



PORTAGAUGE® 4 USER MANUAL





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I. Introduction and key features

What does the Portagauge[®] do?

The Portagauge[®] 4 is a portable, robust device used to accurately measure the thickness of a material using multiple echo, ultrasonic technology. The Portagauge[®] 4 is capable of working across a large number of different applications and environments, whether this be different surface conditions, the presence of rust, small curvature surfaces or for any other maintenance and inspection requirement. The unit operates on a wide range of metal materials (Steel/ Stainless Steel, Cast Iron, Aluminium, Copper, Brass, Zinc, Grey Cast Iron).

Due to its use of ultrasonic methods, the Portagauge[®] 4 only needs access to one side of a surface to measure the thickness of the material. This enables the device to non-invasively measure the wall thickness of metal pipes, tanks, beams and other such structures without any risk of damage.

The Portagauge[®] 4

The Portagauge[®] 4 is the most advanced and accurate model of the Portagauge[®] range. Its use of multiple echo ultrasonic technology allows it to account for coatings of up to 20 mm, ensuring that they are not included in the measurement of the thickness of the material. Its design and function has been built on earlier models to achieve this accuracy as well as its durability and consistency. The enclosure is rated to IP 65 providing a high level of protection in even hard industrial environments.

The Portagauge® 4

Display: Color LCD display for access to the Measuring screen and Menu screen.

Left Option Key: Selects the option at the bottom left of the LCD screen

ON/OFF Button Simple power ON/OFF button – powered by 3 x 1.5V AA batteries providing approximately 20 hours of battery life. Keep turned off when not in use to save battery life

Battery Compartment: The battery compartment is at the back of the unit. It must be opened by a flat head tool

Measuring Screen

Units of Measurements: The units of the measurements can be changed (inch/mm) by navigating to the “Units” section of the menu

Echo Strength: The greater the number of bars the greater the strength of the returning signal

Velocity of Ultrasound: Indicates the velocity of the ultrasound travelling through the material



Lemo Connector: Allows for secure fastening of the cable for the sensor probe.

Right Option Key: Selects the option at the bottom right of the LCD screen

Directional Pad: The directional pad allows the items on the menu and sub-menus to be navigated using the left, right, up and down keys and selected using the Enter/OK key at the centre

Menu Button: Accesses the menu for the unit (see page 5 for more information on menu items).

Sealing: Black rubber sealing for watertight integrity IP 65



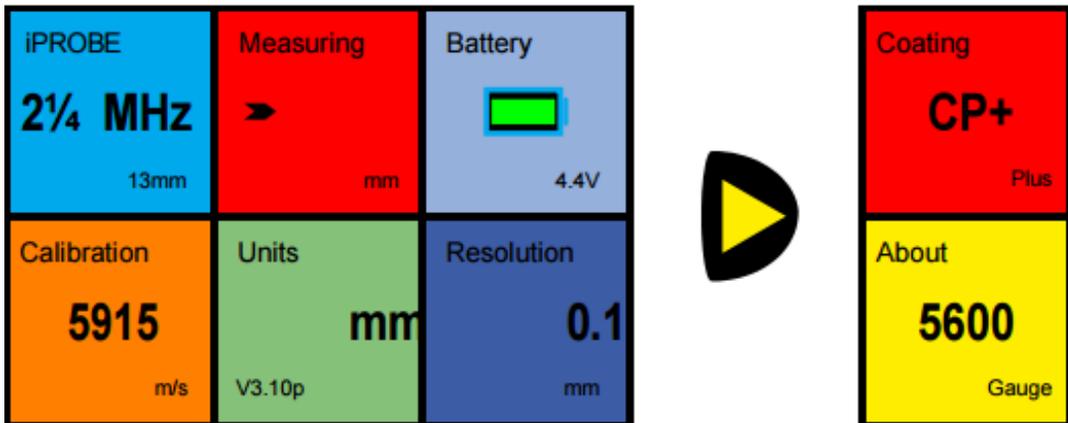
Digital Display: Numerical readings allow users to determine the thickness of the material

BAT OK: Checks battery level

iProbe indicator: Indicates the type of probe connected

Hold Measurement: Fixes the last thickness reading on the screen when the Left Option Key is pressed

