garnet

OPERATING MANUAL

GEISMAR

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SOCIÉTÉ DES ANCIENS ÉTABLISSEMENTS

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LOCAL REPRESENTATIVE

Revision History

V1	- First release (for firmware versions GAD04000001CR onwards)	Oct 08	JW
V2	- Correction clarifying the Twist measurement is only available when 'Groove' is 'Enabled'. - General Corrections.	05/03/09	PH
V3	- Details of new 'Twist Enable' menu.	23/04/09	PH
V4	- New front cover, contacts page and logo updates. Minor changes to existing text.	01/06/09	PH
V5	- Diagram detailing main Garnet components. - Columns changed in section 3.4 to reflect LCD output - Update to Twist parameter to include first measurement (3.6) and battery cycling info (5.0) - Drawings replace text describing gauge thrust bearing options (8.0)	16/09/09	PH
V6	- For GAD04S001r04IR (containing GAD04F000005CR) - Absolute 'Cant Offset' displayed when re-zeroing from setup menu. - New 35mm limit on absolute Cant Re-zeroing. - Troubleshooting guide updated. - New technical support email address added.	14/12/09	PH
V7	- Correction to charge times and autonomy - Correction to front cover (gauge and cross-level wrong way around in photo) - Corrections to the performance table in the technical spec (8.0) - Diagrams changed to show 'X-level' instead of 'Cant' - Changed the term 'Cant' to 'Cross-level' and 'Re-Zero' to 'Rezero'	13/01/10	PH
V8	- Network Rail specific models added to technical specification	14/06/13	PH
V9	- Para 5 New instructions on Charging Batteries added	07/04/15	JAL

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Table of Contents

Chapter 1

1 Introduction

The Geismar Garnet is a portable, lightweight, hand operated digital track gauge for measuring the following seven track parameters:-

- **Gauge**
- **Cross-level**
- **Groove Clearance**
- **Checkrail to opposite Running-rail**
- **Running-rail to opposite Check-rail**
- **Back-to-back Check-rail**
- **Twist**

1.1 Packing List

The Garnet is supplied with the following components. If any of these items are missing then contact your local Geismar representative.

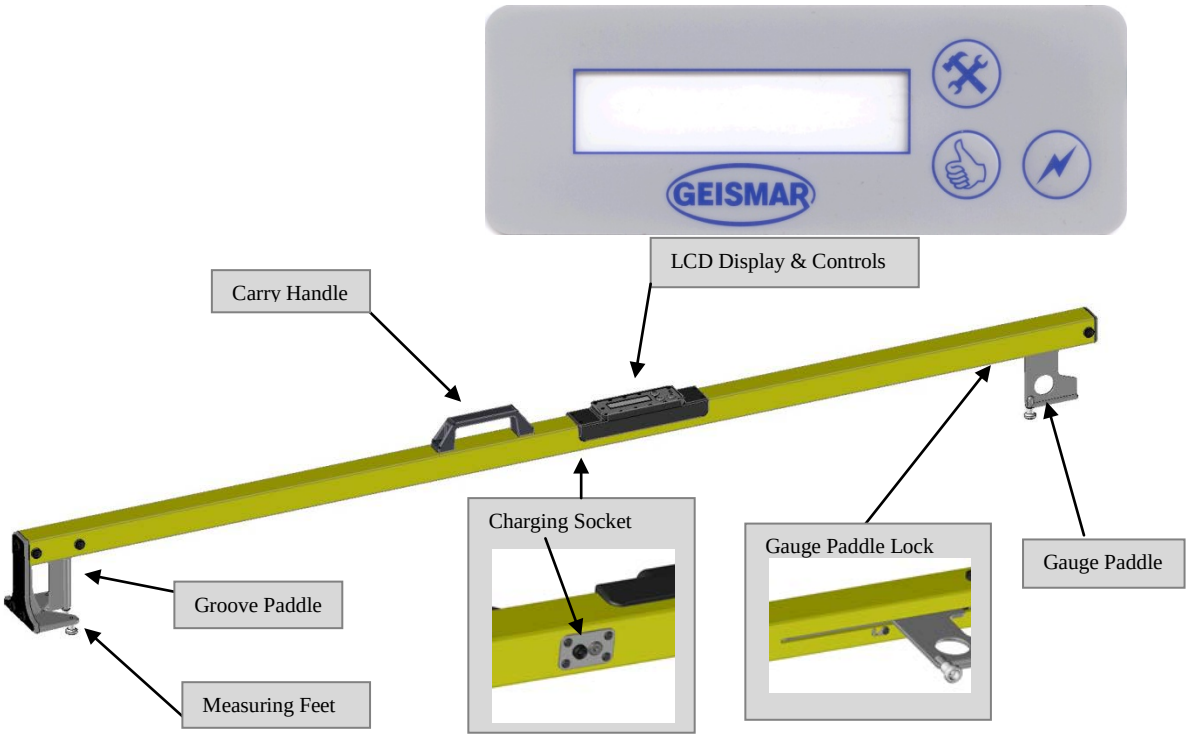
- **Track Gauge**
- **Mains Battery Charger**
- **Operating Manual**
- **Calibration Certificate**

