Cygnus ROV Mountable
Ultrasonic Thickness Gauge
Models M5-ROV-2K, M5-ROV-4K

Operation Manual
and
Accessories List

Doc No.   M5-ROV-M-ENG_Iss6
May 2014
(Mk5 Cygnus ROV Gauges)
QUALITY POLICY STATEMENT

Cygnus Instruments’ mission is to be a premier supplier of niche test and measurement instruments. To achieve this we will:

Customers
• Be dedicated to customer satisfaction by listening to direct and indirect feedback regarding our performance and product requirements in general.
• Design state-of-the-art products that are robust, reliable, simple-to-use and compliant with applicable industry and regulatory requirements.
• Provide products and services that meet or exceed customer expectations in terms of performance, reliability and safety.

Internal Systems
• Operate effective and safe working practices that comply with ISO 9001:2008 and EN ISO/IEC 80079-34 and other applicable regulatory and statutory requirements.
• Provide adequate resources to ensure product and service quality is maintained.
• Set, communicate and measure performance objectives and targets to promote continual improvement.
• Ensure employees are competent and involved in improvement and customer satisfaction matters.

Suppliers
• Use suppliers and subcontractors who share our passion for customer satisfaction and who consistently perform reliably.

Cygnus is an ISO-9001 accredited company. The scope of our accreditation covers all our products and services.
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1. Introduction

Cygnus ROV Mountable Thickness Gauge

The Cygnus ROV Mountable Thickness Gauges are rugged, compact instruments designed for high-reliability ultrasonic thickness measurement using the multiple-echo technique.

The Cygnus ROV Mountable Thickness Gauges are fully sealed pressure rated units designed to be mounted on submersible ROV craft. There are two models with different pressure ratings, a 2000 m (6,561 ft) model and a 4000 m (13,123 ft) model. Both gauges take their power from the ROV craft and output thickness measurement data as serial data in either RS-422/485 or RS-232 format. The thickness measurement data can be viewed top-side a number of ways, by using CygLink software or using the optional Remote Display Unit with Video Overlay facility. The CygLink software also provides Data Logging facilities.

Measurements can be displayed in Metric (mm) or Imperial (inch) units; measurement resolution can be selected for either 0.1 or 0.05 mm, (0.005 inch or 0.002 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 Gauges are able to operate accurately in adverse environmental conditions both underwater and above the sea.

The Gauge 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 Gauge.
Multiple Echo Measurements

The Gauge works on the pulse-echo principle. The Probe transmits a very short pulse of ultrasound which enters the test piece. The Probe then acts as a receiver listening for return echoes, converting them into electrical signals which are processed to produce timing information that can be used to determine the material thickness.

Valid Thickness Measurement only when: $t_2 = t_3$

The multiple-echo beam travel is depicted above, spread out in time, to illustrate the timing method. In reality the beam path is straight and perpendicular to the surface as the ultrasonic energy reverberates up and down within the metal (shown on the left). Each time an echo is reflected back down, a small portion of the energy comes up through the coatings and is detected by the Probe which acts as a receiver ($e_1$, $e_2$ and $e_3$).

The delay between echoes at the Probe-face ($t_2$ and $t_3$) is exactly equal to the time taken to pass through the metal twice, therefore coatings such as paint are ignored and the measurement displayed is the metal thickness only.

Triple Echo Verification

The Gauge requires 3 equi-spaced return echoes in order to calculate a thickness measurement value ($t_2 = t_3$). This method ensures the Gauge only displays valid thickness values, the three
echoes provide a reliable method of signal verification. This process is referred to as Triple Echo Verification.
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.

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2. Gauge Kit Contents

1. ROV Power & Data cable with flying leads
2. Membrane Couplant
3. ‘K3’ RS-422/485 to RS-232 Converter
4. RS-232 to USB Converter
5. ROV Probe Cable with Heavy Duty Remote Probe (5 m)
6. Cygnus ROV Gauge
7. USB Flash Drive CygLink Installation and Operating Manual in PDF format
8. ROV Power & Data Test cable and connectors
   A. ¹Top Side Repeater Video Cables and 12 V Power Supply
   B. Top Side Repeater (TSR) Remote Display Unit

¹ A & B are Optional Accessories to the Gauge Kit.
Accessories in case: Spare O-Rings, Spare Membranes, Membrane Locking Ring Key, 15 mm (½”) Test block, Spare 1A Fuses, 3mm Allen Key, Silicone Grease Sachets. Documentation is attached in the lid of the case.

**Data Conversion Items**

1. RS-232 to USB Converter Module & Cable
2. ‘K3’ RS-422/485 to RS-232 Converter Module
3. Connection from ROV subsea link
Top Side Repeater (TSR) Remote Display Unit

Optional Accessory to the Gauge Kit
3. **Gauge Preparation**
   The Gauge is supplied ready to use. All that is required is to make the necessary electrical connections between the Gauge and the ROV Craft and the chosen top side display.

   There are no controls or display on the gauge, calibration is performed at the surface using the top side display.

**Electrical Connections to the Gauge**
See pages 66, 67, 68 & 69 for schematic connection details.

**Power Supply**
The Gauge requires a DC supply voltage between 7 and 30 volts with a current consumption less than 150 mA. There is an internal 1 Amp fuse and crowbar circuit to protect the instrument from over-voltage surges, the supply input is also protected against accidental reverse polarity connection. There is no on/off switch, the Gauge will operate continuously while the power is connected.

**Data Output**
The Gauge outputs its status and thickness measurements as serial data, there is the option to set the output as RS-422 or RS-232. The RS-232 output option would normally be used when the Gauge is connected to a fibre-optic multiplexer. The RS-422 output option can transmit the serial data up to 1200 m (4,000 ft) along a twisted pair cable. The serial output drivers have ESD protection to ±15 kV. See Serial Data Format on Page 57.