Definition of Menu Items



- iProbe** — Shows that an iProbe has been connected. The probes are automatically recognised by the gauge and all the relevant probe data is transferred to the gauge to perfectly match the probe to the gauge for optimum performance.
- Calibration** — All materials have varying velocity of sound properties and this section allows the gauge to be calibrated for the different materials that the gauge can measure.
- Measuring** — Displays the measurements being taken by the gauge.
- Units** — The measurements can be displayed in metric or imperial.
- Battery** — Displays the remaining battery life. The green changes to yellow when the battery is getting low and then changes to red when the batteries are critically low.
- Resolution** — The measurements can be displayed to a resolution of 0.05mm or 0.1mm.
- Coating Plus+** — Allows measurements to be taken through extremely thick coatings up to 20mm, depending on the type of coating. In normal mode the gauge can still ignore up to 6mm of coating.
- About 5600** — Displays the software and firmware versions and includes a facility to reset the gauge to factory settings.

Note: The “Coating Plus” and “About 5600” menu items may be found by pressing the right key on the directional pad.

How does a Portagauge[®] 4 work?

All sound is physical vibrations which move through a material, and in the case of the sound we are used to, the vibrations move through air. Ultrasound is the same as the sound we experience, but its frequency is beyond that which humans are capable of hearing. Whilst the highest frequency a human can hear is around 20,000 Hz, Portagauge[®] 4 units use sound at a frequency of 2.5 MHz, 3.5 MHz or 5 MHz depending on the specific probe being used.

All Portagauge[®] devices use ultrasound to measure the thickness of a material. The unit sends a strong electrical signal to the probe, causing it to emit a high energy pulse of ultrasound. The transmitted ultrasound pulse travels through both the coating and the metal and reflects from the back wall. The returned echo then reverberates within the metal, with only a small portion of the echo travelling back through the coating each time (Figure 1). The timing between the small echoes gives the timing of the echoes within the metal, which relate to the metal thickness. The returned echoes need not be consecutive as the gauge will interpret them automatically and calculate the thickness. A minimum of three echoes are checked for each pulse that is sent into the metal.

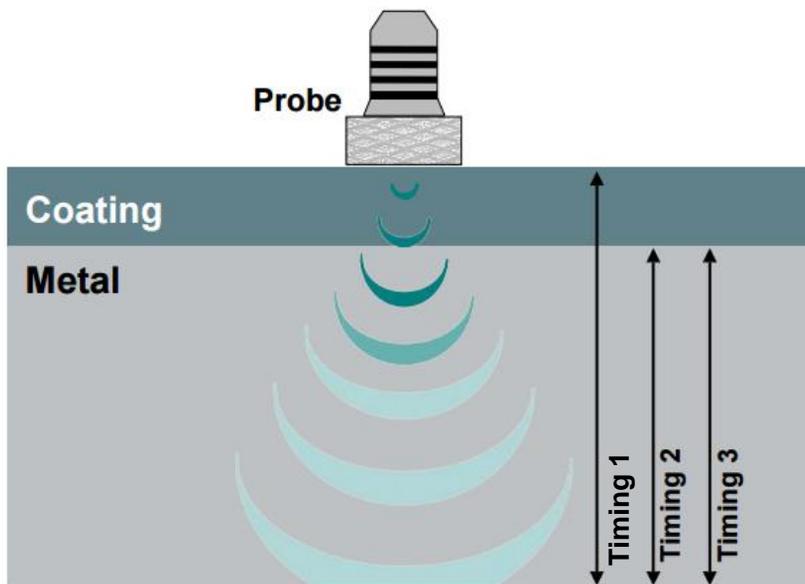


Figure 1



2. Operating Instructions

DO NOT PROCEED BEFORE READING SECTION I.

There are two basic procedures which must be carried out when using the Portagauge[®] 4:

1. Preparation: Calibration ensures that the Portagauge[®] equipment functions properly for the specific metal being tested.

2. Testing: After step one, you can follow the appropriate testing procedure.



I. PREPARATION

Preparation for testing is simple, quick and ensures you get the most reliable and accurate results from your testing. It ensures the equipment is assembled correctly and that the appropriate probe is selected. Calibration ensures that the unit and probe work correctly for the specific metal being tested.

