DELTA – User Guide

WARNING

To reduce the risk of injury, before using or servicing tool, read and understand the following information.
The features and descriptions of our products are subject to change without prior notice.

Revision history

Issue	*Date*	*Description*	*Ref. firmware version*	*Minimum DeltaQC version*
01	04 January 2012	First issue	1.0x	2.0.x
02	13 November 2012	General manual review, added Q54000 statistic, DRT added for quality tests, test scheduling added, SIMAP-Box interface added, Statistics and Settings updated	1.1x	2.2.x
03	02 May 2013	Residual torque/angle automatic added (par.), Quick test added for Delta 6D/7D (par. 8.1), Pset configuration updated (par. 9), Curves viewer updated (par. 21), Statistics updated (par. 19), CVI3 calibration added (par. 8.3.2), Maintenance updated (par. 22), Results via Ethernet added, General manual review	1.3x	2.4.x
04	02 August 2013	Angle peak added, manual barcode insertion added (par. 8.2.3)	1.4x	2.5.x
05	23 January 2014	Results viewer updated (par. 20), Transducer ART added	1.5x	2.6.x
06	20 October 2014	Internal barcode scanner added (par. 3.5 and 8.2.3), Production strategies added (par. 19), “Tightening” added into Demo mode (par. 6.1.4), Customized analog transducer added (par. 5), CVIC II calibration (par. 8.3.3)	2.0x	3.0.x
07	12 February 2015	Result view mode added (par. 20.1.1.8)	2.1x	3.1.x
08	26 May 2015	Introduction – About this document updated (par. 1.1), Torque / Angle parameters updated (par. 9.2), Loose and Tightening updated (par. 15.4), Calculating Correction Coefficient for Extension updated (par. 22)	2.2x	3.2.x
09	12 October 2015	General User Guide review, Transducers updated (par. 5), Torque/Angle parameters updated (par. 9.2), Joints Analysis updated (par. 16), Yield Point added (par. 16.1)	2.3x	3.4.x
10	31 May 2016	General User Guide review, Specifications updated (par. 1.2), Software Installation updated (par. 4.1), Creating a tool updated (par. 8.2.2), Starting a test by the barcode reader	2.4x	3.5.x

Issue	*Date*	*Description*	*Ref. firmware version*	*Minimum DeltaQC version*
		updated (par. 8.2.3.1), Pset updated (par. 9), Main parameters and control strategies updated (par. 9.1), Options updated (par. 9.6), Peak Test – Timeout updated (par. 12.2.1), Results Viewer updated (par. 20)		
11	02 May 2017	Transducers updated (par. 5), added Testing Pulse tools with preload (par 15), Delta settings updated (par. 19), Results viewer updated (par. 21)	2.5x	3.7.x
12	03 October 2017	Executing a Quick Test updated (par. 9.1), Batch options updated (par. 10.4), Test setup for Nutrunner test updated (par. 14.1)	2.6x	3.8.x
13	31 January 2018	Specifications – Interfaces / System requirements updated (par. 1.2), System Overview updated (chapter 2), Transducers chapter updated (chapter 5), Main parameters and control strategy updated (par. 9.1), Timeout options updated (par. 9.3), Batch options updated (par. 9.4), Options updated (par. 9.6), Tool check: Free Angle test added (chapter 16), Statistics updated (chapter 20), Results Viewer updated (chapter 21), Curves Viewer updated (chapter 22), Declaration of Conformity updated	2.7x	3.9.x
14	29 June 2018	Software Installation updated (par. 4.1), Menu list updated (par. 4.2.2), Database backup added (par. 4.3), Executing a Test (par. 8.2.3)	2.7x	4.0.x
15	26 September 2018	About this document updated (par. 1.1), Specifications updated (par. 1.2), System Overview updated (chapter 2), Presentation updated (par. 2.2), Transducers updated (chapter 5), Abbreviations updated (chapter 28)	2.7x	4.1.x
16	30 October 2018	Transducers updated (chapter 5), Configuration updated (par. 20.1.1), Delta date and time updated (par. 20.1.1.2), Delta Factory Settings updated (chapter 27)	2.8x	4.1.x
17	27 January 2019	FCT – Force Clamping Transducer added, Adapters for analog transducers updated (par. 2.2.4), DeltaQC Overview	2.8x	4.3.x

Issue	*Date*	*Description*	*Ref. firmware version*	*Minimum DeltaQC version*
		updated (par. 4.2), Search function updated (par. 4.2.1), Online mode updated (par. 4.2.5), USB connection updated (par. 4.5.1), Ethernet connection updated (4.5.2), Delta LOG file updated (par. 4.6), TRANSDUCERS updated (cap. 5), Creating a Pset updated (par. 8.2.1), Creating a Tool updated (par. 8.2.2), PSET updated (chapter 9), Main Parameters and Control Strategy updated (par. 9.1), OFFLINE MODE updated (chapter 10), Create a Route updated (par. 10.1), K value updated (par. 15.1.4), DELTA FACTORY SETTINGS updated (chapter 27)		
18	29 April 2022	Q-AUDIT added, DLT / DST / DWT / DWTA removed, Presentation updated (par. 2.2), Main Parameters and Control Strategy updated (par. 9.1), Barcode reader scan order updated (par. 20.1.1.9), DELTA FACTORY SETTINGS updated (chapter 27)	2.9x	4.4.x
19	29 July 2022	Main Parameters and Control Strategy updated (par. 9.1), Torque / Angle Parameters updated (par. 9.2); Minimum after breakaway (par. 17.5.1), Residual intersection (par. 17.5.2) and Slope Change (par. 17.5.3) added.	2.10x	4.5.x