**Electrical Connections to the Surface**

**Connection to a Computer**
When connecting the Gauge output to a computer you will either connect to a free RS-232 serial port, or if the computer does not have one use the RS-232 to USB converter supplied in the kit.

When the Gauge outputs data in RS-422 mode you will need to convert the RS-422 signal to RS-232 first. There is a ‘K3’ converter supplied in the kit to do this.

See Schematic for RS-422 to Computer USB on page 66.
Connection through a Multiplexer

The Gauge serial output can be connected to a multiplexer, you can select RS-232 output and change the baud rate from 2400 to 9600 baud. See Schematic for RS-422 to Computer USB on page 66.

Connection to the TSR Remote Display Unit

The TSR Unit has an input for the RS-422 serial data directly from the Gauge. See Schematic for RS-422 to TSR on page 69.

If you have used a multiplexer to transmit the data from the ROV craft to the surface you will need to send RS-422 to the TSR. You can also use the ‘K3’ converter to convert from RS-232 to RS-422 if required. See Schematic for RS-232 to Multiplexer to TSR on page 68.

Connecting the Probe to the Gauge

The Probe is connected to the Gauge using a SubConn® Micro Series 2 way connector pair.

Automatic Probe Frequency Setting

The Gauge will automatically detect the frequency of the probe connected and set the Gauge accordingly.

Gauge Options

There are three options that can be set by the user, these are;

1. Serial Data Format : RS-422 or RS-232
2. Serial Baud Rate : 2400 or 9600
3. Deep Coat Mode : On or Off

To change any of these options the Gauge’s end cover plate must be removed to give access to the option switches. For details on removing the end cover plate see Gauge End Plate Removal on page 46.

Deep Coat Mode

Deep Coat mode can be used to take thickness measurement through extra thick coatings above 3mm thick and up to 20mm
In normal mode (Deep Coat off) the gauge will measure through coatings up to approximately 3mm thick\(^2\). Although Deep Coat may provide useful when attempting to measure through thick coatings, ultimately the acoustic impedance of the coating will determine if the gauge will be able to detect the three echoes required for a valid thickness measurement.

**Deep Coat mode should not be used for measuring coatings less than 3mm thick.**

It is advised to only consider using Deep Coat mode where necessary – do not leave the gauge in Deep Coat with the intent of a “measure all” solution.

**Measuring Through a Water Gap**

In ROV applications the water can be considered to be a coating thus it is possible to measure steel thickness through a small water gap. As the velocity of sound for sea water is approximately 1500m/s this equates to a maximum sea water gap of 2.25mm in normal mode (Deep Coat off).

Although Deep Coat may be used to measure through larger water gaps the performance of the gauge may suffer as a result. It is advised that trials are carried out first to verify the effectiveness of this approach to the application.

\(^2\) Depending on material’s acoustic impedance  
\(^3\) Assuming a velocity of sound around 2000m/s for the coating
4. Displaying the Thickness Measurements

The Gauge transmits the thickness measurement data to surface as a serial data, to display the thickness value and provide a means of calibration Cygnus provide two options;

1. Using a Cygnus Top-Side Repeater (TSR) unit
2. Using a computer with CygLink software

It is also possible for a third party application to read the serial data and process the thickness measurement data, for more information see Design Pressure Test Certificates

<table>
<thead>
<tr>
<th>Model</th>
<th>Certificate Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Date : 19/01/2011</td>
</tr>
<tr>
<td></td>
<td>Certificate Number : PTC893</td>
</tr>
<tr>
<td></td>
<td>Test Pressure : 300 bar</td>
</tr>
<tr>
<td>M5-ROV-4K</td>
<td>Testing Company : MacArtney, Aberdeen</td>
</tr>
<tr>
<td></td>
<td>Test Date : 02/09/2010</td>
</tr>
<tr>
<td></td>
<td>Certificate Number : 1923</td>
</tr>
<tr>
<td></td>
<td>Test Pressure : 600 bar</td>
</tr>
</tbody>
</table>

Serial Data Format
on page 56.

Data Logging

The CygLink software also provides the facility to Data Log the thickness measurements as they are taken and to generate a report document for the survey.
**Video Overlay**

The optional TSR unit has a Video Overlay or On-Screen Display facility where the thickness measurements can be superimposed on to a video signal feed before the monitor and/or video recorder. The video overlay will work with PAL or NTSC video signals.
5. **Calibration**

   The Gauge is supplied tested and calibrated to BS EN 15317:2007. The Gauge will have been calibrated to measure thickness through steel (grade S355JO).

   Either a 15mm or ½” 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 and may not indicate an exact 15.00 mm.

   ! 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 using CygLink see Calibrating to a Known Thickness using CygLink on page 32, or with the TSR see Calibrating to a Known Thickness using a TSR on page 21.

   If there is no test sample available the Gauge can be calibrated by setting the Velocity of Sound directly. A table on page 60 at the back of this manual lists common materials and their velocity of sound value. For instructions on setting the velocity of sound using CygLink see Calibrating to a Known Thickness using CygLink on page 32. **Error! Bookmark not defined.**, or with the TSR see Setting the Velocity of Sound on page 20.

   A third method is to leave the Gauge set to its factory-preset value for Steel [5920 m/s or 0.2332 in/us], and then use a Conversion Factor from the table of velocities on page 60.
6. Using the TSR Remote Display Unit

The Cygnus Top Side Repeater (TSR) is a small handheld display unit that can display the thickness measurement values from the Gauge on its LCD display. It provides the ability to calibrate the Gauge’s output to suit the material or to a specific velocity of sound. A video overlay facility is also included that allows the thickness measurements to be superimposed on to a video signal before the monitor or video recording device.