Assembly

To assemble the gauge for use:

STEP 1: Attach the probe to the probe cable by pushing the cable Lemo plug into the socket on the probe.

STEP 2: Connect the other end to the gauge Lemo socket (see page 4).

To remove the connectors, simply pull back on the connector collars to release the plug from the socket. Do not force or twist under any circumstances.

Probes

The probes used with the Portagauge® 4 thickness gauges are single crystal soft faced probes. The table below identifies the different probe options and which probe is the most suitable for different applications. All probes are color coded to help identify their frequency.

| Frequency | 2.25 MHz | 3.5 MHz | 5 MHz |
|----------------------------|--|--|--|
| Measuring Range | 3 – 250 mm (0.120” to 10”) | 2 – 150 mm (0.080” to 6”) | 1 – 50 mm (0.040” to 2”) |
| Color | Yellow | Green | Blue |
| Diameters Available | 13 mm (0.5”) & 19 mm (0.75”) | 13 mm (0.5”) | 6 mm (0.25”) & 13 mm (0.5”) |
| Suitable For | Most thickness gauging applications. Works particularly well on heavy corrosion, especially the 19 mm probe. | Will measure relatively thin metal which is corroded. Normally used only if measuring down to 2 mm is of importance. | Ideal for measuring thin metal in relatively good condition. Not advisable to use as main probe. |

Note: The details of the probe connected are recognized and displayed on the Measuring Screen, as seen on page 4, or under the iProbe item on the Menu, as seen on page 5.

Probe Membranes

All probes are fitted with protective membranes to help prolong the life of the probe. The membranes also provide a flexible interface which acts as an aid when working on rough surfaces. Membrane wear should be monitored and checked at regular intervals.

Normal Temperature Membranes

Standard membranes allow measurements to be taken on hot surfaces up to a maximum of 158°F (70°C).

High Temperature Membranes

Teflon™ membranes are available for measurements on hotter surfaces. In this case measurements can be taken on surfaces up to 302°F (150°C). Care should be taken that the probe does not overheat. The probe should be allowed to cool down in between each measurement. A high temperature ultrasonic gel is advised for this application.

Note: All probes should be treated with care. When taking measurements, they should not be scraped or dragged along the surface. Although the membranes will protect the probe against everyday wear and tear, they will not protect against rough treatment and misuse.

Calibration

The gauge should be calibrated to the type of material that is being measured. This is because ultrasound travels at different speeds in different materials.

There are two methods of changing the calibration. Either adjust the velocity of sound setting according to the metal being measured, or adjust the gauge to a known thickness of metal.

Gauges are supplied with the calibration set to mild steel at approximately 5900 m/s. This may vary according to the properties of the supplied 15 mm test block material.

Calibrating to the Velocity of the Ultrasound

STEP 1: Navigate to 'Calibration' on the 'Menu' screen using the keys on the directional pad (see page 4). Use the *Definition of Menu Items* on page 5 as a guide.

STEP 2: Press the 'OK' button at the centre of the directional pad.

STEP 3: Use the left and right buttons on the directional pad to adjust the velocity of sound to the required new velocity that the ultrasound travels at in the material being tested. Approximate values for these may be found on page 11.

STEP 4: Press the 'Right Option Key', the gauge will save the new calibration and return to the 'Menu' screen.

Calibrating to a Known Thickness

STEP 1: Navigate to 'Calibration' on the 'Menu' screen using the keys on the directional pad. Use the *Definition of Menu Items* on page 5 as a guide.

STEP 2: Press the 'OK' button at the centre of the directional pad.

STEP 3: Place the probe on a piece of material of known thickness such as the 15mm test block supplied with the kit.

STEP 4: Adjust the measurement displayed to the known thickness using the left and right buttons on the directional pad.

STEP 5: Press the 'Right Option Key', the gauge will save the new calibration and return to the 'Menu' screen.

Note: The calibration does not need to be reset each time the gauge is used. The last setting will be remembered.

