IMPORTANT!
Before taking this instrument in use we strongly advise you to read this manual carefully.

Operating Instructions for the

HULL ROUGHNESS GAUGE MICROPROCESSOR CONTROLLED

1 GENERAL

1.1 Importance of operating manual
This manual is written in order to become familiar with all the functions and possible applications of the instrument. It contains important instructions about how to use the instrument safely and economically; according to the purpose designated. Following these instructions is not only essential to avoid risks. It also reduces repair costs and down-time and increases the products reliability and service-life.
Anyone who works with the instrument should follow the instructions in this manual, particularly the safety related instructions. Additionally local rules and regulations relating to environmental safety and accident prevention should be observed.

1.2 User-responsibility
The user should
a) only allow persons to work with the instrument who are familiar with the general instructions on how to work safely and to prevent accidents. The use of the instrument should have been instructed duly The safety chapter and the warnings in this manual should have been read and understood; acknowledged as evidenced by their signature.
b) regularly check the safety-awareness of personnel at work.

1.3 Responsibility of personnel
Before commencing work anyone appointed to work with the instrument should pay attention to the general regulations relating to working safety and accident prevention. The safety chapter and the warnings in this manual should have been read and understood; acknowledged as evidenced by their signature.

1.4 Dangers
This instrument has been designed and constructed in accordance with state-of-the-art technology and the acknowledged safety regulations. Nevertheless, working with the instrument may cause danger to the life and health of the operator or to others, or damage to the instrument or other property. Therefore the instrument should only be used for its designated purpose, and in a perfect technical condition. Any defect that could have a negative effect on safety should be repaired immediately.

1.5 Designated purpose
The TQC Hull Roughness Gauge is exclusively designed to perform roughness tests on painted and coated or blasted surfaces as described within the specifications.
Other applications constitute improper use. TQC will not be held liable for damage resulting from improper use.
Designated purpose also includes properly observing all instructions in the operation manual, and adherence to inspection and maintenance schedules.

1.6 Copyright
The copyright of this operating manual remains with TQC.
This operating manual is intended solely for the user and his personnel. Its instructions and guidelines may not be duplicated, circulated or otherwise passed on to others, neither fully, nor partly. Infringement of these restrictions may lead to legal action may be taken if this restrictions are infringed upon.

1.7 Manufacturer's/Supplier's address
TQC – Molenbaan 19, 2908 LL Capelle aan den IJssel - The Netherlands,
T +31(0)10 7900100, F +31 (0)10 7900 129

2 SAFETY INSTRUCTIONS

2.1 Meaning of Symbols
The following symbols for dangers are used in this instruction manual.

Symbol	Explanation	Warning
⚠️ Danger	Possible immediate danger to the life or health of personnel	If this guideline is not noted it can lead to severe danger to health, up to fatal injury
⚠️ Warning	A dangerous situation could be caused	Non observance of this guideline can lead to injury or to damage to equipment.
☞	Special tips and particular information	Guidelines to make optimal use of the instrument.

2.2 Availability of Safety Information
The instruction manual should be kept at the place where the instrument operates.
In addition to the information contained in the instruction manual, general and local regulations for accident prevention and environmental protection shall be kept available and observed.
Always ensure all guidelines in respect of safety and dangers on the instrument are in readable condition.
In case of danger the instrument has to be switched off by means of the emergency-button on the front of the instrument. Then eliminate danger.

2.3 Training of Personnel
- Anyone who operates the instrument should be trained properly.
- It has to be clear who has which responsibility regarding commissioning, set-up of maintenance and repairs, installation, and operation.
- Anyone who hasn't finished training should be supervised by an experienced person while working with the instrument.

2.4 Dangers from Electrical Energy
- Work on the electrical supply may only be done by a qualified electrician.
- The electrical equipment of the instrument must be checked regularly. Loose connections and cable damaged by heat must be corrected immediately.
- If any work is to be done on parts connected to a voltage supply, a second person must be present to switch off the main switch if necessary.

