

Ultrasonic Thickness Gauge

Multigauge 4000 ROV Thickness Gauge User Manual



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1. Introduction

Thank you for purchasing a Tritex Multigauge 4000 series ROV 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.

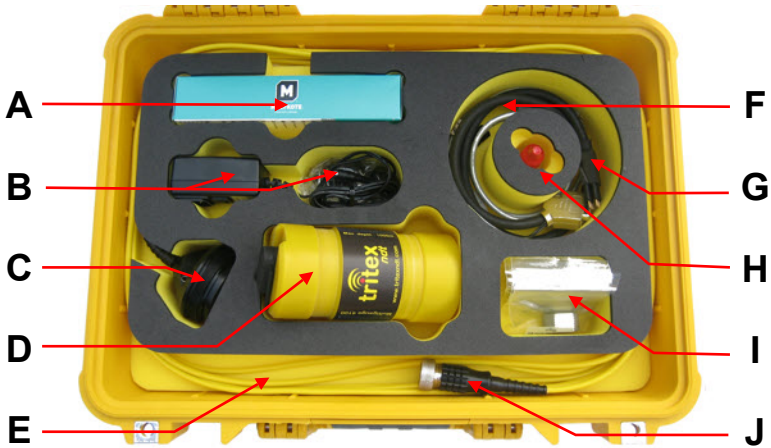
The Multigauge 4000 series ROV Gauge is a simple, robust ultrasonic thickness gauge designed for most common underwater thickness gauging applications. The gauge mounts onto most types of ROV and is available in two models. The Multigauge 4100 is pressure tested to 1000m and the Multigauge 4400 is pressure tested to 4000m. Measurements are transferred to the surface using the ROV's umbilical and a dedicated software called Tritex Communicator is used to display and store the measurements. The gauge is durable and extremely easy to use.

The Tritex Multigauge 4000 series 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 4000 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")		
Output	RS 232		
Depth Rating	1000 m (Multigauge 4100) & 4000m (Multigauge 4400)		
Power	9 Vdc - 30Vdc @ 150mA		
Gauge Dimensions	145 mm x 72 mm (5.71" x 2.83")		
Gauge Weight	Multigauge 4100 ROV: 465 g (16.40 ounces) Multigauge 4400 ROV: 2500g (151.68 ounces)		
Environmental	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:

A	Molykote Grease	Applied to the O-rings to ensure water tightness (pg 7)
B	Power Supply	For use with test cable
C	Nose Cone	Screws onto gauge body
D	Gauge Body	See page 6 for further details.
E	Probe Cable	Normally 3m long.
F	Converter Cable	RS232 or RS422 to USB.
G	Test Cable	For testing the gauge prior to installation.
H	Membrane Oil	See page 11 for further details.
I	Test Block	The 15 mm test block is used to test the performance and serviceability of the gauge.
	Membranes / Key	See page 11 for fitting instructions. Pack of 10 supplied.
	O-Rings	O-rings (10 sets supplied).
J	Probe	Standard probe : 2.25 Mhz 13mm
	Other Accessories	Nose cone release bar, manual, calibration certificate and 3 year warranty certificate.

3. Getting Started

3.1. Quick Start Guide

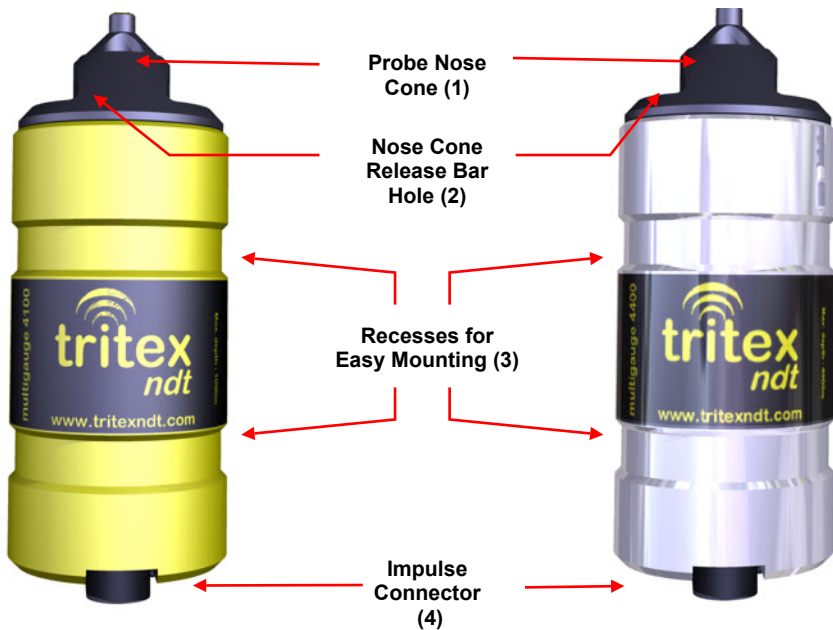
Following is a quick start guide to help you get a feel for the gauge without reading the entire manual. For a more detailed explanation of each of these steps, please read the full manual.