Turning the Unit On

1. Press the red **ON** key
2. The Cygnus Logo screen appears
3. If not connected to a Gauge the display shows “NO CONNECTION”
   *This is normal* – it just means no data has been received yet

Changing the Displayed Units

1. Press the **MENU** key to display the **MENU**
2. Press the **DOWN ARROW** key to scroll down to **UNITS** the current units are displayed
3. Press the **EDIT** key to toggle between **mm** and **Inch**

Setting the Velocity of Sound

The velocity of sound value is displayed at the top of the screen in either m/s or inch/us.

1. Press the **MENU** key to display the **MENU**
2. The **VELOCITY** menu option should be selected at the top
3. Press the **EDIT** key to adjust the velocity of sound value
   *Press the **OK** key to save and exit*
Calibrating to a Known Thickness using a TSR

The TSR display can be calibrated to a known thickness by using the Gauge to measure a sample of the material that will be measured. This method ensures the velocity of sound is set for the actual material being measured rather than using a “generic” value.

1. Place and hold the Gauge’s ultrasonic probe on the material sample using couplant if out of the water
   You should have a stable thickness measurement on the display

2. Press the MENU key to display the MENU

3. The CALIBRATE menu option should be selected at the top

4. Press the EDIT key to adjust the measurement value to the known thickness of the sample being measured
   Press the OK key to save and exit

5. Repeat from step 1 to check the calibration is stable.

Display Hold Function

The middle key HOLD can be used to freeze the display and hold the current thickness measurement.

1. Press the HOLD key to freeze the display

2. Press the HOLD key again to un-freeze the display

Automatic Display Backlight

The display backlight automatically turns off in bright light conditions, it will automatically turn on when the ambient light level drops.

Video Overlay Facility

The TSR can superimpose the thickness measurement on to a video signal to display it on the monitor screen, and also on the
video recording of the survey. This provides a thickness measurement that can be linked to a position or place in the video.

28.10 mm
5920 m/s

Connecting the Video Signal
The TSR has two BNC sockets on its top panel; Video In and Video Out. The video feed to the monitor and video recorder is fed through the TSR. The TSR will automatically detect and adjust for PAL or NTSC video signals, it will work with colour or monochrome images.

Positioning the On-Screen Display (OSD)
Because there is usually other information displayed on the video screen the TSR has the facility to move the thickness measurement display ‘box’ anywhere on the screen using X, Y coordinates. The position selected will be stored in the TSR memory during power off.
1. Press the **MENU** key to display the **MENU**

2. Press the **DOWN ARROW** key to scroll down to **OSD X POS**

3. Press **EDIT** to adjust the X screen position
   Press **EXIT** to save and exit

4. Press the **DOWN ARROW** key to scroll down to **OSD Y POS**

5. Press **EDIT** to adjust the Y screen position
   Press **EXIT** to save and exit

6. Press **EXIT** again to exit the menu screen

**Testing the Link**

Before use on a job it is recommended to test the link between the Gauge and the TSR. To do this simply power on both the display and the gauge then measure the test block - the TSR should display the correct test block thickness.
### Troubleshooting - Error Messages

<table>
<thead>
<tr>
<th></th>
<th>NO CONNECTION</th>
<th>The TSR has not received any valid data since power-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Check that the Gauge is turned-on and displaying either a measurement or the echo strength bar-chart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check all cable connections are secure</td>
</tr>
</tbody>
</table>
7. **CygLink Surface Display and Control Kit**

CygLink is a Windows® application for PCs that allows remote viewing, control and data logging of the ROV gauge. The software can provide the following functionality:

1. Surface display of thickness measurements
2. Remote setting of the velocity of sound
3. Remote setting of the units
4. Data Logging of thickness measurements into a Survey report

**Kit Contents**

The CygLink kit comprises of the following items:

1. USB-RS485 Converter Cable
2. CygLink Software Installer on USB Flash Drive

You will also need an Umbilical cable and connectors to connect the ROV gauge to the top side. Cygnus can supply the complete umbilical cable with connectors fitted, or the customer can make their own umbilical cable using connectors supplied with cable tails.
Connection Diagram

Connector Details and Signals
See Page 66, 67, 68, 69 for wiring details.

Installing CygLink
CygLink is supplied on a USB Flash Drive or can be downloaded from a web link emailed from Cygnus Instruments. Installation of CygLink follows normal software installation conventions after running the setup.exe program and following instructions.

To install from a flash drive, connect it to a free USB port on your computer. Navigate to the flash drive in Windows® Explorer and open the folder present in the root of the drive. Run the application named setup.exe to begin the installation process. You will 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. We advise opting for the Typical setup option for the smoothest installation experience.
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 it 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-RS485 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.

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.

Running CygLink Application

Once installed CygLink will place shortcuts in the start menu and on the desktop. Click either to start CygLink. You are first asked to either Create New Survey, Open Survey or Continue - choose Continue to proceed without a Survey loaded.
Connecting to the ROV Gauge

To connect to the ROV gauge, assuming the gauge is connected and turned on, from the menu click **Gauge** then **Connect to Gauge** then **ROV Gauge**.
The Connection Status is shown in the status bar at the bottom left, this should be green. Also shown in the status bar are:

- The Gauge type (M4-ROV)
- The Echo Mode (Multiple Echo)

### Changing Gauge Settings

To change the gauge settings click **Gauge -> Measurement Settings**. You can change the Units and Velocity.
**Velocity Table**

You can select the Velocity from a table of common materials, in the **Velocity** tab of the **Measurement Settings** screen click the [...] button to display the list.

![Velocity List](image)

**Calibrating to a Known Thickness using CygLink**

The CygLink display can be calibrated to a known thickness by using the Gauge to measure a sample of the material that will be measured. This method ensures the velocity of sound is set for the actual material being measured rather than using a “generic” value.

1. **Place and hold** the Gauge’s ultrasonic probe on the material sample using couplant if out of the water.
   
   You should have a stable thickness measurement on the display.

