

Ultrasonic Thickness Gauge

**Multigauge 3000
Underwater Thickness Gauge
User Manual**



simple . accurate . robust

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1. Introduction

Thank you for purchasing a Tritex Multigauge 3000 Underwater Gauge. We are sure that the gauge will give you many years of reliable use. To ensure that you can gain maximum benefit from the gauge, please read this manual carefully.

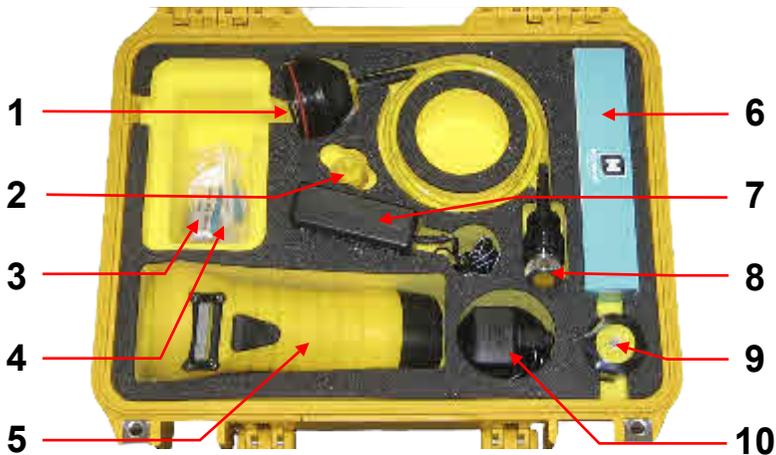
The Multigauge 3000 Underwater Gauge is a simple, robust ultrasonic thickness gauge designed for most common underwater thickness gauging applications. The gauge is pressure tested to 500m and has the option to transfer measurements to the surface to be displayed on a topside repeater with the simple addition of a replacement end cap. The gauge is durable and extremely easy to use.

The Tritex Multigauge 3000 UW has been manufactured to comply with British Standard BS EN 15317:2007, which covers the characterisation and verification of ultrasonic thickness measuring equipment.

1.1. Multigauge 3000 Underwater Specification Table

Sound Velocity Range	<i>From 1000 m/s to 8000 m/s (0.0394 in/μs to 0.3150 in/μs)</i>		
Single Crystal Soft Faced Probe Options	2.25 MHz	3.5 MHz	5 MHz
Probe Measurement Range	3 - 250 mm (0.120" to 10")	2 - 150 mm (0.080" to 6")	1 - 50 mm (0.040" to 2")
Probe Sizes	13 mm (0.5") & 19 mm (0.75")	13 mm (0.5")	13 mm (0.5")
Resolution	0.1 mm (0.005") or 0.05 mm (0.002")		
Accuracy	± 0.1 mm (0.005") or ± 0.05 mm (0.002")		
Display	Red 4 character seven segment LED		
Depth Rating	500 Metres		
Battery	1 x Rechargeable 7.2V 2.3Ah NiMH battery pack		
Battery Life	55 Hours continuous use.		
Gauge Dimensions	235 mm x 80 mm (9.25" X 3.15")		
Gauge Weight	1110g (38.85 ounces) fully assembled		
Environmental	Case rated to IP65. RoHS and WEEE compliant		
Operating Temperature	-10°C to +50°C (14°F to 122°F)		
Storage Temperature	-10°C to +60°C (14°F to 140°F)		

2. Kit Contents



Key:

- 1 - Nose Cone -** Screws onto the gauge body (pg 7).
- 2 - Membrane Oil -** 15 ml.
- 3 - Test Block -** The 15 mm test block is used to test the performance and serviceability of the gauge.
- 4 - Membranes / Key-** See page 13 for fitting instructions. Pack of 10 supplied.
- 5 - Gauge Body -** See page 6 for further details.
- 6 - Molykote Grease -** Applied to the O-rings to ensure water tightness (pg 7)
- 7 - Charger -** Fast charges in approximately 2 hours (pg 10).
- 8 - Probe -** See page 11 for further details.
- 9 - Spare Battery -** Optional Extra. One battery is supplied fitted in the gauge.
- 10 - Charger Lead -** Supplied as either UK, USA or European plug types.
- Other Accessories -** Nose cone release bar, O-rings (front and back), manual, calibration certificate and 3 year warranty certificate.