NOTE: The programming software DeltaQC may be updated with no changes regarding the Delta functionalities. The minimum version indicated here is required for the reference firmware version.

Table of Contents

SAFETY INFORMATION

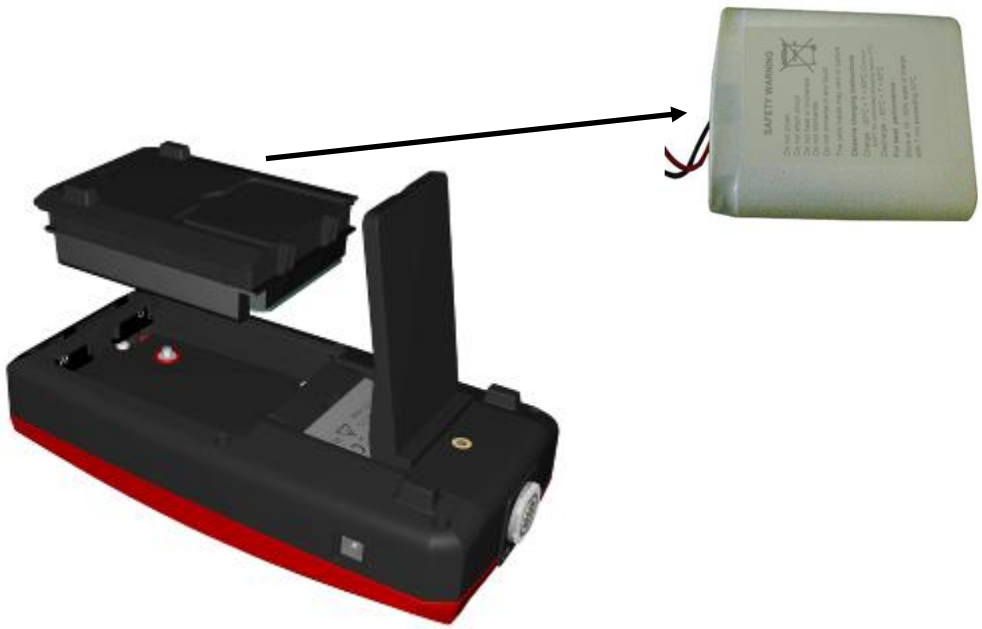
WARNING: PLEASE CAREFULLY READ THE DELTA SAFETY INFORMATION (No. 6159920590) PRIOR TO USE THE PRODUCT AND PAY ATTENTION TO THE SAFETY INSTRUCTIONS PROVIDED.

BATTERIES INFORMATION ACCORDING TO EUROPEAN REGULATION 2006/66/EC

BATTERY SPECIFICATION

TYPE: Lithium-ion, 3.75 V 6.8 Ah
WEIGHT: 155 g

The battery is installed on the back side of the Delta (refer to the picture below):



NOTE: Once removed, the wasted batteries must be dismissed according to local regulations.

NOTE: Refer to the paragraph "*Battery*" for further details.

1 INTRODUCTION

1.1 About this Document

This document is a user manual for the Delta and it is divided into the main following parts:

Part	Name	Description
Chapter 1	Introduction	This part introduces this user manual and provides the Delta technical specifications.
Chapter 2	System Overview	This part introduces the Delta with its models and accessories.
Chapter 3	User Interfaces	This part provides an overview of the user interfaces available on the Delta (LEDs, display, keyboard, ports, etc).
Chapter 4	Working with DeltaQC Software	This part introduces the operations of the Delta management software.
Chapter 5	Transducers	This part explains which types of transducers can be connected to the Delta.
Chapter 6	Getting started with Delta	This part explains to the operator how to execute a Demo test.
Chapter 7	Use of the Delta 1D	This part is dedicated to the specific main menu and settings of the Delta 1D.
Chapter 8	Use of the Delta 6D and 7D	This part is dedicated to the specific main menu and settings of the Delta 6D/7D.
Chapter 9	Pset	This part details all the parameters and tightening strategies available for a tightening or quality control program.
Chapter 10	Offline mode	This part explains how to create test programs on the DeltaQC software even without a Delta connected to the PC.
Chapter 11, 12, 13, 14, 15, and 16	Testing click-wrenches, Peak test, Testing nutrunners, Testing pulse tools, Testing pulse tools – preload, Tool check – free angle test	These chapters explain in detail how to conduct a test on the various tools types.
Chapter 17 and 18	Quality test on joints and Joint analysis	These chapters explain in detail the quality tests available on the Delta 7D.
Chapter 19	Production tightening operations	This part explains the test strategies to execute a tightening operation.