1.2 Initial Instructions

The Garnet track gauge is fitted with an internal Ni-MH battery. Before the instrument is first used, the battery must be fully charged using the procedure described in Chapter 5 of this manual.

2 System Controls

The Garnet has three buttons on its front panel as shown here. Many of the measuring modes are selected automatically and an explanation of these modes and manually selected functions are detailed in the following sections. The diagram below identifies these controls along with the other major components found on the Garnet.



2.1 Switching On

The button marked (⚡) should be pressed for a period of approximately 2 seconds, this will run a system test and then start the gauge operating.

2.2 Switching Off

Pressing both buttons (🛠+👍) simultaneously for 5 seconds will switch off the gauge. Alternatively, if the auto 'Power Off' option has been enabled, then the gauge will automatically switch off after a preset time of inactivity. This is detailed in the '**Software Menus'** section of the manual..

2.3 Control Buttons

These two buttons are marked (🛠) and (👍) and are used to operate the Garnet. Their functions change depending on the current mode, but in most cases contextual help is provided to aid the user.

2.4 Backlight

With the Garnet in measuring mode, pressing the (🛠) button will either will activate the LCD backlight, for a pre-determined period, or toggle the backlight on and off. This is detailed in the '**Software Menus**' section of the manual.

2.5 Contextual Help Icons

To assist the user in menu navigation, the Garnet makes use of on-screen contextual help icons. These appear on the LCD alongside the relevant control button (🛠 or 👆) to remind the operator of their function. Commonly used icons and an explanation of their meaning are listed below:-

(✓) OK or Enter

(↵) Scroll through option

(⏭) Next menu

2.6 DC Charging Socket

This socket is used for charging the battery and can be found on the underside of the Garnet. A battery charger is provided with the Garnet and instructions on charging are covered in Chapter 5 of this manual.

Chapter 3

3 Operating Instructions

- **In order to protect the Garnet from water and dust ingress, it must remain in its normal upright measuring position, even when not in use!!**
- **After use in wet weather, remove standing water from the Garnet using a clean, dry cloth. Pay particular attention to the LCD/keypad recess and surrounding area.**
- **Always remember that the Garnet Digital Gauge is an accurate measuring instrument and not a hand tool. It is designed to operate in the railway environment but must at all times be handled with care!!**
- **During sudden changes in temperature, for example removing the Garnet from a warm car on a cold day, the Garnet should be left to 'stabilise' before it is re-zeroed or used for measurements!!**

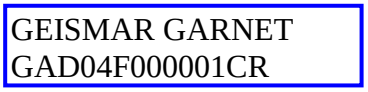
3.1 Positioning the Garnet

To maintain integrity of measurement, it is essential that the Garnet be placed on the track such that it is absolutely perpendicular to the rails. This is achieved by ensuring BOTH measuring 'feet' found on the Groove measuring side of the Garnet are in contact with the running face of the rail.

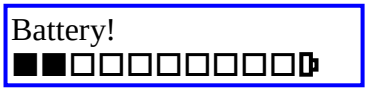
The Gauge paddle is spring-loaded outwards so it is necessary to retract this paddle before it can be correctly positioned. Alternatively, and depending on what is being measured, this paddle can be permanently retracted using the small catch found on the underside of the Garnet.

3.2 Power On

To switch on the Garnet, press the button marked (↗) for approximately 2 seconds. During the start-up process, the equipment model, and the firmware version are displayed on the screen. After approximately 10 seconds the initialisation message is replaced with the measuring screen.



If the remaining battery capacity is at 25% or less, a message is briefly flashed up on the LCD during normal operation to alert the operator. The frequency by which the message is displayed is dependent on the remaining battery capacity, i.e. with 20% charge remaining, the battery level will be displayed every 20 seconds, increasing to every 5 seconds with 5% charge remaining.