2. **Click Gauge -> Calibrate.** With the probe still held on the material sample.
3. Select the value in the Thickness box and enter the known thickness of the sample being measured. Press the **OK** to save and exit.

4. Repeat from step 1 to check the calibration is stable.

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**CygLink Surveys and Data Logging**

CygLink has the facility to store logged thickness measurements in a single Survey file. These measurements are organised into Survey Groups, each Survey Group 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 Groups: (1 to many groups)
- Measurements: (1 to many measurements)
- 1 Survey
Right side of CygLink Main Screen with a Survey Group with Measurements.

You can Save, Open or Create new Surveys from the 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 Details.**
Editing the Survey Group Details

To view and edit the survey Group details select the Survey Group from the top right list and double click to **Edit**.

You can mark the Group as complete by changing its **Completed** status. Once marked as complete you won’t be able to add any further measurements.

To create a new Group click the **+** button in the toolbar at the top right of the Group list, the New Group screen is displayed. Here you can set and related information such as a Reference Thickness and Minimum Thickness. You can also specify linear or grid based logging.

Click the **Pencil** to add a note to the Group.

Click the **X** to delete the Group.

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 first ask you to create a new Group. Further clicks of the **Log** button will then add each thickness measurement to this Group. There is no limit to the amount of measurements that can be added to each Group.
Linear or Grid Data Logging

When you use CygLink to data log measurements you can choose to create a Linear list of measurements or a two-dimensional Grid of measurements.

To create a Grid simply edit the **Record Type** field in the **Survey Group Details** and set it to **Grid**, you can then specify the direction the measurements will be taken in **Grid Type**, and the number of **Rows** and **Columns**.

Reference and Minimum Thickness Criteria

You can set a Reference Thickness and Minimum Thickness for each survey Group in the **Survey Group Details** screen. 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**.

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.
If you double click the selected measurement point you will load the Measurement Details screen.

Here you can edit the **Ref. Thickness** and **Min. Thickness** values.

You can also add a text **Note** or choose one from a list of pre-set comments by clicking on the [...] to the right of the **Notes** field.

The pre-set Comments List
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 ROV gauge is manufactured by KK Systems and uses Prolific drivers. You can search the web for the latest drivers from Prolific;

Type this into Google search “KK SYSTEMS USB232”

Or follow this link directly to the KK Systems website;

Follow the instructions for USB232 Windows Drivers;

Wiring Problems

Sometimes the cable between the ROV gauge and the USB converter is damaged, or has been repaired incorrectly. Although there are only 2 data wires they must be connected the correct way around. Double check the connections from the gauge’s connector to the serial converter connection.

If you have the short serial to USB interface cable – check the gauge 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.
8. **Probes & Membranes**

⚠️ The Gauge should only be used with Soft-Faced probes supplied by Cygnus Instruments.

Cygnus Soft-Faced probes 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.

---

**Probe Selection**

Apart from the physical limitation of the probe size, the diameter of the probe face (crystal) and the frequency affects the probe performance, generally:

- Large diameter probes produce more energy which gives better performance on heavily corroded or coated materials.
- Higher Frequency probes produce a narrower focused beam which is better when looking for small features or on thin materials.
# Changing the Membrane

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Unscrew the Knurled Ring from the end of the Probe</td>
</tr>
<tr>
<td>2.</td>
<td>Use the Locking Ring Key to unscrew the Locking Ring from inside the Knurled Ring. The old membrane can then be removed and discarded</td>
</tr>
<tr>
<td>3.</td>
<td>Place a new membrane into the end of the Knurled Ring ensuring it locates in the groove</td>
</tr>
<tr>
<td>4.</td>
<td>Screw the Locking Ring back inside the Knurled Ring and tighten with the Locking Ring Key</td>
</tr>
<tr>
<td>5.</td>
<td>Place a few drops of Membrane Couplant on to the probe face</td>
</tr>
<tr>
<td>6.</td>
<td>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</td>
</tr>
<tr>
<td>7.</td>
<td>You should see the membrane has a very thin film of couplant between itself and the probe face with no air bubbles</td>
</tr>
</tbody>
</table>
## Probe Selection & Specifications

<table>
<thead>
<tr>
<th>Crystal Diameter</th>
<th>Frequency</th>
<th>Measurement Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 mm (\frac{1}{2}) inch</td>
<td>2¼ MHz</td>
<td>3.0 – 250 mm(^4) 0.12 – 10 inch</td>
<td><strong>This is the standard probe – suitable for most applications.</strong></td>
</tr>
<tr>
<td>13 mm (\frac{1}{2}) inch</td>
<td>3½ MHz</td>
<td>2.0 – 150 mm 0.08 – 6 inch</td>
<td>Suitable for measurement on thinner sections where surfaces are relatively rough</td>
</tr>
<tr>
<td>6 mm (\frac{1}{4}) inch</td>
<td>5 MHz</td>
<td>1.0 – 50 mm 0.04 – 2 inch</td>
<td>The higher frequency and narrower beam makes this Probe ideal for measuring small-bore tubing, thin section plate and other areas where access is limited.</td>
</tr>
<tr>
<td>13 mm (\frac{1}{2}) inch</td>
<td>5 MHz</td>
<td>1.0 – 50 mm 0.04 – 2 inch</td>
<td>Ideal for thin sections without heavy corrosion.</td>
</tr>
</tbody>
</table>

**Lower frequency probes offer better penetration on heavy corrosion/coatings.**

### Probe Frequency Identification

The frequency of Cygnus probes is indicated by colour;

- **Red** = 2.25 MHz
- **Orange** = 3.5 MHz
- **Black** = 5.0 MHz

---

4 To measure thicknesses on tall thin cylinders or columns the height-width ratio should be no less than 1.0:0.6 (Height:Width) otherwise side reflections prevent measurement.
**Mounting the Ultrasonic Probe**

The Ultrasonic Probe is responsible for generating then transmitting and receiving the ultrasonic signal through the material being measured. To ensure the ultrasonic probe has the best chance of detecting the return echoes there are some basic rules that need to be considered when designing the probe holding tooling;

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The probe face must be presented flat/perpendicular to the surface being measured</td>
</tr>
<tr>
<td>2.</td>
<td>Apply gentle pressure to the probe while measuring to maintain contact with the surface</td>
</tr>
</tbody>
</table>

**Cygnus Probe Handling Solutions**

Cygnus Instruments has designed tooling for Work Class ROVs specifically to enable the ultrasonic probe to be held in three or four jaw manipulators whilst offering shock protection and automatic alignment of the probe face.