Speed Table

The given values are in certain cases strongly dependent on the alloy, heat treatment, manufacturing and processing and are therefore only approximate standard values. They are given here as a guide only.

| Material | Speed – m/s |
|---------------------|--------------|
| Aluminium | 6200 – 6360 |
| Rolled | 6420 |
| Duraluminium | 6320 |
| Bronze (5%P) | 3531 |
| Copper | 3666 – 4760 |
| Glass, Plate | 5766 |
| Inconel, Forged | 7820 |
| Lead | 2050 – 2400 |
| Steel, Mild | 5890 – 5960 |
| Supplied Test Block | 5900 approx. |
| Steel, Stainless | 5530 – 5790 |
| 10 Cr Ni 18 8, ann | 5530 |
| Steel, Tool | |
| C105 Annealed | 5490 – 5960 |
| C105 Hardened | 5854 |
| Tin | 3210 – 3320 |
| Titanium | 5823 – 6260 |
| Zinc | 3890 - 4210 |

Reference: Mathies, Klaus (1998), Thickness Measurement with Ultrasound, Berlin: German Society of Nondestructive Testing.



2. TESTING with the Portagauge® 4

PRECAUTIONS:

Check that the material has parallel front and back walls. If the front and back walls are not parallel, the ultrasound hitting the back wall will be deflected away from the face of the probe. The probe will therefore not receive any echoes back.

The surface being measured should be free from dirt or debris. It may be necessary to clean or brush the surface prior to taking measurements.

Ensure the coating is not layered or does not contain foreign objects in its construction. Layered coatings cause reflections at the layer interface. This seriously weakens the strength of the ultrasound and may prevent it from travelling all the way through. The same applies to foreign objects which can deflect the ultrasound path or prevent the ultrasound from passing.

Ensure the coating is solidly adhered to the surface. Triple echo will ignore coatings as long as they are solidly adhered to the surface. If the coating has become loose or delaminated then air pockets will exist which interfere with the Ultrasound.

PROCEDURE:

STEP 1: Unscrew the probe knurled ring and apply a few drops of membrane oil to the face of the probe. Do not apply too much membrane oil underneath the membrane. Once fitted, the membrane should be flat with no air bubbles trapped behind.

STEP 2: Re-screw the knurled ring, ensuring there are no air pockets.

STEP 3: Connect the probe, cable and gauge together (see page 8).

STEP 4: Turn on the gauge using the ON/OFF button (see page 4).

Note: If a compatible probe other than an SDi probe is attached to the unit, the gauge will automatically detect this and display the message “Unrecognised Probe”. If this occurs press the “OK” button and then select the correct parameters (frequency and diameter) for the probe being used.

STEP 5: The normal measurement mode will ignore coatings of up to approximately 6 mm. If a coating between 6 mm to 20 mm exists then the Coating Plus+ mode, accessed by navigating to the right of the Menu screen (see page 5) using the arrow keys on the directional pad and selecting the feature using the ‘OK’ button, can be turned on to measure the metal thickness in such cases.



Note: If the message “No Probe connected” appears, either connect a suitable probe or simply press the “OK” button to enable the navigation of the menus without a probe fitted. No measurements can be taken if a probe is not detected.

The Coating Plus+ feature is automatically switched off when the unit is turned off. If this feature is required permanently, press the ‘Right Option Key’ labelled “SAVE” to keep this as a permanent setting. The CP+ icon will be displayed on the right of the Measuring screen if the feature is selected.

Note: The Coating Plus+ mode should not be left on for all measurements. The gauge will achieve a better performance on standard coatings with this function turned off.

STEP 6: Navigate using the arrow keys on the directional pad to the ‘Measuring’ item on the Menu screen. Press the ‘OK’ button to access the Measuring screen.

STEP 7: Apply a small amount of gel to the surface being measured to eliminate the possibility of air pockets between the surface and the probe.

STEP 8: Apply the probe firmly to the surface, ensuring good contact, and take the measurement. It may sometimes be necessary to rock the probe slightly and gently in order to obtain measurements (only do so if you are having trouble obtaining measurements).

STEP 9: If you wish to hold a measurement, press the ‘Left Option Key’ whilst readings are being taken. The display will hold the measurement and flash ‘Holding’ in the top right corner of the LCD screen. Measuring may be resumed by pressing the ‘Left Option Key’ again which is now labelled “Resume”.