3.3 Intuitive Measuring Mode Selection

The Garnet is fitted with a high accuracy inclinometer, and two measuring 'paddles' enabling it to measure up to seven track parameters. In order to maintain measurement integrity and improve ease of use, the Garnet records the most extreme (max or min) value measured in the selected direction, even if this is not the current value.

In the case of the Gauge paddle, a change in direction (and hence a change in measuring mode) will only be acknowledged if the paddle movement exceeds 5mm in the opposite direction.

In the case of the Groove paddle, the maximum value will be stored until the paddle movement exceeds 5mm in the opposite direction if Groove Latch is [Disabled], or if the user manually exits that measuring mode by pressing the (☝) button if Groove Latch is [Enabled]. See '**Software Menus**'.

3.4 Measuring Modes

The Garnet uses 'intuitive measuring mode selection' to determine which measurement(s) the operator is attempting to make, based whether the paddles are being moved 'In' towards or 'Out' away from the track centre. The table below illustrates how the different measuring modes are selected:-

Groove Paddle Enabled			
Groove Paddle	***Gauge Paddle***	***Display Output***	***Description***
Out	Out	Gauge 1436.4 mm X-level /152.1 mm	Gauge Cross-level including orientation
Out	In	■□--■□ 1436.4 mm X-level /152.1 mm	Running rail to opposite check rail Cross-level including orientation
In	Out	Groove 76.3 mm □■--□■ /1400.1 mm	Groove width or groove Check rail to opposite running rail
In	In	Groove 76.4 mm □■--■□ /1372.1 mm	Groove width or groove Back-to-back check rail
Groove Paddle Disabled			
In/Out	Out	Gauge 1436.4 mm X-level /152.1 mm	Gauge Cross-level including orientation
In/Out	In	Gauge ---- mm X-level /152.1 mm	Error. Invalid Gauge paddle direction! Cross-level including orientation

In the case of the Gauge paddle, a change in direction (and hence a change in measuring mode) will only be acknowledged if the paddle movement exceeds 5mm in the opposite direction.

In the case of the Groove paddle, the maximum value will be stored until the user manually exits that measuring mode by pressing the (☝) button (if Groove Latch is on) or if the paddle movement exceeds 5mm in the opposite direction (if Groove Latch is off).

3.5 Acquiring Measurements

To further increase accuracy and repeatability, software averaging filters are implemented in the Garnet. During the measuring process, these filters will take a few seconds to process the data and therefore the display should only be read once the parameters have stabilised.

3.6 Twist Measurement

The Garnet has the ability to calculate Twist. This is achieved by comparing the current Cross-levelvalue with the Cross-level value previously stored by the operator.

The Twist base is undefined and is dependent on the distance separating the two Cross-level measurements.

The Twist is displayed by pressing the button when 'Cross-level is displayed.

Pressing again will store the current Cross-level value as the new Twist base reference and return the Garnet to 'Cross-level' measuring mode.

- The first time the Twist screen is entered after a power-up will result in an invalid Twist measurement being displayed as no base reference has yet been taken!

3.7 Cross-level Rezeroing Calibration

To maintain integrity of Cross-level and Twist measurements, the Garnet should regularly undergo a Cross-level rezeroing calibration, as described in Chapter 4.2 of this manual. This should be routinely performed on a daily basis **and** in the following circumstances:-

- If the Garnet has had a severe knock
- During sudden changes in temperature
- If the temperature differs by more than 10°C since the last re-zeroing, the garnet will automatically force the user to start a Cross-level Rezero.

Chapter 4

4 Software Menus

The Garnet has a structured menu system, enabling the operator to perform specific tasks and alter the configuration of the instrument. The menu structure can only be entered before the unit is turned on. To enter the menus, press and hold 👆, while turning on the unit by pressing ↗ for 2 seconds.

To assist the user in menu navigation, the Garnet makes use of on-screen contextual help icons. These appear on the LCD alongside the relevant control button (🛠 or 👆) to remind the operator of their function. Commonly used icons and an explanation of their meaning are listed below:-

(✓) OK or Enter

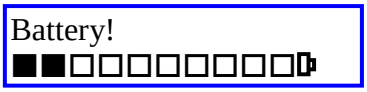
(↵) Scroll through option

(⏭) Next menu

4.1 Menu/Settings Description

Described below is the complete menu structure for the Garnet, a detailed explanation of each menu/option can be found in the following few sections of this manual:-

4.1.1 Battery



Displays the remaining battery life, in percentage. When the battery level falls below 25%, a message is briefly flashed up on the LCD during normal operation to alert the operator. The frequency by which the message is displayed is dependent on the remaining battery capacity, i.e. with 20% charge remaining, the battery level will be displayed every 20 seconds, increasing to 5 seconds when the battery reaches 5%. During this period, the operator should consider charging the Garnet.