Part	Name	Description
Chapter 20	Delta settings	This part explains the instrument settings performed by the DeltaQC software.
Chapter 21	Statistics	This part explains the statistics calculated after the tests and the formulas used.
Chapter 22 and 23	Results viewer and Curves viewer	These chapters explain how to retrieve results and curves from the Delta to the DeltaQC.
Chapter 24	Calculating correction coefficients for extensions	This part explains how to calcite correction coefficients for extensions.
Chapter 25 and 26	Scheduled maintenance and Troubleshooting guide	These chapters are dedicated to the instrument maintenance and troubleshooting.
Chapter 27	Delta factory settings	This part summarizes the default factory settings of the Delta.
Chapter 28	Abbreviations	Table of the abbreviation used in this manual.

1.2 Specifications

TECHNICAL

- Torque range: defined by the transducer connected to the Delta.
- Angle measurement (only for Delta 6D/7D models)
- Results memory capacity: 1000 test results for Delta 1D; 5000 test results for Delta 6D/7D
- Curves memory capacity: 10
- Sampling frequency:
  - Free mode (track and peak): 1 kHz
  - Click-wrench test: 2 kHz
  - Nutrunner test: 4 kHz
  - Peak test: 1 kHz
  - Pulse tool test: 10 kHz
  - Pulse tool – preload 10 kHz
- Number representation for torque values:

Transducer capacity (C)	*Measured torque shown on display*
C < 10 N·m	1.000, 10.00
10 ≤ C < 100 N·m	1.00, 10.00, 100.0
100 ≤ C < 1000 N·m	1.0, 10.0, 100.0, 1000
C ≥ 1000 N·m	1, 10, 100, 1000

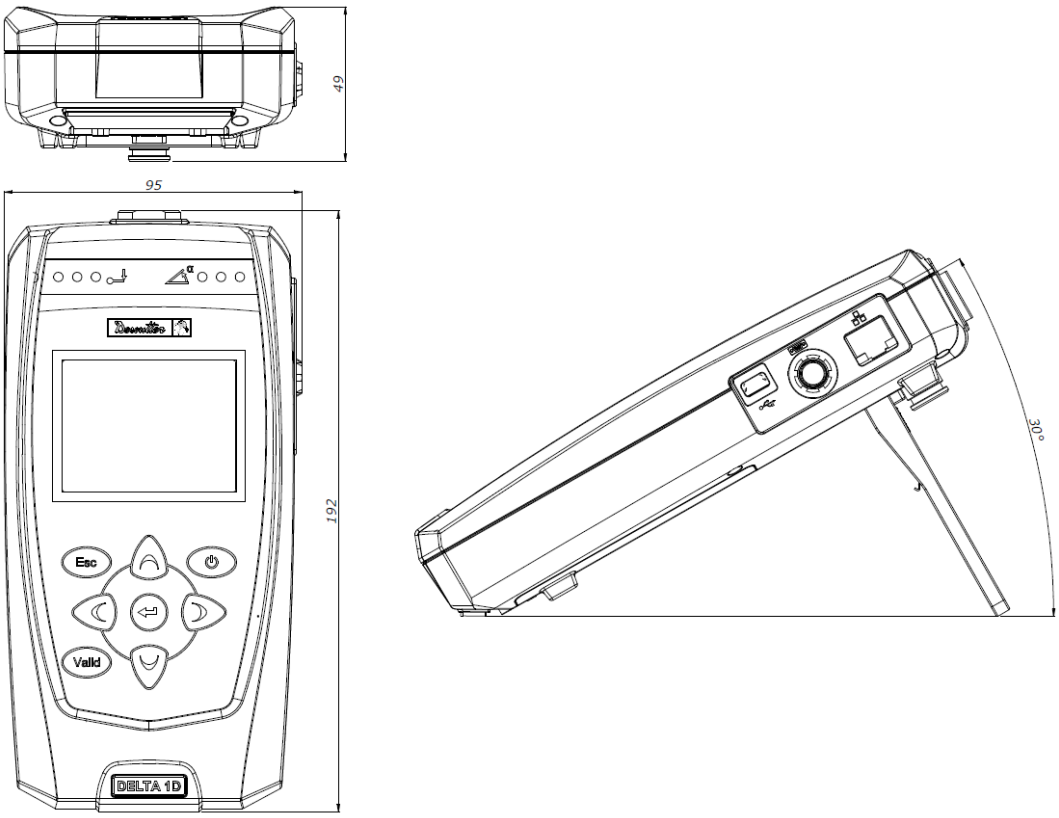
EXTERNAL POWER SUPPLY

- POWER SUPPLY Switching 6VDC 3A Model No. GTM96180-1807-1.05-T3
- Input: 100-240 VAC, 50-60 Hz, 0.6 A
- Output: 5.95 VDC 3A, 18W
- Overvoltage category: II
- IP42
- Separately certified
- Conformity to North American Standards: ETL LISTED; Conforms to UL 1310; Certified to CSA C22.2

BATTERY PACK

- Battery power supply: 3.75 V, 6.8 Ah
- Battery type: Lithium-ion (Li-ion)
- Endurance: 16 hours in operation mode
- Charging time: max. 8 hours

DIMENSIONS AND WEIGHT



Dimensions are in mm.

