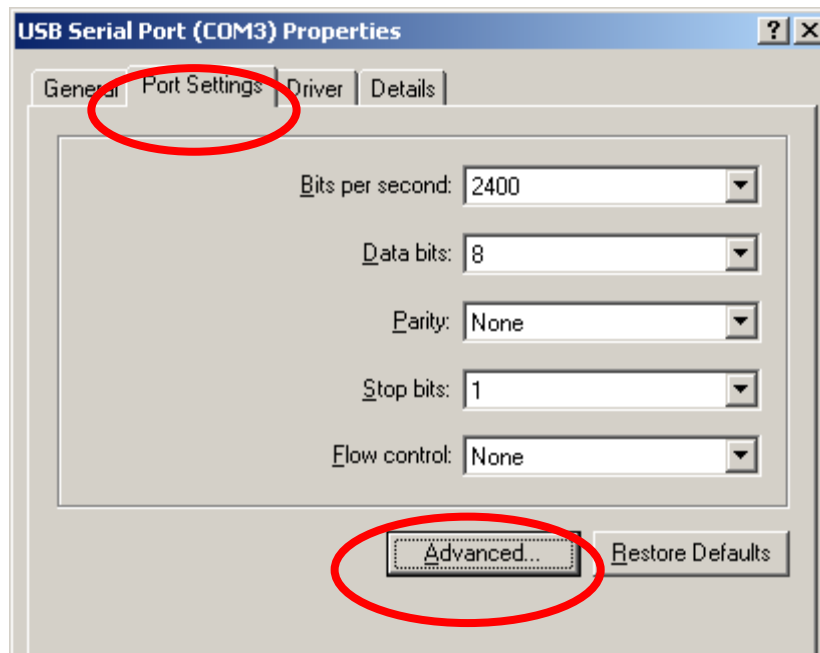
3. On the "**Advanced Settings**" form you can change the COM Port number. Finish by clicking the "**OK**" button.
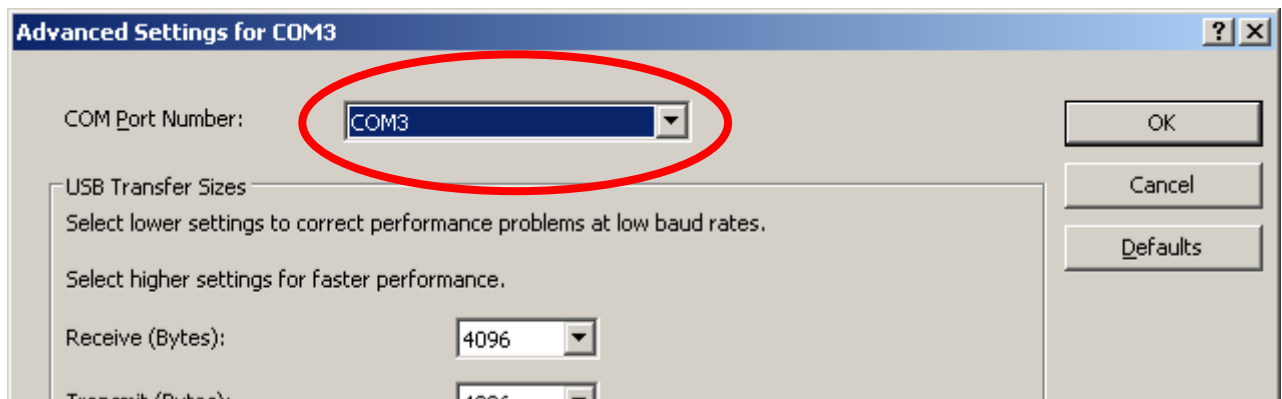
CygLink Trouble Shooting

Connection Problems – USB Drivers

If you are unable to get a connection the first thing to try is updating the USB drivers for the Serial to USB converter. Windows is constantly being updated and as a result, drivers also need to be updated to keep track of changes.

The Serial to USB converter used for the Cygnus ROV UTM gauge is manufactured by FTDI. You can search the web for the latest drivers from FTDI;

Type this into Google search "**FTDI US232R**"

Or follow this link directly to the FTDI website;

https://www.ftdichip.com/Products/Cables/USBRS232.htm

Click on the VCP Drivers link;

You will see a table of drivers with the most recent at the top. The x86 (32bit) driver is recommended.