3. Getting Started

3.1. Quick Start Guide

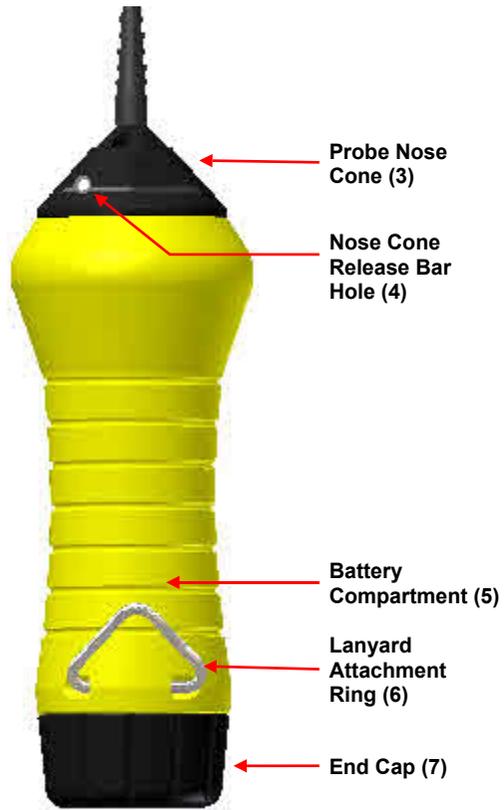
Following is a quick start guide to help you get a feel for the gauge without reading the entire manual. For a more detailed explanation of each of these steps, please read the full manual.

1. Unscrew the probe knurled ring and apply a few drops of membrane oil to the face of the probe. (Pg 9)
2. Screw the knurled ring back onto the probe ensuring no air has been trapped and the membrane is flat to the probe face. (Pg 9)
3. Ensure the 'O' rings are properly fitted to the probe nose cone with Molykote grease applied (Pg 5)
4. Screw the nose cone onto the main body so that it is fully seated and finger tight.
5. Ensure the 'O' rings are properly fitted to the main body, at the bottom of the gauge, with Molykote grease applied (Pg??)
6. Screw the end cap onto the main body so that it is fully seated and finger tight.
7. Turn the gauge on using the 'ON/OFF' switch. (Pg 11)
8. Apply a tiny amount of membrane oil or other suitable couplant to the test piece.
9. Place the probe onto the test piece.
10. A measurement will be displayed.
11. The gauge is now ready to take underwater.

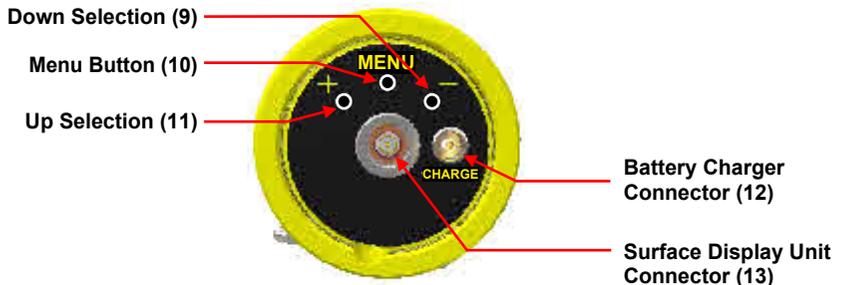
4. Getting to know your Multigauge 3000 UW

Front

Back



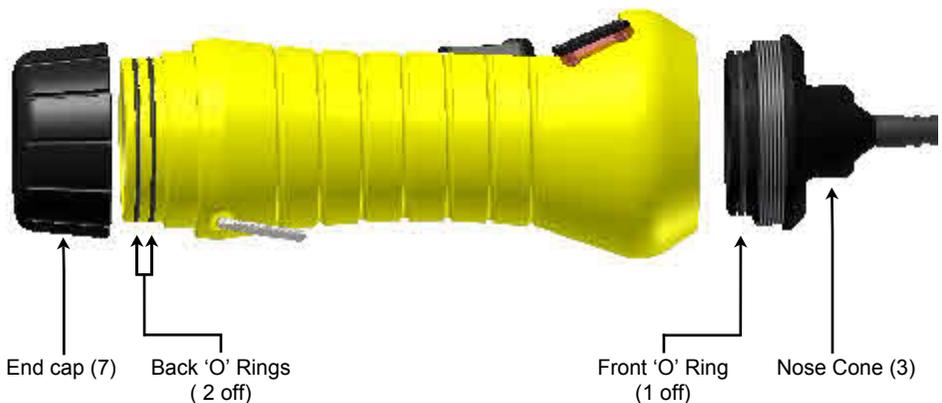
Control Panel (8)



4.1. Assembly

To assemble the gauge for use:

Note: 'O' rings must be fitted in the correct positions with Molykote grease applied each time before the gauge is assembled.