The Cygnus W1 Work Class Probe Holder

‘T’ and Fishtail Handles allow holding in common manipulator jaws.
9. **Gauge End Plate Removal**

   The Gauge has a removable end cover plate which allows access to the Option Switch and Fuse.

   The End Plate has the pressure relief valve and the securing eye fitted to it (NOT the SubConn® connectors).

   The end cover plate must be removed and re-fitted exactly as directed in this manual. Failure to re-fit the cover plate correctly could result in damage to the Gauge when submerged.

**End Plate Removal Instructions**

| 1. | Place the Gauge on a clean work bench and remove the large O-ring from the outside of the Gauge |
| 2. | Using a 3mm hex drive or Allen key gradually loosen each bolt |
|    | Remove the 12 bolts |
3. The end plate can be removed exposing the Options Switch, Fuse and Status LED

### Changing the Options

The DIP Switch (DS1) is used to set the three options as required. Use a small screwdriver and gently slide the white slider left or right as required. The ON position is to the right (marked ON on the switch).

The default position is all options OFF.

<table>
<thead>
<tr>
<th>Options;</th>
<th>Position</th>
<th>OFF</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS-422</td>
<td></td>
<td>RS-232</td>
</tr>
<tr>
<td>2</td>
<td>2400 Baud</td>
<td>9600 Baud</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Normal</td>
<td>Deep Coat</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(not used)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Changing the Fuse

The Gauge is protected by a 1 Amp anti-surge cartridge fuse. Should you suspect the fuse has blown and wish to replace it a spare fuse is included in the Gauge kit. If you wish to order additional fuses they are available from a Cygnus outlet or larger electronic suppliers.
The fuse is removed with a pair of small needle nose pliers.

Littelfuse, Part No. : 0452001.MRL
Farnell stock number : 992-2342
RS Stock No. : 541-3625

**Testing the Gauge for Operation**

There is a small red Status LED which pulses when the Gauge is operating. You can check the operation of the Gauge by applying power to the Gauge and looking for the LED operation.

When the Gauge is idle the LED will flash at 0.5 second intervals.

When the Gauge is measuring thickness the LED will flash at 0.25 second intervals.

**End Plate Refitting Instructions**

1. Clean the mating faces of the Gauge and the end plate removing any old silicone grease

Check the O-Ring – if it shows any signs of damage or ageing replace it
2. Apply a thin coat of Silicone Grease to the clean mating face of the Gauge

Coat the O-Ring with Silicone Grease and fit in to the end plate groove

3. Fit the end plate to the Gauge ensuring the O-Ring stays in place

Screw the 12 bolts in **finger tight** only.

4. Using a Torque Wrench gradually tighten the 12 bolts in the following sequence;

   12, 6, 3, 9, 1, 7, 11, 5, 2, 8, 10, 4

   Torque Settings;

   **M5-ROV-2K Black Gauge** : 1.3 to 1.5 Nm (max)

   **M5-ROV-4K Silver Gauge** : 2.8 to 3.0 Nm (max)

5. Finally re-fit the large outer O-Ring by rolling over the body
10. General Points on Thickness Gauging

On very rough surfaces and especially if both sides are badly corroded, it is often necessary to move the Probe around to locate a back wall reflector. Sometimes a slight rocking movement can help find reflectors which are otherwise impossible.

Beware that in extreme conditions or if the plate is of poor quality and contains many inclusions the ultrasound will be scattered to such an extent that measurement may not be possible.

Beware that the multiple-echo technique will not work if the front and back surfaces of the material being measured are not close to parallel. Also note that long narrow bars cannot be gauged along their length with the multiple-echo method.

The Gauge should not be used near arc-welding equipment, as this affects its performance.
11. Troubleshooting

**Difficulty obtaining a Reading**

If there is 1 single flashing bar on the display – this means the Gauge is not receiving any echoes:

- Check that the Probe-lead is properly connected to both Probe and Gauge.
- Check the condition of the lead, replace if necessary.

If there is mostly 1 fixed bar plus 1 flashing bar this means that the Gauge is having difficulty obtaining more than one echo:

- Check the Probe and its membrane are properly assembled.

If there are up to 3 fixed bars plus 1 flashing bar, but never any reading – this means the Gauge is receiving unrelated echoes from more than one reflector:

- On heavily corroded areas this is often a problem, try and take measurements in adjacent areas of the same material.
- Check the Gauge and Probe together on a test block, if there is still no reading the Gauge may require servicing.

**If Readings are Erratic or Unstable**

- Check that the Probe-lead is properly connected to both Probe and Gauge.
- Check that the Probe and its membrane are correctly assembled with sufficient couplant between the probe face and membrane.
- Check the Probe-frequency is suitable for the probable minimum thickness of the material being measured. Probe frequencies which are too low cause doubling and tripling of the actual thickness.
12. The 3 Point Check

The most frequent reasons found to cause difficulty getting readings are:

1. **Is the Probe-membrane fitted correctly?**
   - Check that there is a thin layer of oil between the membrane and Probe-face, and with no air-bubbles trapped. See Changing the Membrane on Page 43.