2.5 Points of Special Danger
There are some special points of danger:

⚠️ Danger **Always use supplied neck-strap to free your hands while working on scaffolds or platforms**

2.6 Care, Maintenance, Repairs
- Maintenance and inspection should be carried out at the correct intervals
- Operating personnel should be informed before starting with maintenance or repair work
- Do not open the instrument. In case of malfunction always consult the manufacturer.

2.7 Modifications to the Equipment
- Any modifications or additions or alterations to the instrument may solely be made with permission from the manufacturer.
- All measures involving modifications require written confirmation of approval from TQC
- Instruments which are not in fault-free condition must immediately be switched off
- Only use replacement parts from the original supplier. Parts used from other sources aren't guaranteed to take the loading and meet the safety requirements.

2.8 Cleaning of the Instrument and Disposal of Materials
- When in use it is not always possible to avoid some spill of paint on the work surface.
- Try to keep the instrument as clean as possible to prevent distortions of functions.
- To clean the instrument properly use a suitable solvent to dispose remains of paint or ink.
- Wear gloves during cleaning; Don't spill an overdose of solvent during cleaning.
- Cleaning materials must always be used and disposed of correctly.

3 TRANSPORT AND STORAGE

3.1 Packing
Please take note of pictorial symbols on the packing.

3.2 User: Check on Receipt
Check packing for damage
After unpacking check complete supply.

3.3 Reporting Transport Damage and Documentation
Any damage should be documented as accurately as possible (possibly photographed) and reported to the relevant insurers or, in the case of sales "delivered to customers works", to the supplier.

3.4 Storage and Protective Measures when not in use
The instrument must be stored in a dry place at a temperature between 10 - 40°C.
Store instrument in the original packing if possible.

4 INSTRUMENT DATA

4.1 Name / Article
DC9000 TQC Hull Roughness Gauge – Microprocessor Controlled Hull Roughness Gauge.

4.2 Scope of Supply
- TQC Hull Roughness Control unit with neck-strap
- TQC Hull Roughness Sensor
- TQC Hull Roughness Sensor Cable
- DC9015 Calibration plate
- USB thumb drive with software
- USB connection cable for PC
- 4 x AA batteries included

4.3 Technical Data

Memory capacity:	4000 series of measurements
Power Supply:	Batteries, 4 x AA batteries
Display:	LCD 80mm, illuminated
Interface:	Menu driven interface with 4-way directional push button by Rotation / Pushing

.

4.4 Dimensions and Weight
Sensor Depth:	205 mm
Sensor Width:	80 mm
Sensor Height:	40 mm
Sensor weight:	approx. 630 g

Control unit Depth:	200 mm
Control unit Width:	115 mm
Control unit Height:	40 mm
Control unit weight:	approx. 350 g

4.5 Basic Unit
|	
Power Supply:	Batteries, 4 x AA batteries (included)
Power consumption:	
Display:	LCD 80mm, illuminated
Safety:	Neck-strap
Interface:	Menu driven interface with 4-way directional push button by Rotation / Pushing

5 INSTALLATION AND ASSEMBLY

5.1 Installation and Operation

Carefully unpack the apparatus and the accessories and check complete supply. Please assemble your equipment before climbing upon scaffolds or platforms. Use supplied neck-strap to securely attach the apparatus and prevent possible damage from falling.

5.2 Preparation

Your unit comes with a fresh set of worldwide easily available AA batteries already installed.

Connect the sensor and control unit with the supplied sensor cable. The direction of the cable is not important, both sides of the cable are identical male plugs and interchangeable. Firmly press the plugs in corresponding connectors on both the sensor and control unit. The plug is properly connected and locked into place when you hear / feel a click.
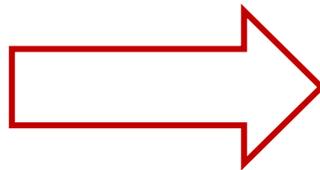
Note: To release the sensor cable from both sensor and control unit push the little fuse button beside both connectors. The plug should be able to eject from the connector without the use of excessive force.