- i Fit new front and back 'O' rings into the grooves on the nose cone (3) and gauge body in the positions shown above.
- ii Apply a thin coat of Molykote grease onto the fitted 'O' rings.
- iii Fit the probe to the gauge by screwing the nose cone (3) onto the gauge, being careful not to cross the threads. The nose cone (3) should only be finger tight with no gaps apparent.
- iv Screw the end cap (7) onto the gauge body. The end cap (7) should only be finger tight with no gaps apparent.
- v Turn the gauge 'ON' by sliding the 'ON/OFF' switch (2) forward.

4.2. Disassembly

After a dive, the nose cone (3) may become tight. Use the nose cone release bar, supplied with the kit, to help unscrew the nose cone (3).

4.3. Switching the Gauge On

- i To switch the gauge on, slide the 'ON/OFF' switch (2) forward and release.
- ii The gauge will display the following sequence:

<u>Display</u>	<u>Description</u>
HELLO	<i>Greeting</i>
5920	<i>The current velocity set into the gauge (pg 15)</i>
≡ ≡ ≡ ≡	<i>Battery levels (pg 10)</i>
ProbE=2.25 P13	<i>The current probe connected to the gauge (pg 11)</i>

- iii One or two flashing bars will indicate that the gauge is ready to measure.

Note 1: If no probe is connected when the gauge is turned on, the display will show 'no ProbE'. See page 17 for further details.

Note 2: If a probe other than a Tritex probe is attached before switching on then the gauge will display 'SELEcT=2.25 P13'. See manual selection on page 16 for further details.

4.4. Switching the Gauge Off

- i To switch the gauge off, slide the 'ON/OFF' switch (2) forward and release.
- ii After a few seconds the gauge will display 'byE byE' and turn off.

4.5. Automatic Shutoff

The gauge will automatically shut off after 10 minutes of inactivity to save battery power.

4.6. Lanyard Attachment Ring

The lanyard attachment ring can be used to connect the gauge to the diver to prevent loss of the gauge during a dive.

5. Battery

5.1. Battery

The Multigauge 3000 Underwater Gauge uses a rechargeable 7.2V 2.3Ah NiMH battery pack supplied with the kit. The battery pack should not need to be removed unless faulty. The battery is located behind the control panel at the bottom of the gauge.



Control Panel (8)



Battery Compartment
with Control Panel
removed



Battery Pack

5.2. Replacing the Battery

- i Remove the control panel retaining ring holding the control panel in place.
- ii Turn the gauge upside down and shake out the control panel. It is attached to the gauge with a cable. Alternatively, connect the charger plug to the charger socket and gently pull the control panel out using the plug.
- iii Remove the battery by giving a sharp tap on the side of the gauge whilst still holding it upside down. Keep a hand cupped underneath to catch the battery.
- iv Insert the new battery into the battery compartment with the connector going in first.
- v Refit the control panel ensuring the cable is not kinked.
- vi Refit the control panel retaining ring.

Note: If the gauge is to be left unused for an extended period of time then it is advisable to remove the battery pack prior to storage.

Warning: Do not use any other battery pack other than the one supplied.

5.3. Low Battery Warning

When the gauge is first turned on, a series of lines indicate the remaining amount of charge in the battery as follows:

<u>Display</u>	<u>Description</u>
	Full battery - approximately 55 hours remaining
	Battery partly used - approximately 35 hours remaining
	Battery partly used - approximately 20 hours remaining
	Battery requires recharging

When the battery becomes low, the warning 'LO Bat' is given in advance. The battery should now be charged. Otherwise after a short time the gauge will turn off automatically.