***Weight**: 500 g*

NOTE: The Delta 1D / 6D / 7D have the same dimensions and weight. For further differences between these models, refer to the paragraph "*Delta Models*".

ENVIRONMENTAL

- Indoor use only
- Altitude up to 2000 m
- Environmental Class II
- Pollution degree 2
- Overvoltage category II
- Mains supply voltage fluctuations: ± 10 %
- Ambient temperature: 5 °C to 40 °C / 41 °F to 104 °F
- Atmospheric humidity: 10% to 75% (non-condensing)
- Maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C
- Battery Operating Temperature: -20 °C to +60 °C / -4 °F to 140 °F

INTERFACES

- MiniUSB 2.0 port
- Barcode reader (for Delta 7D model only):
  - Visible laser diode 655 nm *
  - Output power: 390 µW maximum *
  - Scan rate: 104 ± 12 scans/second (bi-directional)
  - Scan angle: 47° ± 5°
  - Scan patterns: Linear
  - Laser Safety: IEC 60825-1:2014 class 1 (class 2 when open)

  * *Values measured on the radiation emitted by the Delta with the protection glass*
- Serial port for:
  - Barcode reader interface. The barcode reader must be configured with start of text 02 (hexadecimal) and end of text 03 or 0D (hexadecimal).
  - CVI II / CVI3 calibration
  - Simap-Box
- Transducer connector for:
  - DRT
  - DSTxs
  - Q-AUDIT
  - FCT
  - PST
  - ART
  - CMD series (CMD adapter required (refer the paragraph "*Adapters for analog transducers*" for adapter pin-out)).
  - ST series (CMD adapter required (refer the paragraph "*Adapters for analog transducers*" for adapter pin-out)).
  - GSE series (CMD adapter required (refer the paragraph "*Adapters for analog transducers*" for adapter pin-out)).
  - Custom transducers (CMD adapter required (refer the paragraph "*Adapters for analog transducers*" for adapter pin-out)).

SYSTEM REQUIREMENTS

The following are the PC minimum requirements for installation of the management software DeltaQC:

- Processor: 800 MHz or above
- Memory: 256 MB or above
- Hard disk space: 10 GB
- Display: 800 x 600, 256 colors (1024 x 768, High Color (16-bit) recommended)
- Operating Systems: Windows XP SP3, Windows 7, Windows 8, Windows 8.1, Windows 10
- Internet Explorer 5.01 or later (required for installation of the .NET Framework)
- Windows Installer 3.1
- Microsoft Excel (required to view the exported file with the tightening results)

NOTE: A system should meet these or the minimum requirements for the operating system, whichever is higher.

1.3 EC Declaration of Conformity

The Delta is in conformity with the following Directive(s):

- 2014/30/UE EMC Directive – Electromagnetic Compatibility
- 2011/65/EU RoHS2 Directive – Risk Of Hazardous Substances
- 2012/19/EU WEEE Directive – Waste of Electrical and Electronic Equipment

Harmonized standard applied:

- EN 61010-1:2010 + A1 2016
- EN 61326-1:2020

USA:
FCC Compliance: FCC 15.107:2019 and FCC 15.109:2019

CAN:
ICES 003 Issue 7:2020

2 SYSTEM OVERVIEW

The Delta 1D/6D/7D are instruments designed for optimal operations in:

- ***Tools testing***: The Delta offers a set of tests for evaluating click-wrenches, slip-wrenches, nutrunners and pulse tools, measuring the torque values and producing results with statistical parameters. This makes possible to keep the quality of the tightening operations on a production line under control. The test results can be retrieved by the Delta management software (DeltaQC), or exported into Microsoft Excel.
- ***Quality test on joints***: The Delta 7D model offers also a set of strategies to perform residual torque check on joints, including the joint analysis function to analyze the joint torque/angle characteristics.
- ***Production tightening operations***: The Delta 7D model offers a set of strategies to perform a tightening operation, controlling the tightening in torque only or torque and angle.