Note that the battery status value is only an **indicator** and not an exact figure. If the Garnet is charged from flat for only 10 minutes, the indicator may display 100%, however, this will rapidly deplete if removed from charge.

4.1.2 Cross-level Rezero

See Section 4.2 of this operating manual.

4.1.3 Language

Sets the operating language of the Garnet

4.1.4 Power

In Auto-off mode, the Garnet automatically switches itself off after 10 miniuts, pressing either of the control buttons will reset the timer. In Manual mode, the Garnet will remain on until the operator manually switches it off, by pressing the (🛠 + 👆) buttons.

4.1.5 Backlight

In Auto-off, the backlight can be switched on for 10 seconds, by pressing 🛠. When the backlight, is set to manual then pressing 🛠 will toggle the backlight on and off. Prolonged use of the backlight will have a detrimental effect on the battery life!

4.1.6 Measure Units

Selects whether the Garnet displays measurements in milimeters or inches. When set to milimeters, temprature is displayed 8C, when set to Imperial, temprature is displayed 8F.

4.1.7 Twist

Enables or disables the 'Twist' parameter. If enabled, the Twist parameter can be seleced by pressing the button while in Gauge mode.

4.1.8 Groove

Enables or disables the Groove measuring paddle. If disabled, only Cross-level, Gauge and Twist can be measured, thus simplifying the operation of the Garnet.

4.1.9 Groove Latch

Enables or disables the Groove latch mechanism. If set, the maximum Groove value will be stored until the user manually exits that measuring mode by pressing the button. If disabled, the Groove value will be reset if the paddle movement exceeds 5mm in the opposite direction.

4.1.10 Firmware Version

Displays the current firmware version, the operator cannot change this value. Please contact your Geismar representative regarding firmware updates.

4.1.11 Serial Number

Displays the serial number, the operator cannot change these values. Please quote this serial number when you contact your Geismar representative.

4.1.12 Calibration Date

Displays the date when last calibrated, if more than 12 months has elapsed, then the unit should be returned to your local Geismar representative for re-calibration.

4.1.13 Exit Menu

Select ✓ to exit the menu, or select ⏭, then menu will loop around to the start (Battery).

4.2 Cross-level Rezeroing Calibration

To maintain integrity of Cross-level and Twist measurements, the Garnet should regularly undergo a Cross-level Rezeroing calibration. This should be routinely performed **and** in the following circumstances:-

- If the Garnet has had a severe knock
- During sudden changes in temperature
- If the temperature differs by more than 10°C since the last re-zeroing (warning given)

In the event of sudden changes in temperature, for example removing the Garnet from a warm car on a cold day, the Garnet should be left to 'stabilise' before it is re-zeroed or used for measurements.

The 'Cross-level Rezeroing Calibration' should be performed on a section of track clear from welds, joints and any other irregularities that may prevent the Garnet from sitting firmly on the rails. For best results, the track Cross-level should be close to zero (<30mm).

During each re-zeroing process, the internal temperature is stored by the Garnet. During operation, the current temperature is constantly monitored and compared to this stored value. If it differs by more than 10°C then the user is forced to perform a Cross-level Rezero!!The Cross-level Rezeroing Calibration function can also be found within the front-end user menu and is accessed by pressing the

button, while turning on the unit with the button .

Scroll through the menu options using the ( ) button until the following message is displayed, then select by pressing the button.	X-level ✓ Rezero? ▶▶
When prompted with the following message, place the Garnet firmly and squarely on the track, making a note of its exact location.	Measure ✓ A--==--B
Press the button to begin the calibration process. During the measuring process a 'thermometer' bar graphs indicates the progress. It is essential that the Garnet is not touched during this measuring process	Processing… ■■■■
When prompted with the following message, turn the Garnet around so the Gauge paddle is now on the opposite rail but at EXACTLY the same location on the track	Rotate 180? ✓ B--==--A
Ensure that the Garnet is firmly and squarely positioned and press the button to continue the calibration process. During the measuring process a 'thermometer' bar graphs indicates the progress. It is essential the Garnet is not touched during this measuring process.	Processing… ■■■■
Once the calibration process is complete, the following message will be displayed. If Cross-level Rezeroing was initiated manually by selecting from within the 'user menu' then the number displayed represents the ABSOLUTE offset for Cross-level. If however the rezeroing was initialised automatically (due to a change in temperature) then the number displayed represents the 'adjustment' made to the previously stored value, thus giving an indication of the previous offset error.	Calibrated: ✓ +0.4 mm
At the end of the Cross-level Rezeroing process the final value is checked to ensure it is within certain criteria. If these criteria are not met then the calibration is aborted and the following message is displayed. In this instance, the user should attempt to re-zero again before using the Garnet.	Failed! ✓