5.4. Charging the Battery

- i Remove the end cap (7) to allow access to the control panel (8).
- ii Connect the charger lead to the socket marked 'Charge' on the control panel.
- iii Plug the charger into a suitable wall socket.
- iv A yellow light will show for the first 10 seconds during initialisation. Then an orange light will show during charging followed by an alternating green and yellow light during the trickle charge at the end.
- v The battery will charge in approximately 2 hours and will then be ready for use. A solid green light on the charger indicates a fully charged battery.

Note: A list of charger conditions is printed on the charger.

Note: The gauge and battery may feel warm to the touch during charging. This is normal.

Note: The charger will automatically switch between 110v and 220v.

Warning: Do not use any other battery charger other than the one supplied.

6. Probes

6.1. Introduction

All probes used with Tritex Multigauges 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 colour coded to help identify their frequency.

The single crystal means that measurements are taken using a straight path of ultrasound, giving perfect linearity throughout the measuring range. The probes are not affected by V-beam error.

6.2. Intelligent Probe Recognition (IPR)

All probes also have **IPR** (Intelligent Probe Recognition). IPR transmits data from the probe to the gauge so that it is instantly recognised. This includes data such as the probe serial number, frequency, size and the unique signature of the probe. The gauge uses this information to automatically adjust settings to achieve the best performance. When a probe is connected, the display will show 'ProbE=2.25 P13', depending on the probe that has been connected.

6.3. Probe Selection Table

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")
Colour	Yellow	Green	Blue
Diameters Available	13 mm (0.5") & 19 mm (0.75")	13 mm (0.5")	13 mm (0.5")
Suitable for	<i>Most thickness gauging applications. Works particularly well on heavy corrosion, especially the 19 mm probe.</i>	<i>Will measure relatively thin metal which is corroded. Normally used only if measuring down to 2 mm is of importance.</i>	<i>Ideal for measuring thin metal in relatively good condition. Not advisable to use as the main probe.</i>

6.4. 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 70°C (158°F).

High Temperature Membranes

Teflon™ membranes are available for measurements on hotter surfaces. In this case measurements can be taken on surfaces up to 150°C (302°F). 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.

6.5. Changing the Membrane



- i Unscrew the knurled ring (1) from the probe (4).
- ii Using the membrane key (5), remove the retaining ring (3) from inside the knurled ring (1).
- iii Push the old membrane (2) out from the front.
- iv Fit a new membrane (2) from the back and push it down until it locates in the groove on the inside front edge.
- v Refit the retaining ring (3) and secure it in place using the membrane key (5).
- vi Place a few drops of membrane oil (6) onto the face of the probe (4). Do not use too much.
- vii 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.

Note: Do not apply too much membrane oil underneath the membrane. Once fitted, the membrane should be flat with no air bubbles trapped behind.

Warning: Never use a probe without a membrane fitted.

6.6. Care of Probes

All probes should be treated with respect. 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.

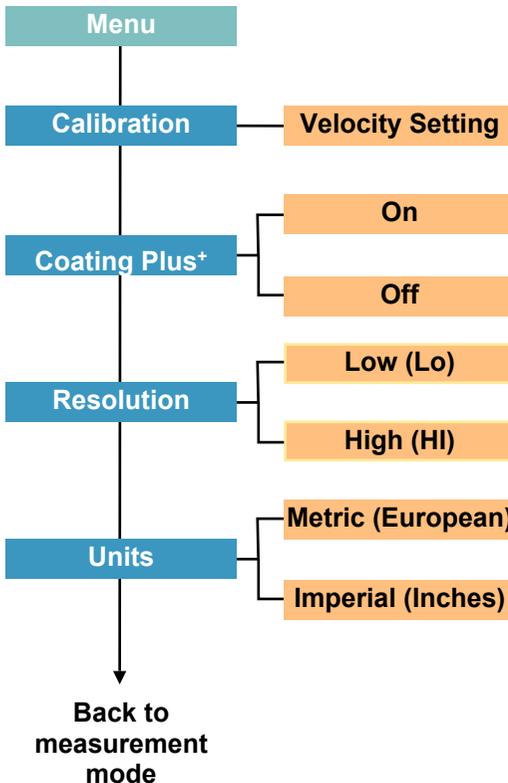
Warning: Never try to repair a probe or try to remove scratches from the face of the probe. This may result in further damage. Always return it to Tritex NDT for investigation and possible repair.