2.1 Delta Models

This paragraph provides an overview of the "*Delta Models*":

	Delta 1D	Delta 6D	Delta 7D
FUNCTIONS			
Demo mode	**YES**	**YES**	**YES**
Click Wrench test	**YES**	**YES**	**YES**
Peak test (Slip Wrench)	**YES**	**YES**	**YES**
Nutrunners test	**YES**	**YES**	**YES**
Pulse Tool test	**YES**	**YES**	**YES**
Quick Test	**YES***	**YES**	**YES**
Pset definition	**-**	**1000**	**1000**
Angle measurement	**-**	**YES**	**YES**
Statistic Control and Cm-Cmk	**-**	**YES**	**YES**
Integrated barcode reader	**-**	**-**	**YES**
External barcode connection	**-**	**YES**	**YES**
Tool database	**-**	**1000**	**1000**
Results viewer	**YES**	**YES**	**YES**
Curves viewer	**YES**	**YES**	**YES**
Quality strategies	**-**	**-**	**YES**
Joint analysis	**-**	**-**	**YES**
Production tightening	**-**	**-**	**YES**
CVI calibration	**-**	**YES**	**YES**
Analog transducers	**-**	**YES**	**YES**
SIMAP-Box interface	**YES**	**YES**	**YES**

* Quick test mode of the *Delta6D/7D* is equal to the operation mode of the *Delta1D*

2.1.1 Delta 1D (*P/N 6159351010*)

The Delta 1D provides a demo mode menu (track or peak functions) and the test function of wrenches, nutrunners and pulse tools. The measurements are made only in torque.

The results and curves are stored in the Delta memory and can be retrieved (and possibly printed) by the management software (DeltaQC); they can be exported to Excel and possibly printed.

2.1.2 Delta 6D (*P/N 6159351020*)

The Delta 6D provides a quick test menu (track, peak and tachometer functions) and the test of wrenches, nutrunners and pulse tools. The quick test menu provides also a set of predefined test for wrenches, nutrunners and pulse tools, to start a test in few steps.

Furthermore, it provides Tools and Pset definition, statistics, and angle measurement, CVI II / CVI3 / CVIC II calibration.

Barcode reader connection is supported on the serial port, to associate a barcode to the test program, or to start the test program by scanning a specific string.

The results and curves are stored in the Delta memory and can be retrieved (and possibly printed) by the management software (DeltaQC), or exported to Excel.

2.1.3 Delta 7D (*P/N 6159351470*)

The Delta 7D provides a quick test menu (track, peak and tachometer functions) and the test of wrenches, nutrunners and pulse tools. The quick test menu provides also a set of predefined test for wrenches, nutrunners and pulse tools, to start a test in few steps.

Furthermore, it offers quality tests to evaluate the residual torque on joints and production tightening strategies. Joint analysis function is also available.

It provides Tools and Pset definition, statistics and angle measurement, CVI II / CVI3 / CVIC II calibration.

An integrated Barcode reader is available to associate a barcode to the test program, or to start the test program by scanning a specific string. An external barcode reader can be used as well.

The results are stored in the Delta memory and can be retrieved (and possibly printed) by the management software (DeltaQC), or exported to Excel.

2.2 Presentation

The Delta consists of the following parts:

	**Delta controller** The main part that contains all the hardware and firmware. It is provided with battery.
	**External power supply (*P/N 6159361430*)** The external power supply is mainly used for battery recharge. If the battery is disconnected, the Delta can be powered by the external power supply.
	**DeltaQC software** The Alpha management software. It allows Alpha configuration and retrieving results and curves from the instrument.
	**Delta battery (*P/N 6159361420*)** Power supply, included with Delta.
	**Delta clip** Clip to be fixed on the operator's trousers. The Delta can be easily attached and removed from the clip.

The following accessories can be also ordered:

P/N 6159361410	**Delta rubber protection** Rubber protection recommended to protect the device.
P/N 6159365300	**Delta neck holder** Case and lanyard to carry the device hands-free.
P/N 6159174300	**Cable for transducers 2m length** Cable to connect the Delta to the DRT, DSTxs, Q-AUDIT, FCT and PST.
P/N 6159174330	**Cable for transducers 5m length** Cable to connect the Delta to the DRT, DSTxs, FCT and PST.
P/N 6159174320	**Cable for transducers spirally wound, 2m length stretched** Cable to connect the Delta to the DRT, DSTxs, FCT and PST.
P/N 6159176710	**ART 4, CMD and ST 4000 Adapter** Cable to connect the Delta with the ART 4, CMD ST 4000 and custom transducers.
P/N 6159176720	**ART 5, CMD 5000 Adapter** Cable to connect the Delta with the ART 5, CMD 5000 and custom transducers.
P/N 6159176700	**RS232 Cable + Adapter** Cable with adapter to connect the Delta to a barcode reader and for CVI calibration.
P/N 6159176740	**GSE 2500 Adapter** Cable to connect the Delta to the GSE 2500 and custom transducers.
P/N 6159176750	**GSE 8500T Adapter** Cable to connect the Delta to the GSE 8500T and custom transducers.
P/N 6159176760	**GSE 8500T/A Adapter** Cable to connect the Delta to the GSE 8500 T/A and custom transducers.
P/N 6159361400	**Delta Demo Case (empty)**