1. Unscrew the probe knurled ring and apply a few drops of membrane oil to the face of the probe. (Pg 11)
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 11)
3. Ensure the 'O' rings are properly fitted to the probe nose cone with Molykote grease applied (Pg 7)
4. Screw the nose cone onto the main body so that it is fully seated and finger tight.
5. Install the latest version of Tritex Communicator software on the relevant PC or laptop.
6. Connect the test lead and power supply to the gauge.
7. Connect the test lead to the RS232 / RS422 to USB converter.
8. Connect the USB from the converter to the PC or laptop
9. Ensure the communication and port settings are correctly set up as per the installation guide.
10. Apply a tiny amount of membrane oil or other suitable couplant to the test piece.
11. Place the probe onto the test piece.
12. A measurement will be displayed.
13. Remove the test cable and replace with the supplied Impulse connector and fly lead.
14. Mount the gauge in a suitable position on the ROV and hard wire the fly lead onto the ROV as per the installation instructions.(pg 8)
15. Mount the probe in a suitable position at the front of the ROV.
16. The gauge is now ready to use underwater.

4. Getting to know your Multigauge 4000

**Multigauge 4100
1000m**

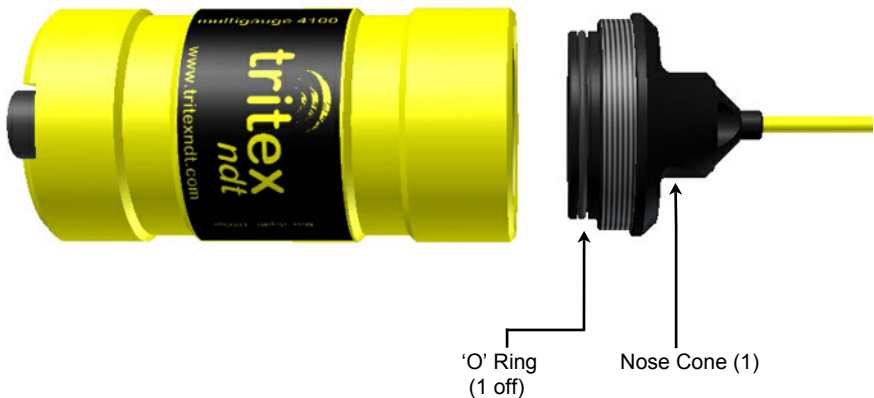
**Multigauge 4400
4000m**



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 'O' rings into the grooves on the nose cone (1).
- 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 (1) onto the gauge, being careful not to cross the threads. The nose cone (1) should only be finger tight with no gaps apparent.
- iv Connect the Impulse fly lead to the Impulse connector (4).

4.2. Disassembly

After a dive, the nose cone (1) may become tight. Use the nose cone release bar, supplied with the kit, to help unscrew the nose cone (1).

4.3. Mounting the gauge onto the ROV

The gauge can be mounted anywhere on the ROV which will not cause an obstruction and so that the power and signal connections are within easy reach. The Multigaugage 4000 series has recesses around the body to aid installation and prevent slippage when in use.

The probe has 3 m of cable length to ensure that it can be installed even on large ROV's.