7. Navigating the Menu

7.1. Entering the Menu

- i First, gain access to the 'control panel' (8) by unscrewing the 'End Cap' (7) from the gauge.
- ii Press the 'MENU' button (10) on the control panel.
- iii The display will show the first menu item 'CAL'.
- iv To navigate the menu, use the 'MENU' button (10).
- v After scrolling through once, the gauge will return to measurement mode.

7.2. Navigation Table



7.3. Setting the Calibration

The gauge should be calibrated to the type of material that is being measured. This is because all materials have different velocity of sound properties.

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 (0.2323 in/ μ s). This may vary according to the properties of the supplied 15 mm test block material.

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

Calibrating the Velocity of Sound

- i Select 'CAL' from the menu using the 'MENU' button (10). *Use the navigation table on pg 14 as a guide.*
- ii 'CAL' and the current velocity setting will be displayed alternately.
- iii Use the '+' (11) and '-' (9) buttons to adjust the velocity of sound to the the required new velocity.
- iv Press the 'MENU' button (10), the gauge will display 'rEADY' and return to the measurement mode.

Calibrating to a Known Thickness

- i Select 'CAL' from the menu using the 'MENU' button (10). *Use the navigation table on pg 14 as a guide.*
- ii 'CAL' and the current velocity setting will be displayed alternately.
- iii Place the probe on a piece of material of a known thickness such as the test block supplied with the kit.
- iv 'CAL' and the measurement will be displayed alternately.
- v Adjust the measurement displayed to the known thickness using the '+' (11) and '-' (9) buttons.
- vi Press the 'MENU' button (10), the gauge will display 'rEADY' and return to the measurement mode.

7.4. Velocity Table (approximate values)

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.

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

Material	Velocity - m/s	Velocity - in/μs
Aluminium	6200 - 6360	0.2441 - 0.2504
Rolled	6420	0.2528
Duraluminium	6320	0.2488
Bronze (5%P)	3531	0.1390
Copper	3666 - 4760	0.1443 - 0.1874
Glass, Plate	5766	0.2270
Inconel, Forged	7820	0.3079
Lead	2050 - 2400	0.0807 - 0.0945
Steel, Mild	5890 - 5960	0.2319 - 0.2346
Supplied Test Block	5900 approx.	0.2323 approx.
Steel, Stainless	5530 - 5790	0.2177 - 0.2280
10 Cr Ni 18 8, ann	5530	0.2177
Steel, Tool		
C105 Annealed	5490 - 5960	0.2339 - 0.2346
C105 Hardened	5854	0.2305
Tin	3210 - 3320	0.1264 - 0.1307
Titanium	5823 - 6260	0.2293 - 0.2465
Zinc	3890 - 4210	0.1531 - 0.1657

7.5. Coating Plus⁺

Coating Plus⁺ mode is used to measure metal thickness when thick coatings up to 20 mm exist. Normal measurement mode will ignore coatings up to approximately 6 mm. In both modes, the actual thickness of coating that can be ignored depends on the type of coating.

- i Select 'CoatinG-PLUS' from the menu using the 'MENU' button (10). *Use the navigation table on pg 14 as a guide.*
- ii Either 'CoatinG-PLUS=On' or 'CoatinG-PLUS=OFF' will be displayed depending on the current setting.
- iii Use the '+' (11) and '-' (9) buttons to select the required setting between 'ON' and 'OFF'.
- iv Press the 'MENU' button (10), the gauge will display 'StorEd' and return to the measurement mode.

Note: 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.

7.6. Setting the Resolution

The resolution can be set between low (0.1 mm / 0.005") and high (0.05 mm / 0.002").

- i Select 'rES' from the menu using the 'MENU' button (10). *Use the navigation table on pg 14 as a guide.*
- ii Either 'rES=LO' or 'rES=HI' will be displayed depending on the current setting.
- iii Use the '+' (11) and '-' (9) buttons to select the required resolution between 'HI' and 'LO'.
- iv Press the 'MENU' button (10), the gauge will display 'StorEd' and return to the measurement mode.

7.7. Setting the Units

Either metric (mm) or imperial (inch) units can be selected.