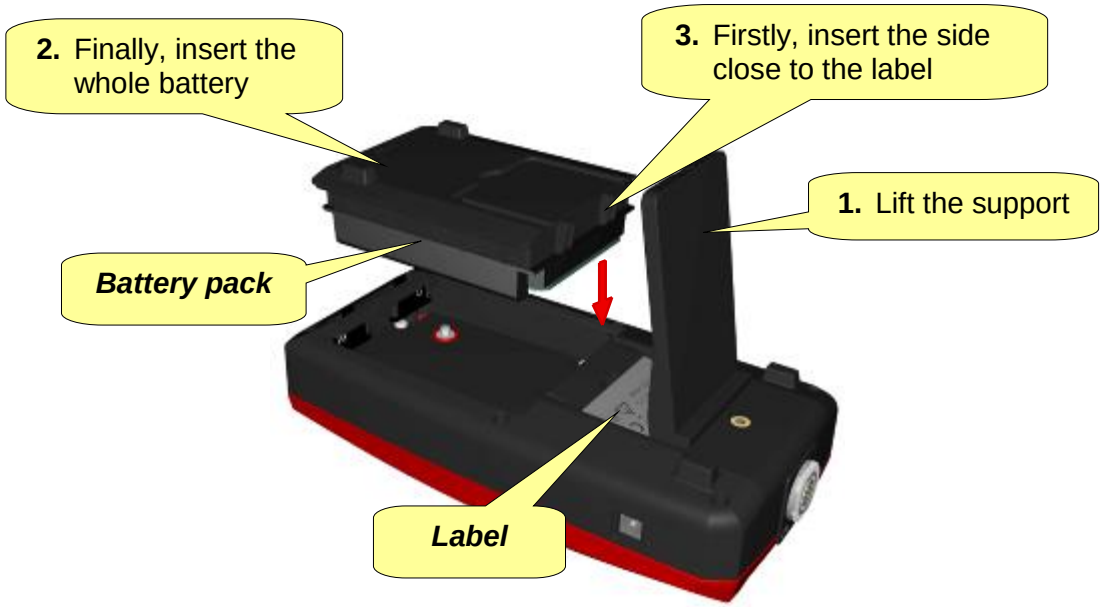
The Delta is ready for working either by connecting the power supply or inserting a charged battery.
It is characterized by the following features:

The next paragraphs describe all the Delta components and user interfaces in detail.
To start working with the Delta immediately, refer to the paragraph "*Getting started with Delta*".

2.2.1 Battery

The Delta can operate powered either by its battery pack or by the external power supply.

NOTE: The rechargeable Lithium-ion battery ensures over 16 hours of operating time.



To install the battery into the Delta, turn off the Delta and install the battery, following the above instructions.
To replace a battery, switch off the Delta, remove the battery and install a new one, following the above instructions.

NOTE: Refer to the paragraph "*Battery Pack Maintenance*" for further details about how to keep battery in a good working order.

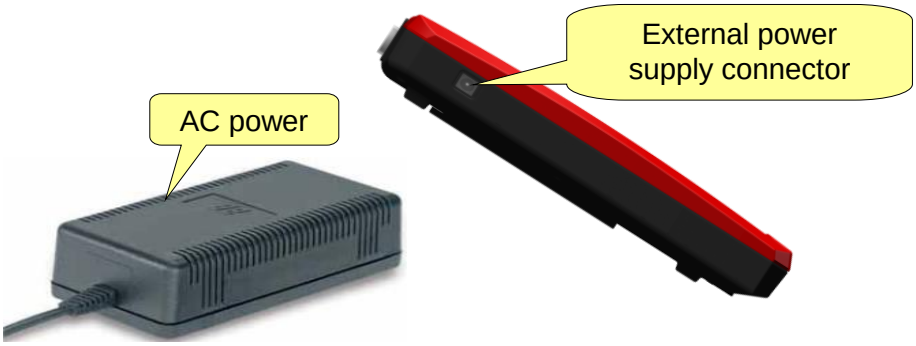
2.2.2 External power supply

The external power supply charges the battery, even when the Delta is switched off. The battery icon on the Delta display shows the recharging process only when the Delta is switched on.
The external power supply can also be used to power on the Delta if the battery is not installed.

Connect the external power supply to an earthed socket AC power 100-240 VAC 50-60 Hz, and plug the connector into the Delta.

NOTE: The socket-outlet shall be near the equipment and shall be easily accessible.

NOTE: The cord for connection to the mains cannot be replace by inadequately rated cords.



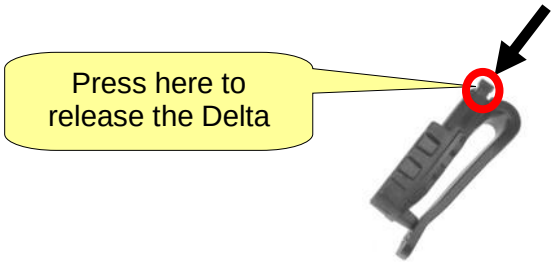
WARNING: Use only the power supply ordered from Desoutter. Warranty will not cover damages to the Delta caused by the use of a different external power supply.