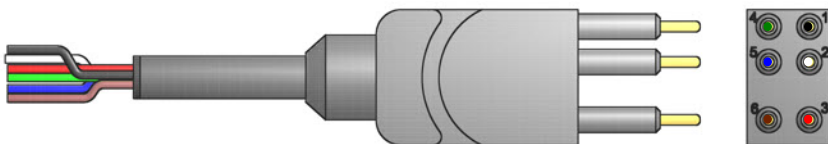
5. Connecting the Multigaugage 4000

5.1. Connecting the Gauge using the Test Lead

A test lead is supplied in the kit to allow connection of the gauge directly to a PC. This allows the functionality of the gauge to be tested without it being connected through an ROV and its umbilical.

- i Connect the probe to the gauge.
- ii Plug the Impulse connector from the test lead into the socket on the ROV.
- iii Connect the power supply to the test lead and plug into a suitable wall socket.
- iv Connect the D connector from the test cable to the USB converter.
- v Insert the USB plug into an available socket on the PC or laptop.
- vi Run the Tritex Communicator software.
- vii Place the the probe onto the supplied 15 mm test block ensuring couplant has first been applied.
- viii The software should display the measurement of 15 mm.

5.2. Connecting the Gauge to an ROV



Plug Pin Number	Wire Colour	ROV Signal
1	Black	Tx - NEG
2	White	Tx - POS
3	Red	Rx - NEG
4	Green	Rx - POS
5	Blue	GND
6	Brown	Vin

The Multigaue 4000 series is connected to the ROV using the 6 way impulse socket on the gauge. The kit includes an Impulse connector with a short fly lead. The pin connections are detailed in the table on the previous page.

Pins 1 and 2 are used to transmit data from the gauge to the PC via the ROV's umbilical. Pins 3 and 4 are used to transmit information to the gauge from the PC during test only, when the test cable is attached.

Pins 5 and 6 supply power to the Multigaue 4000 Gauge which is taken locally from the ROV. The input voltage can be between 9Vdc and 30Vdc.

6. Probes

6.1. Introduction

All probes used with Tritex Multigaues are single crystal soft faced probes. The table on page 10 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.

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	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 the main probe.

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.

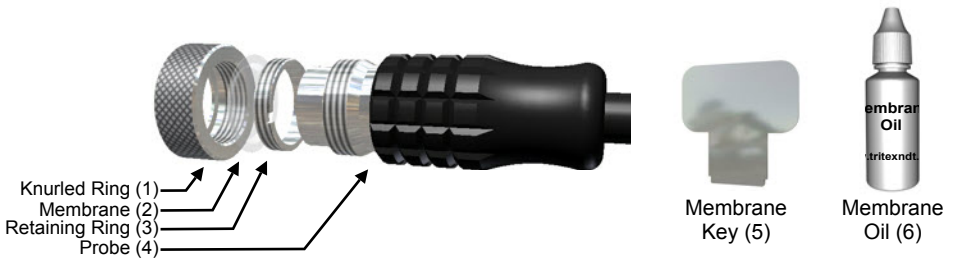
Normal Temperature Membranes

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. Displaying & Logging the Measurements

The Multigauge 4000 has been designed to work with Tritex Communicator software which is supplied with the kit.

Communicator has the facility to display the current measurement and store the results in either a string or grid format. Templates can be easily developed or adapted to cover most applications.

The result files from Communicator are saved in a standard format (.csv) which can be opened in other spreadsheet type programs.

For information about how to store measurements and set up templates, please refer to the Communicator Software manual.

8. Adjusting settings in the Multigauge 4000

8.1.1 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.

Calibration is set in the Communicator software which converts the raw string of data sent from the gauge.

There are two methods of changing the calibration. Either adjust the velocity of sound setting according the metal being measured, or adjust the the gauge to a known thickness of metal. For standard velocity settings, please refer to the table on page 13.

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.

For information about how to change the calibration, please refer to the Communicator Software manual.

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

8.1.2 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

8.2. 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.

Coating plus can only be turned on or off when the test cable is connected. These settings are changed in the Communicator Software.

For information about how to turn on Coating Plus⁺, please refer to the Communicator Software manual.

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.