- i Select 'UnitS' from the menu using the 'MENU' button (10). *Use the navigation table on pg 14 as a guide.*
- ii Either 'UnitS=EUrOPEAn' or 'UnitS=InchES' will be displayed depending on the current setting.
- iii Use the '+' (11) and '-' (9) buttons to select the required units between 'Euro' (metric) and 'Inch' (imperial).
- iv Press the 'MENU' button (10), the gauge will display 'StorEd' and return to the measurement mode.

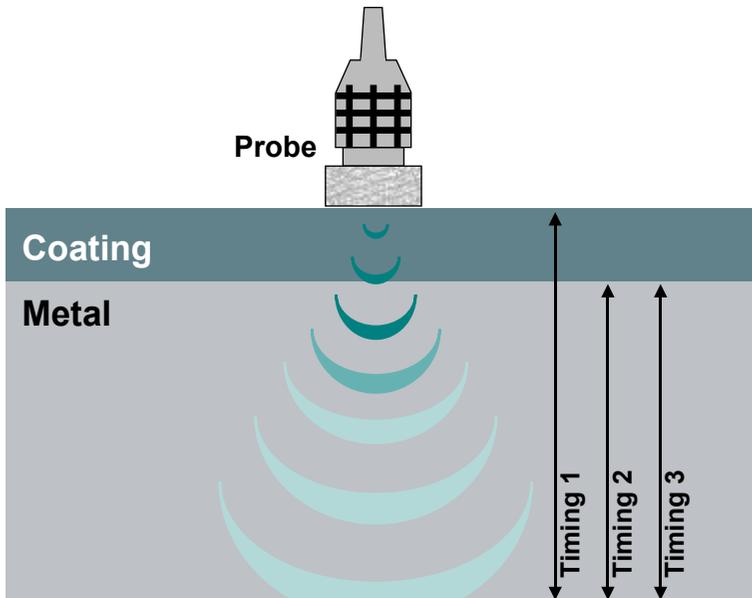
8. Using the Multigauge 3000 UW

8.1. How Triple Echo Works

All Ultrasonic Thickness Gauges should be calibrated to the velocity of sound of the material being measured. Coatings have a different velocity of sound than metal and it is important they are not included in the measurement. Triple echo ensures all coatings are completely eliminated from the measurement.

How it works:

A 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. The timing between the small echoes gives us 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 is checked each time. This is referred to as the **Automatic Measurement Verification System (AMVS)**.



8.2. Echo Strength Indicator

The gauge will display a series of flashing bars to indicate the strength of the returning echoes. The stronger the returning echoes are, the more bars will be displayed.

8.3. Precautions When Measuring

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 organic growth, dirt or debris. It may be necessary to clean or brush the surface prior to taking measurements.

Couplant is not required underwater. Water acts as a very good couplant between the probe and object being measured.

A membrane should be correctly fitted to the probe.

Place the probe firmly on the surface being measured to make good contact.

Do not remove protective coatings. The gauge is designed to ignore these.

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.

Remove debris from the probe face between measurements.

Sometimes it is necessary to rock the probe slightly and gently in order to obtain measurements. This often helps the probe to receive echoes from the back wall.

- ❑ **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.

- ❑ **Some types of casting may cause problems for ultrasonic gauges.** Castings can contain foreign elements within their construction and they also have varying velocity of sound properties throughout their structure. This may result in inaccurate measurements due to the inherent inconsistencies in the material.

- ❑ **Always ensure new membranes are correctly fitted prior to a dive.**

9. Help

9.1. Gauge fails to switch on

Advice	Action
Check the battery is present and fully charged.	Recharge the battery (see pg 10).
The battery will not hold charge	Replace the battery (see pg 9)
The 'ON/OFF' switch may be defective.	Return the gauge to Tritex NDT (see pg 26).

9.2. Difficult to obtain readings

Advice	Action
Check the gauge against the 15 mm test block supplied.	If this works, the problem is with the material being measured (see pg 19).
Check the correct probe for the material being measured has been selected.	Select the correct probe (see pg 11).
Check the probe membrane is properly fitted with membrane oil applied and no trapped air present.	Refit or replace the membrane (see pg 13).
Check the probe 'O' ring is in the correct position and the nose cone is properly fitted	Re-fit and re-connect as necessary (see pg 7).
Check the serviceability of the probe and lead.	Contact Tritex NDT for replacement items (see pg 26).
Check the serviceability of the gauge.	Return the gauge to Tritex NDT (see pg 26).