There is a green and red LED inside the USB connector end of the cable – when installed correctly the green LED will flash every time the Cygnus ROV UTM gauge sends data, the red LED will flash when CygLink sends data to the Cygnus ROV UTM gauge.

Wiring Problems

Sometimes the cable between the subsea instrument and the USB converter is damaged, or has been repaired incorrectly. Although there are only 3 wires they must be connected the correct way around. Double check the connections from the instrument's connector to the serial converter connection.

If you have the short serial to USB interface cable – check the instrument can connect to CygLink using this cable – if it works then the USB driver must be ok, the problem may lie in the long umbilical cable.

9. Care and Servicing

Cleaning the Instrument

✔ After each dive while the instrument is still assembled, wash the unit in fresh water and allow to dry.

✘ Do not use solvents to clean the instrument.

Environmental

✘ Do not subject the instrument to temperatures greater than 60˚C (140˚F).

✘ Do not store the instrument and its kit for long periods in conditions of high humidity.

Repairs

✘ There are no user serviceable parts inside the instrument. Therefore all repair work should be carried out by Cygnus Instruments or by an Authorised Cygnus Service dealer.

Returning the Gauge for Servicing

A full Manufacturer's Factory Service is available from Cygnus Instruments.

🛈 The Complete Kit should always be returned for Service or Repair, including all Probes and Leads.

If you do need to return your instrument for Repair, please let us know the details of the problem to help us guarantee the best possible service.

10. Technical Specifications

Cygnus ROV UTM Technical Specifications	
General Attributes	
Size	105 mm x 110 mm x 35 mm (W x H x D) (4.1 in x 4.3 in x 1.4 in)
Weight In Air	Gauge body 3.7kg max (8.2 lb.) *Gauge Body 557 g (1.22 lb.)*
Power Supply Input to Electronics Bottle	12-24V supply input @ 60mA (average current) @ 200mA (maximum current)
Probe Sockets	CRE 'A' Series. (BR-A-09-F)(PL-A-09-M)
Operating Temperature Range	-10°C to +50°C (14°F to 122°F)
Storage Temperature Range	-10°C to +60°C (14°F to 140°F)
Measurements	
Through Coating Measurements	Through coating measurement in Echo-Echo and Multiple Echo modes. Ignores coatings up to 1 mm thick depending on coating velocity.
Materials	Sound Velocity from 2000 m/s to 9000 m/s [0.0780 in/us to 0.3543 in/us]
Measurement Modes	Manually Set; Single Echo SE : ISO 16809 Mode 2 Echo-Echo EE : ISO 16809 Mode 3 Multiple Echo ME : ISO 16809 Mode 3 Extended Optional Automatic SE/EE/ME mode.
Accuracy	±0.1 mm (±0.004") or 0.1% of thickness measurement whichever is the greatest.
Resolution	0.1 mm (0.005")
Zero	Automatic Zero measurement on probe connection. Manual Zero measurement can be initiated at any time by the user.
Measurement Range	Measurement Ranges in Steel Multiple Echo mode; SD2C probe 4 to 20 mm [0.157 in. to 0.787 in.] Single Echo mode; SD2C probe 4 to 50 mm [0.157 in. to 1.969 in.] Echo-Echo mode; SD2C probe 4 to 30 mm [0.157 in. to 1.181 in.]

Cygnus ROV UTM Technical Specifications	
Display	
Type of Display	Remote Display Unit
Display Size	N/A
Transmitter	
Shape of Pulse	Square
Pulse Energy : Voltage (peak-to-peak)	70 V p-p
Pulse Energy : Rise Time	3 ns (max)
Pulse Energy : Pulse Duration	SD2C : 220 ns
Receiver	
Gain Control	Automatic Gain Control up to pre-set Maximum Gain value 100 dB dynamic range. Manual Gain control, 0 to 70 dB.
Frequency Range	1.0 MHz to 10.0 MHz (-6dB)
Ultrasonic Probe	
Ultrasonic Probe	2.25 MHz x ø13mm single element piezo-composite crystal. Bonded to a 30mm acoustic length Rexolite delay line with ø16mm tip face.
Contact Surface Temperature	Maximum 100°C (212°F)
Other Information	
Data Output	RS232 2-wire duplex serial data output, 115200 Baud. 8 Data Bits, 1 Stop Bit, No Parity.
Data Connector	Subconn MCBH6M
Calibration setting storage	Calibration Data stored to Internal Flash Memory
Calibration Mechanisms	Not required for Multiple Echo mode. Automatic V-path correction for twin crystal probes.
Display & Recall Facilities	N/A
Display Response Time	125 ms / 500 ms
Printer Output	N/A
Environmental Rating	IP68 Rated to 3000m (9,843 ft) continuous immersion in sea water
Compliance	RoHS Compliant.