STEP 10: Remove debris from the probe face between measurements.

Note: The units and resolution of measurements can be changed using the respective options on the Menu screen (see page 5).

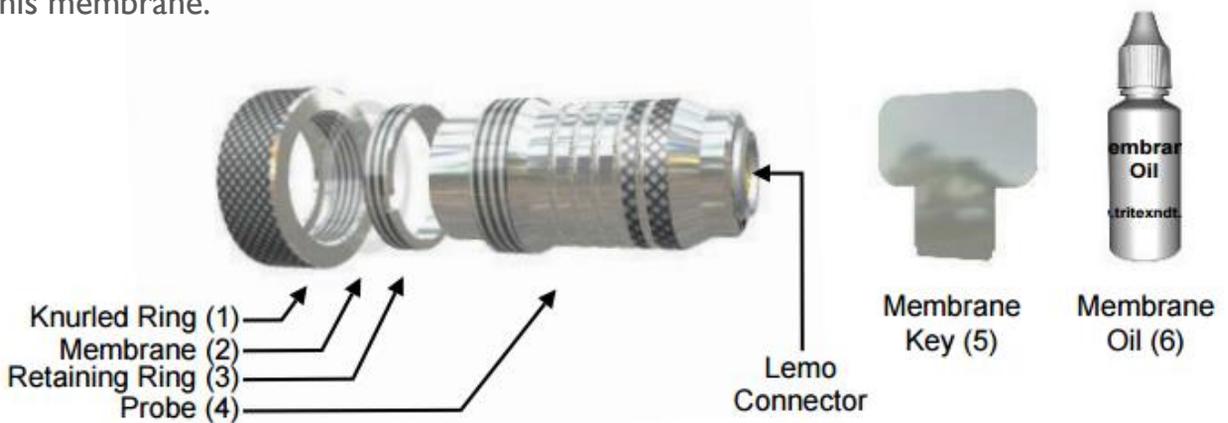
3. Maintenance

This section contains instructions on how to maintain the equipment to extend its lifetime as long as possible. Maintenance of the equipment is simple and only requires the cleaning of the probe and battery care. For any major works or re-calibrations the unit can may need to be sent to the manufacturer for repair.

Probe Care

The ultrasonic probe is the most delicate part of a Portagauge®, and care must be taken when using it. After using a Portagauge®, it is essential to ensure that the probe is dried off and free from dirt. The probe is robust, but damage may occur if it is dropped, or if the probe is dragged across the surface rather than being removed and replaced. Never try to repair a probe or try to remove scratches from the face of the probe. This may result in further damage. Always return it to SDi for investigation and possible repair.

The membrane requires changing from time to time to ensure the protection of the probe and the prolonging of its lifetime. See below for instructions on how to change this membrane.



STEP 1: Unscrew the knurled ring (1) from the probe (4).

STEP 2: Using the membrane key (5), remove the retaining ring (3) from inside the knurled ring (1).

STEP 3: Push the old membrane (2) out from the front.

STEP 4: Fit a new membrane (2) from the back and push it down until it locates in the groove on the inside front edge.

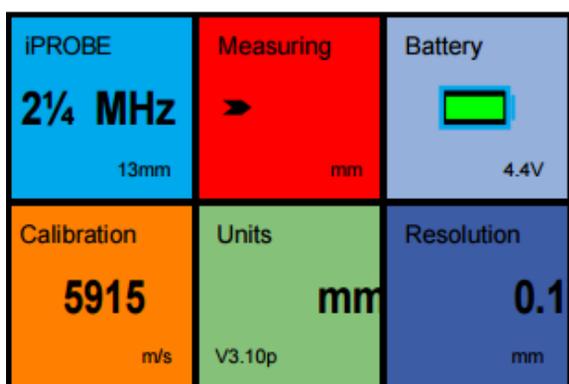
STEP 5: Refit the retaining ring (3) and secure it in place using the membrane key (5).

STEP 6: Place a few drops of membrane oil (6) onto the face of the probe (4). Do not use too much.