2. **Is the Probe-lead OK?**
   - Check the probe lead is in good condition and is correctly inserted into the Probe and the Gauge. See Connecting the Probe to the Gauge on Page 14

3. **Is the material measurable at all?**
   - Are the front and back faces of the material parallel?
   - Is the material too heavily corroded?
   - Is the material too thin for the Probe being used? (See page 44)

It is often worth confirming that the Gauge is operating OK using a test sample, and also to confirm that the material can actually be measured by ultrasonic multiple-echo thickness measurement.
13. Care and Servicing

Cleaning the Gauge

- Do not use solvents to clean the Gauge
- Do not use any abrasive cleaners

Environmental

- Do not subject the Gauge to temperatures greater than 60°C (140°F)
- Do not store the Gauge and its kit for long periods in conditions of high humidity

Repairs

- Apart from the fuse there are no user serviceable parts inside the Gauge. 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.

Cygnus Gauges are renowned for their reliability, very often problems with getting measurements are simply due to the way the Gauge is being used. See Troubleshooting on Page 51.

However, if you do need to return your Gauge for Repair please let us know the details of the problem, to help us guarantee the best possible service:

- Is the problem of an Intermittent Nature?
- Is there a problem turning the Gauge On? Or a problem with the Gauge turning itself off?
• Does the Gauge consistently give Incorrect or Unsteady Readings?
• Is it not possible to calibrate the Gauge?
## 14. Information

### Technical Specifications

<table>
<thead>
<tr>
<th>General Attributes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>127 mm long x 90 mm diameter (5 in x 3.5 in)</td>
</tr>
<tr>
<td>Weight In Air</td>
<td>Model M5-ROV-2K 900 g (2 lb)</td>
</tr>
<tr>
<td></td>
<td>Model M5-ROV-4K 4100 g (9 lb)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>External 7 to 30 V DC 150mA Supply</td>
</tr>
<tr>
<td>Probe Sockets</td>
<td>SeaCon / SubConn Micro Series 2 Way Connector MCBH2F / MCIL2M</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-10°C to +50°C (14°F to 122°F)</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-10°C to +60°C (14°F to 140°F)</td>
</tr>
<tr>
<td>PRF</td>
<td>602 Hz</td>
</tr>
<tr>
<td>Monitor Outputs</td>
<td>N/A</td>
</tr>
<tr>
<td>Through Coating Measurements</td>
<td>Coatings up to 3 mm thick as standard.</td>
</tr>
<tr>
<td></td>
<td>Coatings up to 20 mm thick in <strong>Deep Coat</strong> mode.</td>
</tr>
<tr>
<td>Materials</td>
<td>Sound Velocity from 2000 m/s to 7000 m/s [0.0800 in/uS to 0.2780 in/uS]</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>Measurement Ranges in Steel:</td>
</tr>
<tr>
<td></td>
<td>2¼ MHz probe 3 mm to 250 mm [0.120 in. to 10.00 in.]</td>
</tr>
<tr>
<td></td>
<td>3½ MHz probe 2 mm to 150 mm [0.080 in. to 6.000 in.]</td>
</tr>
<tr>
<td></td>
<td>5 MHz probe 1 mm to 50 mm [0.040 in. to 2.000 in.]</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.05 mm (±0.002&quot;) High Resolution Mode and measurement &lt;100.0 mm</td>
</tr>
<tr>
<td></td>
<td>±0.1 mm (±0.005&quot;) Low Resolution Mode or measurement &gt;99.95 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.05 mm (0.002&quot;) High Resolution Mode and measurement &lt;100.0 mm</td>
</tr>
<tr>
<td></td>
<td>0.1 mm (0.005&quot;) Selectable. Low Resolution Mode or measurement &gt;99.95 mm</td>
</tr>
</tbody>
</table>

### Display

| Type of Display                  | Remote Display Unit                                           |
| Display Size                     | N/A                                                             |

### Transmitter

| Shape of Pulse                   | Square                                                         |
| Pulse Energy : Voltage (peak-   | 30 V p-p                                                       |

---

5 To use **Deep Coat** mode consult Cygnus Instruments Ltd.
to-peak)
Pulse Energy : Rise Time 25 ns (max)
Pulse Energy : Pulse Duration 110 ns / 135 ns / 230 ns (5 MHz, 3.5 MHz, 2.25 MHz)

**Receiver**

Gain Control  
Automatic Gain Control up to pre-set Maximum Gain value  
Frequency Range  
1.5 MHz to 5.0 MHz (-6dB)

**Other Information**

Data Output and Storage.  
RS-422 or RS-232 serial data output, 2400 or 9600 Baud  
Power & Data Connector  
SeaCon / SubConn Micro Series 6 Way Connector MCBH6M / MCIL6F  
Calibration setting storage.  
Calibration performed at Remote Display Unit  
Calibration Mechanisms.  
N/A (Multiple Echo Gauge)  
Display & Recall Facilities.  
N/A  
Display Response Time.  
250ms/500 ms  
Printer Output.  
N/A  
Environmental Rating.  
Model M5-ROV-2K  
IP68 Rated to 2000m (6,562 ft) continuous immersion in sea water  
Model M5-ROV-4K  
IP68 Rated to 4000m (13,123 ft) continuous immersion in sea water  
Compliance.  
RoHS Compliant.  
BS EN 15317:2000

**Design Pressure Test Certificates**

<table>
<thead>
<tr>
<th>Model</th>
<th>Certificate Details</th>
</tr>
</thead>
</table>
Test Date : 19/01/2011  
Certificate Number : PTC893  
Test Pressure : 300 bar |
| M5-ROV-4K   | Testing Company : MacArtney, Aberdeen  
Test Date : 02/09/2010  
Certificate Number : 1923  
Test Pressure : 600 bar |
15. Serial Data Format

The CygLink program and TSR are provided to automatically decode the measurement data sent from the Gauge, and to provide a calibrated display of the results. For users who want to display and log the data using their own software such as StarFix®, this section describes the arrangement of the data sent from the Gauge.