Use supplied neck-strap to securely attach the apparatus and prevent possible damage from falling.

5.3 Operation

The whole unit is operated by one single 4-way directional push button. You can press this button to confirm menu options or rotate it in order to navigate through the menu options.

Turn on your device. Press the Jog knob once to power up the Hull roughness Gauge. If correctly powered up the display briefly shows the TQC logo and the current firmware version.

You are presented following screen when the gauge is ready:
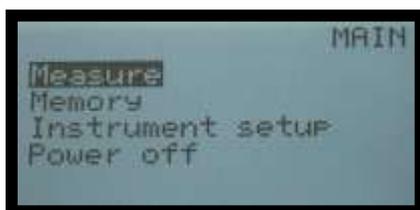
6 INSTRUMENT CONTROLS AND FUNCTIONS

1. Hull Roughness sensor
2. Sensor cable attachment
3. Soft rubber non-slip wheels
4. Status indication / warning lights
5. Neck-strap to securely carry your gauge
6. Hull Roughness Control unit
7. Hull Roughness Sensor cable
8. Illuminated LCD
9. 4-way directional push button
10. Indicating LED for 'Measure'
11. Indicating LED for 'Full series'
12. Indicating warning LED for 'High Speed'
13. Hull Roughness Surface profile probe

7 INSTALLATION AND PREPARATIONS

Carefully unpack the apparatus and the accessories and check complete supply. Please assemble your equipment before climbing upon scaffolds or platforms. Use supplied neck-strap to securely attach the apparatus and prevent possible damage from falling.

7.1 Batteries
Your gauge runs on standard alkaline AA batteries. These batteries are easily available worldwide by local suppliers. The Hull Roughness gauge needs 4 AA batteries to operate.

Note: Only use standard AA alkaline batteries to ensure proper functioning of your gauge. The use of rechargeable batteries is not recommended because they tend to suffer from to big voltage drops possibly influencing measuring results.

Your gauge is supplied with a set of 4 AA batteries.

7.2 Connect your equipment
Connect the sensor and control unit with the supplied sensor cable. The direction of the cable is not important, both sides of the cable are identical male plugs and interchangeable. Firmly press the plugs in corresponding connectors on both the sensor and control unit. The plug is properly connected and locked into place when you hear / feel a click.

Note: To release the sensor cable from both sensor and control unit push the little fuse button beside both connectors. The plug should be able to eject from the connector without the use of excessive force.

7.3 Protect yourself and your equipment
Please assemble your equipment before climbing upon scaffolds or platforms. Use supplied neck-strap to securely attach the apparatus. Using the neck-strap is for your own safety and allows you to free one hand while it also prevents your gauge from falling.

7.4 Switching on your gauge
A single press on the 4-way directional push button will present you with the start-up screen. You are welcomed by our TQC logo and the current firmware version is displayed.

8 MENU DISPLAY INFORMATION AND OPERATION

8.1 Main menu

The TQC Hull Roughness Gauge has an advanced menu structure. The Main Menu allows the user to access all the features available. To select a function turn the Jog shuttle till the selector is on the item and push the Jog shuttle to confirm your choice.

8.2 Instrument setup

The setup menu allows you to calibrate your gauge. The calibrate procedure is explained in chapter 9 on page 15 of this manual. The other options need to be set once before first time use of your gauge.

8.2.1 Setup time and Date

Please set the correct time in your gauge. (24 hour format).

Use the 4-way directional push button to select the digit you would like to change. Confirm your selection with a single press on the 4-way directional push button. Use up- and down buttons till the desired digit is displayed. Confirm your selection with a single press on the 4-way directional push button and Continue with the next digit.

Please set the correct date in your gauge.
(DD/MM/YYYY format)

Use the 4-way directional push button to select the digit you would like to change. Confirm your selection with a single press on the 4-way directional push button. Use up- and down buttons till the desired digit is displayed. Confirm your selection with a single press on the 4-way directional push button and Continue with the next digit.