5 Charging the Batteries

The Garnet has an internal 7.2v Ni-MH rechargeable battery pack that must not be removed by the operator. The maximum autonomy of the battery pack for the Garnet is approximately 200 hours use, actual autonomy will be dependent upon operational process and Bluetooth usage (with PDA)

It is strongly recommended that the battery is never charged if the capacity showing on the control panel (section 3.2) is more than 4 bars. This will correspond to a minimum of 20 hours use and so the Garnet can be safely used for one shift and then recharged. Displaying the battery status is described in section 4.1 above.

The following procedure should be used when charging the Garnet.

1) Position the Garnet on a flat surface ensuring it is clean and dry.

2) Insert the charger DC jack into the socket found on the underside of the Garnet and then plug the charger unit into the mains supply. The charger has an input operating voltage range of
100VAC to 240VAC, 50-60 Hz.

3) The unit will take approximately 15 hours to charge, assuming a completely uncharged condition.

4) Once the battery is charged, disconnect the charger from the mains supply and remove the charging plug from the instrument. The Garnet is now ready for use.

The instrument should never be left charging for more than 24 hours as this will cause long-term damage to the batteries. If the Garnet is left unused, the batteries will discharge in about 5 months, so it is recommended that the Garnet be recharged approximately every 4 months, even when not in use.

Under normal operating conditions it is not necessary to 'cycle' (discharge and charge) the Garnet batteries, however if the autonomy of the instrument is reduced, a complete discharge cycle may help restore the battery capacity. This is achieved by setting the 'Power' mode to 'Manual' (see section 4.1.4), restarting the Garnet and leaving it on for 24 hours (or until it switches itself off). The unit should then be placed on charge for no more than 24 hours.

Chapter 6

6 Maintenance of the Equipment

Provided the Garnet Digital gauge is handled with care and the operating instructions are adhered to, only minimum maintenance is required.

Always remember that the Garnet digital gauge is an accurate measuring instrument and not a hand tool. It is designed to operate in the railway environment but must at all times be handled with care!!

Note that the Garnet must not be oiled as this may damage the instrument.

6.1 Routine Inspection and Maintenance

- The Garnet should be cleaned after use and any grease that has accumulated should be removed.
- If the Garnet has been used in rain, it should be dried with a clean cloth prior to storage.
- Ensure that the internal battery is regularly re-charged (See chapter 5) in order to prevent long-term damage.
- Regularly check for any signs of damage or misuse.
- Regularly check for excessive play in the measuring paddles.
- Regularly check that the paddle movement is smooth and free from glitches.

6.2 Calibration

Spot checks for calibration accuracy should be carried out as part of the routine maintenance. This is achieved by taking measurements with the Garnet at specific points where the geometry is already known. If a fault is suspected then the instrument must be returned immediately to your local Geismar representative for full calibration or repair.

It is recommended that the Garnet be returned to your local Geismar representative for calibration every 12 months or in accordance to your companies QA policy.

Chapter 7

7 Trouble Shooting

Listed below is a trouble-shooting guide for the Garnet. If after trying the solutions described below the problem still exist, contact your Geismar representative.

- ***The Garnet doesn't switch on:-***

Hold the power on key (↗) down for several seconds. If the display shows no changes or flickering, then charge the battery. See also 'The Garnet Freezes' troubleshooting guide below.

- ***The Garnet only lasts a few hours between charges:-***

Check that the Backlight timer is not set to manual as having the backlight on continuously will significantly reduce the battery life of the Garnet. 'Auto Off' is the recommended setting.

- ***The Garnet displays 'ErrorTrap 7' on the LCD:-***

Re-zero the Garnet using the procedure described in Section 4 of this manual. Please report the error, along with the serial number and firmware version of your unit (displayed on the LCD at start-up) to 'garnet@geismar.co.uk'.