Note the ROV Gauge has a fixed Velocity of Sound value of 6400 m/s, you must re-scale the received thickness value for the velocity of sound required.

For example when measuring carbon steel with a velocity of 5920 m/s you will need to apply the following conversion factor;

\[
\text{True Thickness} = \text{Received Thickness} \times \frac{5920}{6400}
\]

Protocol

1. Unidirectional - Gauge transmits only
2. Eight Data bits, 1 Start bit, 1 Stop bit, No Parity; 2400 baud
3. Four packets per second
4. Valid-Reading packet-length : 7 bytes
5. No-Reading packet-length : 3 bytes

Valid Thickness Measurement Packet Arrangement

<table>
<thead>
<tr>
<th>Byte</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>SOH</td>
<td>Status</td>
<td>Data1</td>
<td>Data2</td>
<td>Data3</td>
<td>Data4</td>
<td>ETB</td>
</tr>
<tr>
<td>Type</td>
<td>1h</td>
<td>ASCII</td>
<td>ASCII</td>
<td>ASCII</td>
<td>ASCII</td>
<td>ASCII</td>
<td>17h</td>
</tr>
</tbody>
</table>

No Thickness Measurement Packet Arrangement

<table>
<thead>
<tr>
<th>Byte</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>SOH</td>
<td>Status</td>
<td>ETB</td>
</tr>
<tr>
<td>Type</td>
<td>1h</td>
<td></td>
<td>17h</td>
</tr>
</tbody>
</table>
**Status-byte Structure**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Gauge Type</td>
<td>=1 (always)</td>
</tr>
<tr>
<td>6</td>
<td>Resolution</td>
<td>1 = High Resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Low resolution</td>
</tr>
<tr>
<td>5</td>
<td>Units</td>
<td>0 = Metric mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Imperial Inch</td>
</tr>
<tr>
<td>4</td>
<td>Reading Range</td>
<td>1 = High Range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Low Range</td>
</tr>
<tr>
<td>3, 2</td>
<td>Echo Count</td>
<td>Number of echoes found (0..3)</td>
</tr>
<tr>
<td>1</td>
<td>Calibration</td>
<td>1 = Remote (always)</td>
</tr>
<tr>
<td>0</td>
<td>No-Reading</td>
<td>1 = No Thickness Reading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Valid Thickness Reading</td>
</tr>
</tbody>
</table>

**Data-bytes Arrangement**

The four data bytes are ASCII-encoded, decimal thickness value. Data byte 0 is most-significant. Leading-zeroes are replaced by ASCII Space [hex 20]. Decimal points are implied from the Status-byte – Units, Resolution and Range bits:

<table>
<thead>
<tr>
<th>Reading-type</th>
<th>Hi-Range</th>
<th>Lo-Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperial, Lo-Resolution</td>
<td>xx xxx</td>
<td>x xx xx</td>
</tr>
<tr>
<td>Metric, Lo-Resolution</td>
<td>xx xx x</td>
<td>x xx x x</td>
</tr>
<tr>
<td>Imperial, Hi-Resolution</td>
<td>xx . xx</td>
<td>x xx xx</td>
</tr>
<tr>
<td>Metric, Hi-Resolution</td>
<td>xx xx x</td>
<td>x xx xx</td>
</tr>
</tbody>
</table>

**Interpreting the Readings sent from the Gauge**

<table>
<thead>
<tr>
<th>Decimal Point position</th>
<th>Decimal Point position is implied from the combination of Range, Resolution, and Units bits in the Status byte of each Reading [see table above]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>The Gauge returns all Readings in a 4-byte decimal string Readings which require 5-bytes [e.g. 100.00+mm, or 10.000+inch] are auto-ranged to the 4 most significant bytes Range bit for every Reading must be read from the</td>
</tr>
<tr>
<td></td>
<td>Status-byte</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Resolution</td>
<td>The Gauge is factory set to Lo-Resolution setting: 0.1 mm, or 0.005 inch but may be changed by the user to Hi-Resolution setting: 0.05 mm, or 0.002 inch as required</td>
</tr>
<tr>
<td>Units</td>
<td>The Gauge has a default Metric Units-setting. The Units bit must be read from the Status-byte</td>
</tr>
</tbody>
</table>
16. **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 compression wave velocity \( c_l \).

<table>
<thead>
<tr>
<th>Material</th>
<th>Velocity of Sound (V)</th>
<th>Conversion Factor (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{m/s} )</td>
<td>( \text{in/us} )</td>
</tr>
<tr>
<td>Aluminium (alloyed)</td>
<td>6380</td>
<td>0.2512</td>
</tr>
<tr>
<td>Aluminium (2014)</td>
<td>6320</td>
<td>0.2488</td>
</tr>
<tr>
<td>Aluminium (2024 T4)</td>
<td>6370</td>
<td>0.2508</td>
</tr>
<tr>
<td>Aluminium (2117 T4)</td>
<td>6500</td>
<td>0.2559</td>
</tr>
<tr>
<td>Brass (CuZn40)</td>
<td>4400</td>
<td>0.1732</td>
</tr>
<tr>
<td>Brass (Naval)</td>
<td>4330</td>
<td>0.1705</td>
</tr>
<tr>
<td>Brass (CuZn30)</td>
<td>4700</td>
<td>0.1850</td>
</tr>
<tr>
<td>Copper</td>
<td>4700 - 5000</td>
<td>0.1850 – 0.1969</td>
</tr>
<tr>
<td>Grey Cast Iron</td>
<td>4600</td>
<td>0.1811</td>
</tr>
<tr>
<td>Inconel</td>
<td>5700</td>
<td>0.2244</td>
</tr>
<tr>
<td>Lead</td>
<td>2150</td>
<td>0.0846</td>
</tr>
<tr>
<td>Monel</td>
<td>5400</td>
<td>0.2126</td>
</tr>
<tr>
<td>Nickel</td>
<td>5630</td>
<td>0.2217</td>
</tr>
<tr>
<td>Phosphor Bronze</td>
<td>3530</td>
<td>0.1390</td>
</tr>
<tr>
<td>Mild Steel</td>
<td>5920</td>
<td>0.2331</td>
</tr>
<tr>
<td>Tool Steel</td>
<td>5870</td>
<td>0.2311</td>
</tr>
<tr>
<td>Stainless Steel 302</td>
<td>5660</td>
<td>0.2228</td>
</tr>
<tr>
<td>Stainless Steel 347</td>
<td>5790</td>
<td>0.2279</td>
</tr>
<tr>
<td>Stainless Steel 314</td>
<td>5715</td>
<td>0.2250</td>
</tr>
<tr>
<td>Stainless Steel 316</td>
<td>5750</td>
<td>0.2264</td>
</tr>
</tbody>
</table>
### 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] :