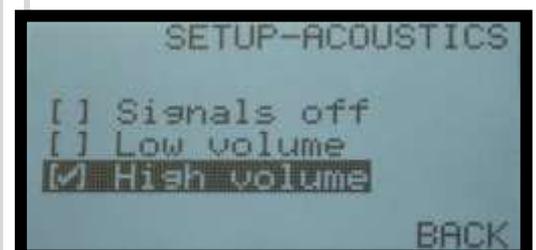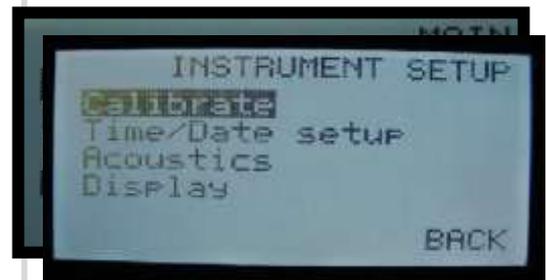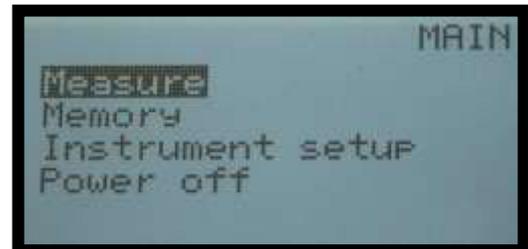☞ Note: Your time and date settings are AutoSaved.

8.2.2 Setup acoustics

The sound level can be adjusted to your needs. You can set the gauge to either: Signals off / Low volume and high volume.

Use up- and down buttons to select the desired acoustics level and confirm with a single press on the 4-way directional push button.

☞ Note: Your acoustics settings are AutoSaved.

8.2.3 Setup display
You can change both backlight and contrast settings.

Use up- and down buttons to select either 'Backlight' or 'Contrast' and confirm with a single press on the 4-way directional push button.

Use left- and right buttons to adjust the 'Backlight' or 'Contrast' level. Confirm with a single press on the 4-way directional push button.

☞ Note: Your display settings are AutoSaved.

8.3 Memory
Measurements can be stored in different batches. The Hull Roughness Gauge can store up to 8 batches that can be named individually.

Click the 4-way directional push button once to select a batch. A checkmark will appear before the selected batch.

Click the 4-way directional push button once more in order to access the batch options.

8.3.1 Batch options
Allows you to either name/rename batches, delete batches and send batches to a personal computer for further data analysis.

8.3.2 Renaming batches
Click 'Rename' to give the batch a name.

Use the 4-way directional push button to select the character you would like to change. Confirm your selection with a single press on the 4-way directional push button. Use up- and down buttons till the desired character is displayed. Confirm your selection with a single press on the 4-way directional push button and Continue with the next character.
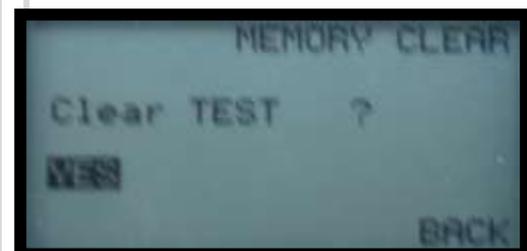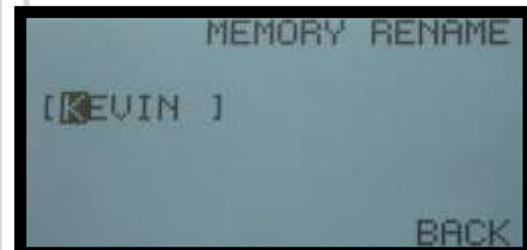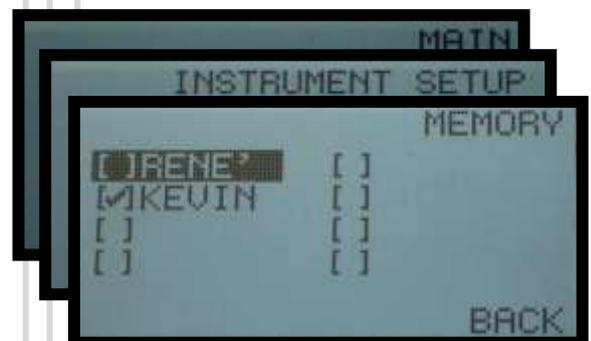
☞ Note: Your batch names are AutoSaved.