2.2.3 Delta clip

The clip can be fixed on the operator trousers. The Delta can be easily attached and removed from the clip.

Attach the Delta to the clip by sliding the support into the clip:

To remove the Delta from the clip, press the button on the bottom of the clip and extract the Delta.



2.2.4 Adapters for analog transducers

A set of adapters is available to connect analog transducers (ART, CMD, ST 4000, GSE, Custom transducers) to the Delta.

To connect the adapter to the Delta, use the same cable for connecting the Desoutter digital transducers:

WARNING: Do not connect or disconnect the transducer while the Delta is switched on; it may cause damages to both the Delta and the transducer.
Always switch off the Delta before connecting or disconnecting the transducer.

NOTE: Refer to the paragraph "*Transducers*" for further details.

The following tables show the transducer connector pin-out (to connect a custom transducer) for all of the adapter models:

P/N 6159176720 - ART 5, CMD 5000 Adapter

Pin	Description
A	Phase A encoder
B	Phase B encoder
C	+ 5V
D	0V
E	Not connected
F	Not connected

Pin	Description
G	Ground /shield
H	Not connected
J	+ 5V Torque excitation
K	- 5V Torque excitation
L	+ Torque signal
M	- Torque signal

P/N 6159176710 - ART 4, CMD and ST 4000 Adapter

Pin	Description
A	+ 5V Torque excitation
B	- 5V Torque excitation
C	+ Torque signal
D	- Torque signal
E	Ground /shield
F	Not connected

P/N 6159176740 – GSE 2500 Adapter

Pin	Description
A	+ 5V Torque excitation
B	- 5V Torque excitation
C	+ Torque signal
D	- Torque signal

P/N 6159176750 – GSE 8500T Adapter

Pin	Description
A	+ 5V Torque excitation
B	- 5V Torque excitation
C	+ Torque signal
D	- Torque signal
E	Not connected
F	Not connected

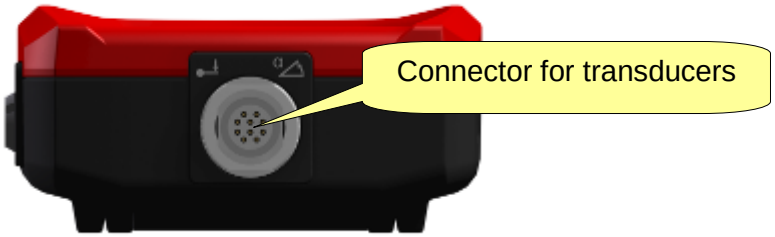
P/N 6159176760 – GSE 8500T/A Adapter

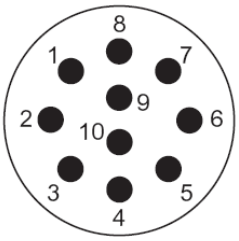
Pin	Description
A	+ 5V Torque excitation
B	- 5V Torque excitation
C	+ Torque signal
D	- Torque signal
E	0V

Pin	Description
F	+ 5V
G	Phase A encoder
H	Not connected Phase B encoder
J	Ground /shield
K	Not connected

3 USER INTERFACES

3.1 Transducer Connector





The ten pins connector is available to connect the transducers to the Delta.

The connector pin-out is as follows:

Pin	Description	Pin	Description
1	MOSI	*6*	- 15 V (- Mains supply)
2	CLOCK	*7*	CDE. CAL
3	CS. MEM	*8*	MISO
4	CS. ADC	*9*	CS. MON
5	+ 15 V (+ Mains supply)	*10*	A. GND

The models of the connecting cables for transducers are as follows:

- 2m (*P/N 6159174300*)
- 5m (*P/N 6159174330*)
- spirally wound 2m stretched (*P/N 6159174320*)

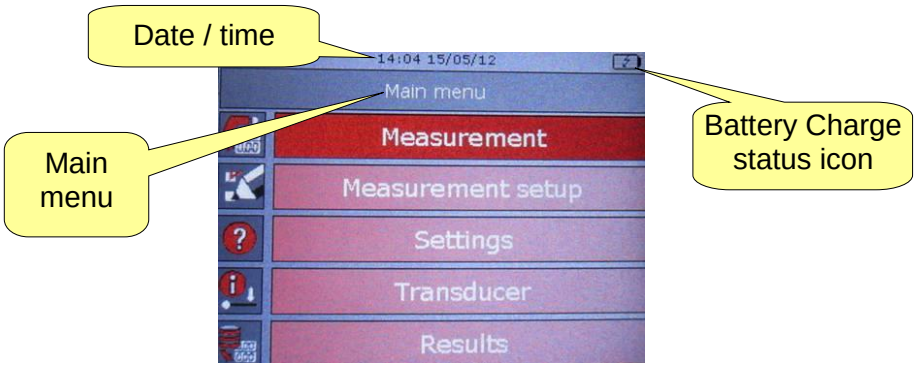
3.2 LEDs

Two set of three LEDs provides information about the ongoing test. One set is dedicated for the torque result, while the other is dedicated for the angle result (and thus it is not active for the Delta 1D).