9.3. Gauge displays up to three ascending bars

Advice	Action
Not all echoes received are equal. The gauge has Automatic Measurement Verification System (AMVS).	Move or rock the probe slightly until all echoes are received (see pg 19).

9.4. Standing readings are displayed when not measuring

Advice	Action
Excessive membrane oil under membrane.	Refit or replace the membrane (see pg 13).

9.5. Gauge measures correctly on steel test block but not on the material under test

Advice	Action
Check the material is not too thin for the frequency of the probe being measured.	Select the correct probe (see pg 11).
Check that the material has parallel front and back walls.	See pg 19 - Precautions When Measuring.
Ensure plenty of ultrasonic gel is used between the probe and the material to eliminate any air pockets when measuring above water.	See pg 19 - Precautions When Measuring.
Ensure the coating is solidly adhered to the surface.	See pg 19 - Precautions When Measuring.
Ensure the coating is not layered or contains foreign objects in its construction.	See pg 20 - Precautions When Measuring.
Some types of casting may cause problems for ultrasonic gauges.	See pg 20 - Precautions When Measuring.

10. General Information

10.1. Safety

Only use the battery pack supplied with the kit.

Only use the battery charger supplied with the kit. Do not attempt to charge the battery with any other charger.

Do not submerge the gauge in water unless the gauge has been correctly assembled (see page 7)

Do not open the gauge body other than to change the batteries. Always return the gauge for repair.

Never dispose of battery pack in a fire. There is a serious risk of explosion and/or the release of highly toxic chemicals.

Do not expose to direct sunlight for extended periods of time.

10.2. RoHS

New legislation to help safeguard the environment has been introduced to ensure companies act responsibly. Tritex products are fully RoHS compliant which means that we do not use hazardous substances and materials at any stage of manufacture. Lead cadmium, mercury and other such materials used in electronic equipment are not present in Tritex products.

RoHS compliance is already law in the United Kingdom and European Union and will soon be adopted in other countries seeking to protect the planet for future generations.

At Tritex we are aware of our corporate social responsibility towards all our stakeholders. We take pride in our work and our environment.

10.3. WEEE Disposal Instructions

Do not dispose of this device with unsorted waste. Improper disposal may be harmful to the environment. Please refer to your local waste authority for information on return and collection schemes in your area. Otherwise, return the product to Tritex NDT for safe disposal.

10.4. Cleaning

Clean the gauge using a mild detergent, a damp (not wet) cloth, or an anti-static wipe. Never use abrasives, solvents or other cleaning products as this will damage the instrument. Do not soak the gauge with water or other liquids when un-assembled.

10.5. Warranty

Tritex products are guaranteed against defects in material and/or workmanship for a period of 3 years from date of delivery.

Any equipment that may be defective should be returned carriage paid direct to Tritex or to their approved local distributor who will at their discretion repair or replace equipment that proves to be defective during the warranty period. This warranty includes parts, labour and return at no charge.

Repairs due to abuse of the equipment, accident, fair wear and tear and use of non approved third party hardware is not covered by this warranty. Probe warranty is limited to 1 year. Rechargeable battery pack warranty is limited to defects and workmanship only for 1 year. Failing to hold a charge is not covered.

No other warranty is expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

The customer should not attempt any repair as this will void the warranty.

Tritex shall not be liable for collateral or consequential damage of any kind from either the use or the interpretation of the results from the equipment.

10.6. Service & Repair

A full manufacturer's factory repair service is available from Tritex NDT. Priority is given to customer repairs so the gauge can be returned ready for action in the shortest possible time. The complete kit should be returned to Tritex direct or through your local agent.

Before you return your gauge

Check through the troubleshooting guide on page 21. If this does not solve the problem we can sometimes give advice over the phone.

When returning the gauge

If after troubleshooting, the gauge is still faulty, you will need to return your gauge for repair. Please package the **complete kit** in a suitable protective container and return to us at the address on page 26.

Please include your contact details including name, address, e-mail and phone number, along with a brief description of the problem.

11. Contact Information

Telephone: +44 (0) 1305 257160

Facsimile: +44 (0) 1305 259573

E-mail: Sales@tritexndt.com

Website: www.tritexndt.com

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