8.3.2.1 Clear
Clear allows you to erase all measurements of the selected batch. A single press on the 4-way directional push button will prompt you with a confirmation screen. Confirm the clearing of all batch data with a single press on the 4-way directional push button.

⚠ Warning: Your data is permanently erased!

👉 Note: Depending on the amount of data, deleting data can take up to a minute. Please wait for the progress bar to fully complete the process.

MEMORY CLEAR

Clearing TEST

8.3.2.2 Send data to PC

In order to process your measured data it is essential to send your data to a PC. Before sending the data following precautionary measures need to be taken:

1. Connect your gauge with the PC
2. Open the HRG application
3. Select the proper COM port
4. Click 'Open port'
5. When a connection is established you can confirm to Send your batch data by a single press on the 4-way directional push button.
6. Your raw data appears in the HRG application
7. Press 'Data -> Excel'

MEMORY BATCH1

Rename
Clear
Send data to PC

BACK

👉 Note: More information on setting COM ports is available in chapter 10 on page 16.

MEMORY DUMP

Send BATCH1 to PC?

YES

BACK

8.4 Measure

Once a batch is selected to store your measurements it is time to start your first measurements. Press start to advance.
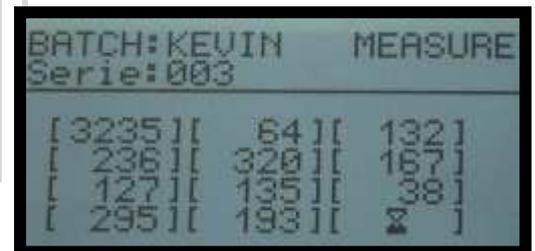
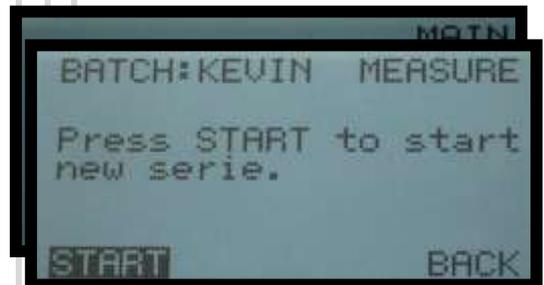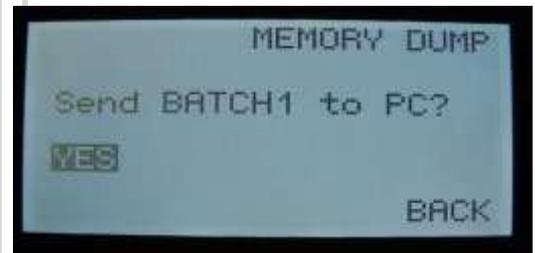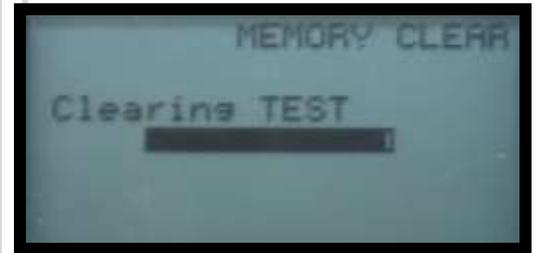In the following screen you can see your selected batch name. 'Series' indicates the taken runs of measurements.