STEP 7: Screw the knurled ring (1) back onto the probe (4) whilst applying pressure on the membrane (2) with the thumb to expel any air from behind the membrane.

Battery Care

The Portagauger[®] 4 has a battery indicator on the right of the 'Measuring' screen and on the top right of the 'Menu' screen.



When the battery is indicated to be low on power, the battery must be replaced before it is used further, or the unit may provide anomalous results.

When a Portagauger[®] unit is going to be stored, or not used for a long period of time, remove the battery from the main unit to prevent corrosion damage to the unit.

Battery Replacement

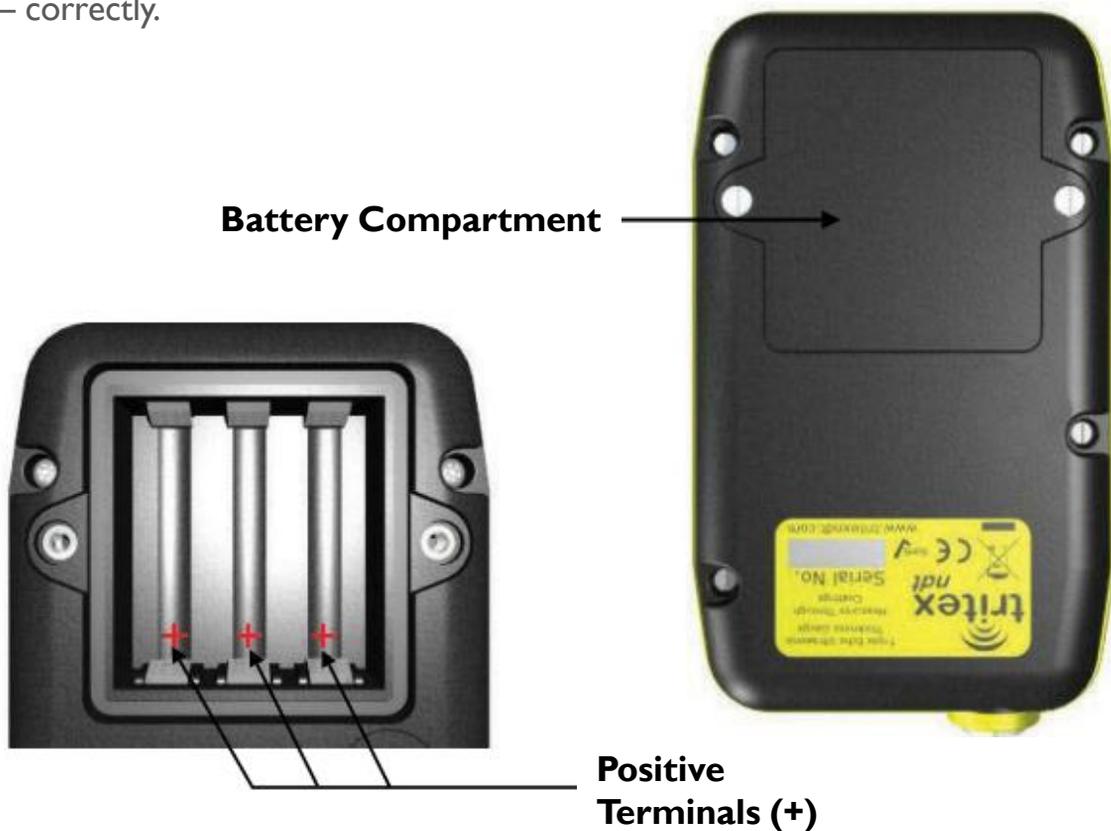
You will need a small flathead screwdriver and three 1.5V AA batteries.

STEP 1: Ensure the unit is off and turn the unit so that the front fascia faces downwards.

STEP 2: Take a small, flat head screwdriver and unscrew the two screws holding down the hatch of the battery compartment.

STEP 3: Lever the screwdriver gently to remove the hatch.

STEP 4: Remove the old batteries and replace with the new, taking care to connect + and – correctly.



STEP 6: Close battery cover, ensuring that the wires are not trapped.

STEP 7: Press battery hatch and use the screwdriver to replace the screws so that the hatch of the battery compartment is closed once again..