11. 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 Instrumnet 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 compression wave velocity c_l.

Material	Velocity of Sound (V)		Conversion Factor (f)
	m/s	in/us	
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
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 314	5715	0.2250	0.965

Material	Velocity of Sound (V)		Conversion Factor (f)
	m/s	**in/us**	
Stainless Steel 316	5750	0.2264	0.971
F51 Duplex Steel UNS S31803	5715 - 5750	0.225 – 0.2264	0.956 – 0.971
Core Ten Steel EN12223 S355-J0	5920	0.2331	1.00
Titanium	6100 - 6230	0.2402 – 0.2453	1.030 – 1.052
Epoxy Resin	2500	0.0986	0.422
Acrylic	2730	0.1076	0.461

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] :

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

thus : **T = t x 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

12. 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.

13. Electrical Connections

Power & Comms Port (Bulkhead plug)

MCBH6M (mates with MCIL6F). The picture below is shown looking into the bulkead connector.

Pin No.	Colour	Description	Pinout
1	Black	Ground	
2	White	12-24V DC Input	
3	Red	RS-232 TXD	
4	Green	RS-232 RXD	
5	Orange	*No connect*	
6	Blue	*No connect*	

Probe Port (Bulkhead)

CRE A Size (BR-A-09-F) Bulkhead Socket Assembly mates with CRE A Size (PL-A-09-M) Cable Plug Assembly.

Pin No.	Description
1	Probe Signal
2	Probe Screen
3	N/C
4	N/C
5	N/C
6	N/C
7	N/C
8	Probe Screen
9	Probe Screen

14. Cygnus Instruments

Cygnus Instruments Limited, founded in 1983, pioneered the development of the Digital *Ultrasonic Multiple-Echo Technique* used for measurement through coatings.

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.

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15. Warranty Information

LIMITED THREE YEAR WARRANTY
FOR CYGNUS ULTRASONIC THICKNESS GAUGES

1. Cygnus Instruments Limited ("CYGNUS") warrants that, subject as set out below, the Products manufactured by it (excluding consumables, batteries, probes, leads, microphones and telescopic extensions) will be free from defects in materials and workmanship for a period of three years from the date of purchase either from CYGNUS or from an Authorised CYGNUS Distributor. Batteries, probes, leads, microphones and telescopic extensions are warranted for 6 months. This warranty is limited to the original Purchaser of the Product and is not transferable. During the warranty period, CYGNUS will repair, replace or refund, at its option, any defective Products at no additional charge, provided that the product is returned by the original Purchaser, shipping prepaid, to CYGNUS or an Authorised CYGNUS Distributor. If shipped by mail or any common carrier, the Purchaser must insure and accept all liability for loss or damage to the Product and must use shipping containers equivalent to the original packaging. Replacement products or parts will be furnished on an exchange basis only. All replaced products or parts become the property of CYGNUS.

2. Any defects in materials or workmanship must be notified to CYGNUS by the Purchaser within seven days after the discovery of the defect or failure.

3. Dated proof of purchase must be provided by the Purchaser when requesting warranty work to be performed or making any other claim under this warranty. CYGNUS will not be liable under this warranty unless the total price for the Product was paid by the due date for payment.

4. This warranty does not extend to any products which have been damaged as a result of, accident, misuse or abuse, natural or personal disaster, service, modification or repair by anyone other than CYGNUS or an Authorised CYGNUS Service Centre, failure to properly store or maintain the Product, negligence, abnormal working conditions, fair wear and tear, or failure to follow the instructions issued by CYGNUS in relation to the Product.

5. Except as expressly set forth above or in the CYGNUS Terms of Sale, subject to which the Products were purchased, all warranties, conditions or other terms implied by Statute or Common Law are extended to the fullest extent permitted by law.

6. Except in respect of death or personal injury caused by the negligence of Cygnus, Cygnus shall not be liable to the Purchaser or to any other person 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 or their use or resale by the Purchaser or by any other person. The entire liability of Cygnus under or in connection with the Products shall not exceed the price paid for the Products, except as expressly provided in this warranty.

16. Index