BATCH:KEVIN   MEASURE

Press START to start new serie.

START   BACK

Role the Hull Roughness sensor over the hull's surface, firmly pressing the sensor to the surface. One full run is taken over a length of approximately 90cm.

Keep moving the sensor over the surface until the indication LED 'Full series' starts to blink. A full run will also be indicated by a beep if acoustics are enabled.

BATCH:KEVIN   MEASURE
Serie:003

[⌛][   ][   ]
[   ][   ][   ]
[   ][   ][   ]
[   ][   ][   ]

👉 Note: To enable acoustics see chapter 8.2.2 on page 11 of this manual.

BATCH:KEVIN   MEASURE
Serie:003

[3235][64][132]
[236][320][167]
[127][135][38]
[295][193][⌛]

8.4.1 Accept series

After each measurement the Average Hull Roughness (AHR) of the last series and the AHR of all series is displayed.

If you encounter measurement errors or want to measure the last Hull section once again, simply press 'Back' and redo your measurement. If you agree with the result you can click 'Accept'. In the next step you can allocate your series of measurements to the proper hull section.

8.4.2 Assign measurement-series to hull sections

After accepting the measurement results each series of measurements can be assigned to a specific hull section.

Either a starboard or portside image of the ship is displayed. Use the 4-way directional push button to select the corresponding hull section and click to assign your series to this hull section.

To switch between starboard and portside images select:

'**SB < - > PS'**   (Starboard vs. Portside)

Click the 4-way directional push button to switch the displayed image.

Already measured sections are indicated with a small square.

Once a hull section has been measured you could overwrite the section data. Select the square marked section and click the 4-way directional push button once to overwrite older measurements.

  Note: Overwrites are permanent, you are not asked or warned with a confirmation screen.

.
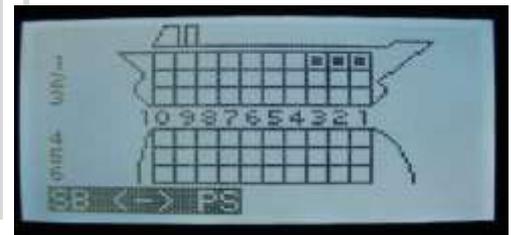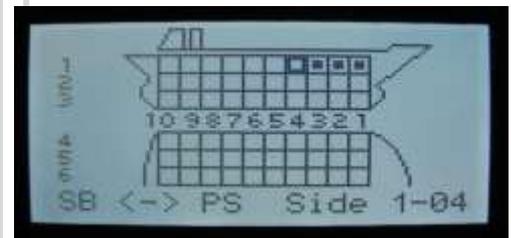
9 CALIBRATION

To ensure proper measurements it is required to regularly calibrate your gauge. Your gauge comes supplied with a calibration plate which contains the reference standard.

👉 Note: Calibration should only be performed in similar climatic conditions as where the actual measurements will take place.

⚠️ Note: For proper calibration allow both units to adjust to the ambient temperature for at least ten minutes. Switch your control unit on and choose instrument set-up, choose calibrate, choose calibrate gauge. Keep your control unit switched on and leave it in calibration mode.
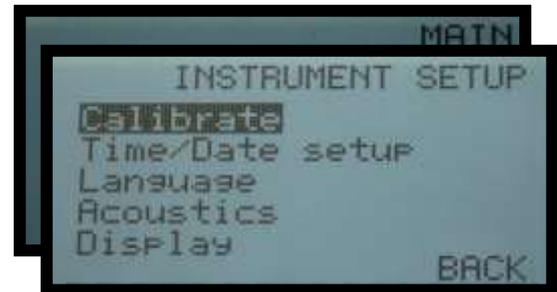
9.1 Calibrate gauge
Selecting the instrument set up menu option 'Calibrate' , calibrate gauge' refers you to this manual for further instructions.

The gauge needs to be calibrated on 4 different points. As soon as you bypass the screen referring to this manual you need to perform the zero reference calibration.