\[
T = t \times \frac{V_{\text{Copper}}}{V_{\text{Steel}}} \\
= t \times \frac{4700}{5920} \\
= t \times 0.794
\]

thus: \[ T = t \times f \]  

where:

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

The **Conversion Factor** \( f \) is given for various materials in the **Table of Sound Velocities**
17. Accessories List

Underwater Probes with 5 Meter Lead

All probes are fully assembled and include a spare membrane pack and knurled ring locking key.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-9393</td>
<td>ROV Remote Probe 2.25 MHz 13 mm (1/2”)</td>
</tr>
<tr>
<td>001-9395</td>
<td>ROV Remote Probe 2.25 MHz 19 mm (3/4”)</td>
</tr>
</tbody>
</table>

Lower frequency probes offer better penetration on heavy corrosion/coatings. Please refer to page 44 for correct probe selection.

Probe Spares and Membranes

Polyurethane Membranes are for normal use on surface temperatures up to 75°C.
Teflon Membranes are for use on surface temperatures up to 150°C

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-3702</td>
<td>Standard Membranes (Polyurethane) (20pk) 6 mm (1/4”’)</td>
</tr>
<tr>
<td>001-3701</td>
<td>Standard Membranes (Polyurethane) (20pk) 13 mm (1/2”)</td>
</tr>
<tr>
<td>001-3700</td>
<td>Standard Membranes (Polyurethane) (20pk) 19 mm (3/4”)</td>
</tr>
<tr>
<td>001-4873</td>
<td>Teflon Membranes (10pk) (High Temperature) 6 mm (1/4”)</td>
</tr>
<tr>
<td>001-4874</td>
<td>Teflon Membranes (10pk) (High Temperature) 13 mm (1/2”)</td>
</tr>
<tr>
<td>001-4875</td>
<td>Teflon Membranes (10pk) (High Temperature) 19 mm (3/4”)</td>
</tr>
<tr>
<td>001-3706</td>
<td>Membrane Couplant</td>
</tr>
</tbody>
</table>

Knurled Rings

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-2611</td>
<td>Probe Knurled Ring Locking Key 13 mm (1/2”)</td>
</tr>
<tr>
<td>001-2610</td>
<td>Probe Knurled Ring Locking Key 19 mm (3/4”)</td>
</tr>
<tr>
<td>001-3704</td>
<td>Probe Knurled Ring Assembly 13 mm (1/2”)</td>
</tr>
<tr>
<td>001-3705</td>
<td>Probe Knurled Ring Assembly 19 mm (3/4”)</td>
</tr>
</tbody>
</table>

Cables and Leads

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-0431</td>
<td>SeaCon 6way In Line Socket with flying lead</td>
</tr>
<tr>
<td>001-0430</td>
<td>Test Cable (SeaCon 6way In Line Socket to DC power connections and Lemo/9D connectors)</td>
</tr>
</tbody>
</table>
## Electronic Bodies Only

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-7189/5</td>
<td>Cygnus ROV Mountable 2000m Gauge Body</td>
</tr>
<tr>
<td>001-7191/5</td>
<td>Cygnus ROV Mountable 4000m Gauge Body</td>
</tr>
<tr>
<td>001-7182/4</td>
<td>Cygnus Topside Repeater Display Unit with OSD</td>
</tr>
</tbody>
</table>

## Miscellaneous Spares

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-4850</td>
<td>Steel Test Block 15 mm</td>
</tr>
<tr>
<td>001-4851</td>
<td>Steel Test Block 1/2&quot;</td>
</tr>
<tr>
<td>001-4852</td>
<td>Coated Test Block</td>
</tr>
<tr>
<td>001-4856</td>
<td>Carbon Steel Step Block 5-25mm in 5mm steps set in Perspex supplied with material type and dimensional accuracy traceable certificate.</td>
</tr>
<tr>
<td>001-8308</td>
<td>'K3’ RS-232 to RS-422 Isolated Converter</td>
</tr>
<tr>
<td>003-0422</td>
<td>RS-232 to USB Converter</td>
</tr>
<tr>
<td>001-3719</td>
<td>Spares Kit (O Rings, Silicone Grease, Fuses)</td>
</tr>
</tbody>
</table>

## Carry Case

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-4813-ROV</td>
<td>Pelican Carry Case for Cygnus ROV Gauge Kit</td>
</tr>
</tbody>
</table>

## Software

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-8212</td>
<td>CygLink Topside Data Logging Program for Windows</td>
</tr>
</tbody>
</table>
18. 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.
19. Schematic for RS-422 to Computer USB
20. Schematic for RS-232 to Multiplexer
21. Schematic for RS-232 to Multiplexer to TSR
22. Schematic for RS-422 to TSR
23. Index

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