- ***The Garnet has a Cross-level offset error:-***

Rezero the Garnet using the procedure described in Section 4 of this manual.

- ***The Garnet Freezes:-***

Reset the Garnet by holding down the (🛠+☝) buttons for 10 seconds and then release. Once switched off, re-initialise by pressing the (↗) button. If the Garnet does not switch on then it may be necessary to first recharge the battery.

- ***The Garnet does not measure Twist or Groove clearances:-***

Ensure that the Groove measuring mode is 'Enabled' in the setup menu.

Geismar has a commitment to constant improvement of its measuring equipment. Should the Garnet report an error on the LCD screen then please report this error, along with the serial number and firmware version of your unit (displayed on the LCD at start-up) to 'garnet@geismar.co.uk'. It is possible your unit may require a firmware update.

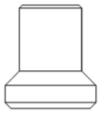
8 Technical Specification

Performance

	Nominal Track Gauge Model				
Parameter	1000	1435	1600	**Accuracy**	**Resolution**
Gauge **(mm)**	-50 to +50	-50 to +50	-50 to +50	±1.0	±0.1
Cross-level **(mm)**	± 150	± 200	± 200	±1.0	±0.1
Groove gap **(mm)**	25 - 120	25 - 120	25 - 120	±1.0	±0.1
* **Check/Running Rail** (mm)	830 - 1025	1265 - 1460	1430 - 1625	±1.0	±0.1
* **Check/Check Rail** (mm)	815 - 1010	1250 - 1445	1415 - 1610	±1.0	±0.1

* Measuring ranges are absolute maximums. Actual range will vary, and maybe less, depending on measurement being taken.

Gauge Thrust Bearings (contact point)

	Shape	**Contact point**
	Cylindrical	0-14mm below rail top (Standard A)
	Shouldered	13-16mm below rail top (Standard B)
		11-14mm below rail top (Standard C)

Batteries Integral rechargeable Ni-MH

Autonomy Nominal 200 hours without backlight

Charging Via external universal input charging unit (110-220VAC 50/60 Hz)

Charging Time 15 hours for complete charge

Weight 3 Kg.

Size Standard 1000 1250mm long x 175mm high x 100mm wide

Standard 1435 1700mm long x 175mm high x 100mm wide

Standard 1600 1850mm long x 175mm high x 100mm wide

8.1 Network Rail NR/L3/TRK/4900 Specific Models

Models (deviation from standard technical specification)

Network Rail Track Inspection Digital Gauge TYPE 2 (incorporates shouldered thrusts)

- **Geismar Garnet P8** (single piece unit)
- **Geismar Garnet P8-T** (two-piece unit)

Parameter	Range	Accuracy	Resolution
Gauge **(mm)**	1410 to 1490	±1.0	±0.1
Groove gap **(mm)**	25 to 125	±1.0	±0.1

Network Rail Layout Inspection Digital Gauge TYPE 3 (incorporates cylindrical thrusts)

- **Geismar Garnet P8-P** (single piece unit)
- **Geismar Garnet P8-P-T** (two-piece unit)

Parameter	Range	Accuracy	Resolution
Gauge **(mm)**	1410 to 1490	±0.5	±0.1
Groove gap **(mm)**	25 to 125	±1.0	±0.1

Electrical Insulation

The Garnet digital track gauge comprises of a yellow GRP body which has an electrical insulation resistance greater than 800 GΩ per cm. It does not interfere with track signals and is compatible for use in Live 3rd and 4th rail areas. It complies with NR/L3/TRK/4900.

8.2 CE Certification

CE Declaration of Conformity

Design Authority	**:**	**Geismar (UK) Limited**, Salthouse Road, Brackmills Industrial Estate, Northampton, England, NN4 7EX
Telephone	:	01604-769191
Fax	:	01604-763154
E-Mail	:	Sales@Geismar.co.uk

Description	:	GARNET Digital Track Gauge
Weight	:	3.00kg
Noise Level (dBA)	:	n/a
Vibration Level (m/s²)	:	< 1

This machine conforms to
The Supply of Machinery (Safety) Regulations 1992
Rail Safety Group Standard GM/RT 1310
EMC Regulations for Railway Applications EN50121
The Low Voltage Directive

Supplied By Societe L. Geismar

N. MacCuaig
UK Development Manager

Attention: Any modification to this gauge without the prior written agreement of the Manufacturer will invalidate this certificate