👉 Note: Please watch supplied reference standard closely and notice the different slots.

From left to right: 0000, 0500, 1500 & 2500 micron reference plates.

👉 Note: Proper calibration takes patience and attention. Never try to hurry the procedure. Since the hull roughness gauge measures in microns, a small mistake causes great irregularities in measurements

9.2 Procedure
1. Position the Hull Roughness Surface profile sensor onto the reference standard until it reaches the zero reference plate.
2. Start the calibration procedure on the control unit. If the reference standard is properly positioned your gauge's screen should display a reference value close to 0000*. If it does, enter OK. If it doesn't, check if the sensor is located above the zero reference plate and try again. *
3. Slide the sensor unit until it's positioned on the 0500 micron reference plate. Then enter OK on the control unit.
4. Repeat step 3 for the 1500 and the 2500 micron reference plate.
5. Finally if all reference points are set, confirm your new calibration by pressing 'Synchronize'. If you press "Cancel" the complete procedure will be cancelled.

*Note: If your gauge has never been calibrated or deviates a lot from the reference values repeating the complete calibration process multiple times will improve both accuracy and calibration.

9.3 Program ref. std.

This advanced feature should only be used if you have equipment to exactly measure your reference standard.

This feature should only be changed if the reference standard deviates from the standard 0000, 0500, 1500 & 2500 micron reference.

10 SETTING COM PORTS

The computer system will automatically assign a COM port number to the gauge. Please check Windows 'Device Manager' to learn the assigned COM port.
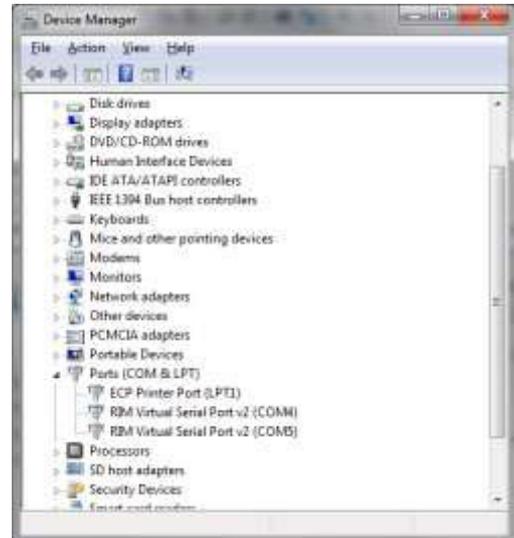
Tip: Windows shortcut to 'Device Manager': Windows key + Pause key

Unfold 'Ports (COM & LPT)'. The gauge is recognized as:

'USB Serial Port (COM…)'

If you have failed to recognize the Hull Roughness Gauge within Windows Device Manager reconnect your gauge and pay close attention to the list in Windows Device Manager as the gauge will reappear here.

10.1 COM ports 1,2,3 & 4
Please set HRG software COM port settings to the assigned COM port. Currently only 4 COM ports are available.

If you gauge is recognized as COM 5 or higher please contact your IT department for a workaround or continue reading next chapter '10.2 COM ports 5 and above'.

10.2 COM ports 5 and above
Your gauge has an assigned COM port number of 5 or higher since 1-4 are in use or have been in use by other computer devices in the past.