8.3. Setting the Resolution

The resolution can be set between low (0.1 mm / 0.005") and high (0.05 mm / 0.002"). These settings are changed in the Communicator Software.

For information about how to adjust the resolution, please refer to the Communicator Software manual.

8.4. Setting the Units

Either metric (mm) or imperial (inch) units can be selected. These settings are changed in the Communicator Software.

For information about how to change the units, please refer to the Communicator Software manual.

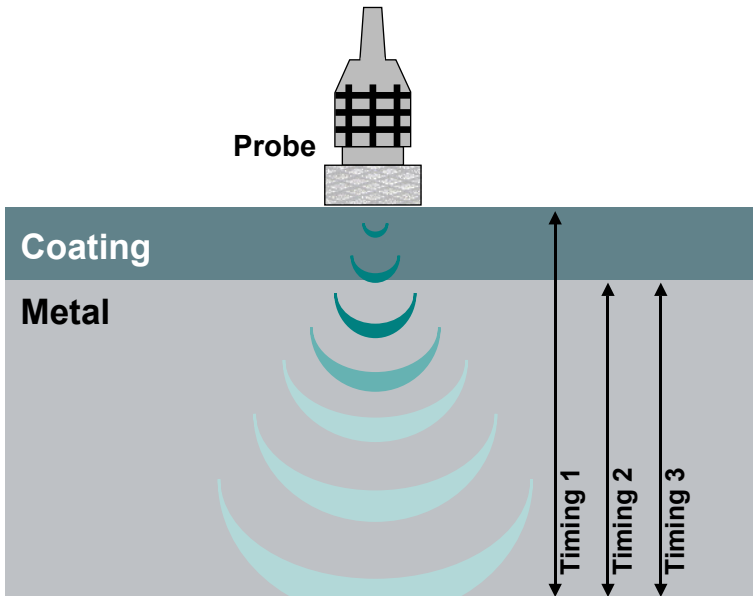
9. Using the Multigauge 4000

9.1. 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)**.



9.2. 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.

Ensure there is no build up of debris on the probe face.

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.

10. Help

10.1. Gauge fails to switch on

Advice	Action
Check the gauge has been connected correctly.	Re-check connections and change if necessary (see pg 8).
Check the correct voltage is being supplied to the gauge.	Only supply the gauge with 7.5 Vdc to 30Vdc (see pg 8)

10.2. 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 16).
Check the probe membrane is properly fitted with membrane oil applied and no trapped air present.	Refit or replace the membrane (see pg 11).
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 22).
Check the serviceability of the gauge.	Return the gauge to Tritex NDT (see pg 22).

10.3. 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.

10.4. Standing readings are displayed when not measuring

Advice	Action
Excessive membrane oil under membrane.	Refit or replace the membrane (see pg 16).

10.5. 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 16 - 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 16 - Precautions When Measuring.
Ensure the coating is solidly adhered to the surface.	See pg 16 - Precautions When Measuring.
Ensure the coating is not layered or contains foreign objects in its construction.	See pg 16 - Precautions When Measuring.
Some types of casting may cause problems for ultrasonic gauges.	See pg 16 - Precautions When Measuring.

10.6. No communication between the Multigauge 4000 and Communicator Software

Advice	Action
Check all the connections have been properly made.	Reconnect any plugs and sockets that have become disconnected (see pg 8).
Ensure the correct port is selected in Communicator software	See the Communicator Software manual for information on selecting ports.
Ensure the gauge is working correctly using the test lead supplied	Contact Tritex NDT for replacement items (see pg 22).
Check that there is power to the Multigauge 4000.	Supply the correct power to the gauge (see pg 8).

11. General Information

11.1. Safety

Ensure only the the correct voltages are supplied to the gauge.

Ensure the gauge has been correctly connected before switching on.

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

Do not open the gauge body. Always return the gauge for repair.

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

11.2. 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.

11.3. 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.

11.4. 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.

11.5. 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.

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.

11.6. 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 18. 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 22.

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

12. Contact Information

Telephone: +44 (0) 1305 257160

Facsimile: +44 (0) 1305 259573

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Website: www.tritexndt.com

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