10.2.1 If COM port 1-4 are currently occupied
Move one of your devices connected to COM ports 1,2,3 or 4 to port number 5 or above:
- Select the device to move in 'Device Manager' and right click your mouse.
- Subsequently select Properties / Port settings tab / Advanced
- Edit current port number and confirm any changes you have made.
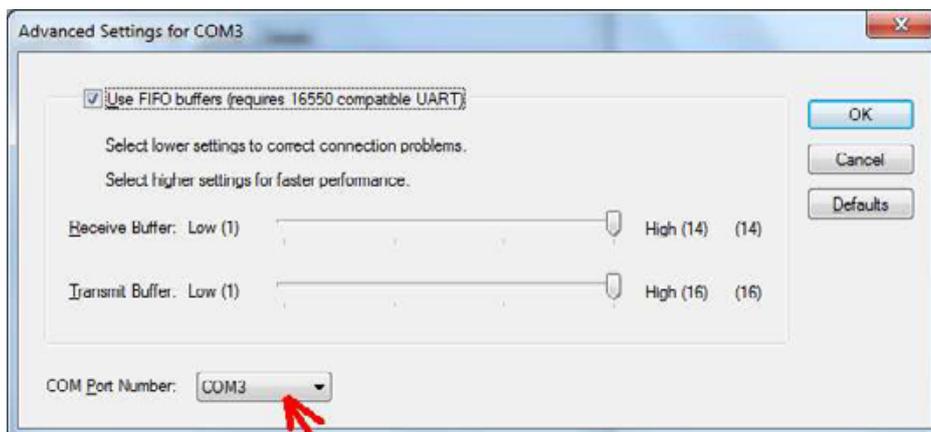
Set current COM (1-4) to 5 or higher.

Subsequently repeat previous steps to move your gauge to either COM ports 1,2,3 or 4.

10.2.2 If COM ports 1-4 are currently not occupied

If COM ports 1-4 are currently not in use but the Hull Roughness Gauge has an assigned COM port number of 5 or higher:

- Select the Hull Roughness Gauge in 'Device Manager' and right click your mouse.
- Subsequently select Properties / Port settings tab / Advanced
- Move your gauge to either COM ports 1,2,3 or 4 and confirm any changes you have made.

11 HRG WINDOWS APPLICATION

11.1 Installation

The HRG application supplied on the USB thumb drive does not require any installation. Double click the HRG V1.01 file to launch the application.

 Your Windows installation might prompt you with a "The publisher could not be verified" message. Please click 'Run' to continue.

11.2 Processing data with the HRG application

This application functions as an interface between your Hull Roughness Gauge and the Microsoft Excel Survey Report.

- Please select the proper COM port (chapter 10 of this manual) and click 'Open Port'.
- Use your gauge to select a batch and send it to the HRG application (chapter 8.3.2.2)
- Click 'Data -> Excel' to generate your Hull Roughness Survey Report.

12 CARE AND MAINTENANCE

12.1 Inspection and Maintenance
- Though robust in design, this instrument is precision-machined. Never drop it.
- Always clean the instrument after use.
- Clean the instrument using a soft dry cloth. Never clean the instrument by any mechanical means such as a wire brush / abrasive paper. This may cause, just like aggressive cleaning agents, permanent damage.
- Do not use compressed air to clean the instrument.
- Generally the TQC Hull Roughness Gauge does not require any maintenance.

⚠ **Warning**   Make sure that no paint or other liquids are spilled on the electronics or left in the holes.

12.2 Disposal of Materials
Disposal of materials used in the operation of the instrument or for auxiliary functions and exchanged items should be dealt with safely and in a manner that will not harm the environment. Follow the local regulations.

12.3 Customer Service
Customer service is provided on request by
TQC – Molenbaan 19, 2908 LL Capelle aan den IJssel - The Netherlands, T +31(0)10 7900100,
F +31 (0)10 7900 129 or by local representatives.

13 DISCLAIMER

The right of technical modifications is reserved.
The information given in this manual is not intended to be exhaustive and any person using the product for any purpose other than that specifically recommended in this manual without first obtaining written confirmation from us as to the suitability of the product for the intended purpose does so at his own risk. Whilst we endeavour to ensure that all advice we give about the product (whether in this manual or otherwise) is correct we have no control over either the quality or condition of the product or the many factors affecting the use and application of the product. Therefore, unless we specifically agree in writing to do so, we do not accept any liability whatsoever or howsoever arising for the performance of the product or for any loss or damage (other than death or personal injury resulting from our negligence) arising out of the use of the product. The information contained in this manual is liable to modification from time to time in the light of experience and our policy of continuous product development.