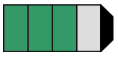
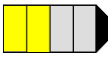
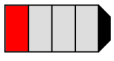
OK (green)	Result *OK*
Low (yellow)	Result low
High (red)	Result high

3.3 Display

The Delta display allows the user to explore the Delta menu, and monitoring torque and angle during the tightening operation:

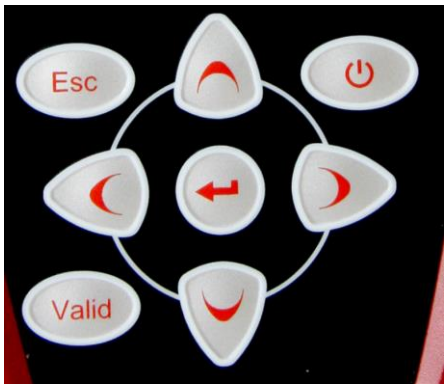


The battery charge status icon shows the battery status:

Icon	Description
	Battery charge over the 75% of the battery capacity.
	Battery charge between 50% and 75% of the battery capacity.
	Battery charge between 25% and 50% of the battery capacity.
	Battery charge under the 25% of the battery capacity; the battery should be recharged.
	External power supply connected to the Delta.

3.4 Keyboard

Use the keyboard to browse the Delta menu:

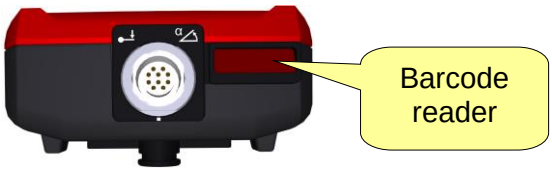


Icon	Name	Description
	ON	Switch on the Delta.
	ENTER	Enter menu.
	RIGHT	Explore curve.
	UP	Up (browse menu), increase value in settings menus.
	DOWN	Down (browse menu), decrease value in settings menus.
	LEFT	Explore curve.
	Esc	Exit menu.
	Valid	Confirm button.

NOTE: The ***Enter*** and ***Valid*** buttons have different meaning: the ***Enter*** button is used only to enter the various menu of the Delta, while the ***Valid*** button is required for all of the operations where the user is asked to confirm a choice (for example, when entering a parameter, selecting an option, validate a setting).

3.5 Barcode Reader

WARNING: CLASS 1 LASER PRODUCT
CAUTION – CLASS 2 LASER RADIATION WHEN OPEN DO NOT STARE INTO BEAM
IEC 60825-1:2014



The Delta 7D is characterized by an integrated barcode reader, to scan barcode strings for easy traceability. The barcode reading can be also used to automatically start a test program.

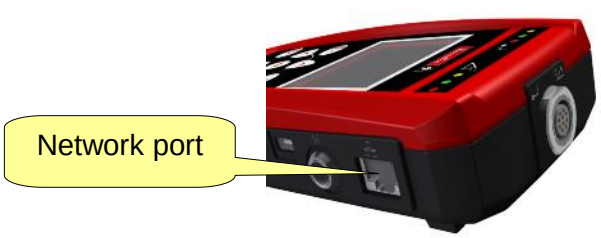
NOTE: The barcode reader is present only in *Delta 7D* (***P/N 6159351470***).

3.6 Buzzer

Along with the onboard LEDs, the Delta has also a buzzer, to give more indications on the result of the current operation. A high tone is emitted in case of *OK* result, while a lower tone is emitted in case of test *Not OK*.

NOTE: For further details, refer to the specific chapters for various tests available on the Delta.

3.7 Ethernet Port

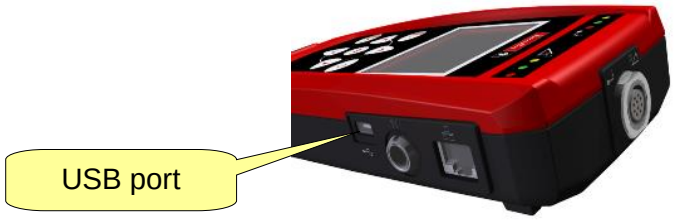


The Ethernet port can be used (as the USB port) for programming the Delta with the DeltaQC software.
It is also possible to export test results on the Ethernet port.

NOTE: The Delta 1D does not support the Ethernet connection.

Refer to the paragraph "*Connecting with the Delta*" for further details.

3.8 Mini USB Port



The USB port is available for programming the Delta with DeltaQC software.
It is also used for firmware upgrade (reserved for Desoutter Service Personnel).

Refer to the paragraph "*Connecting with the Delta*" for further details.

3.9 Serial Port

The "*Serial Port connector*" is available for the following functions:

Connect an external barcode reader to the Delta 6D/7D. The barcode reader can be used either to select the test to be performed by a barcode scanning or to associate the barcode to the test results. Refer to the paragraph "*Pset*" for further details.

NOTE: The serial cable to be connected to an external barcode reader (using a standard serial connector) can be ordered from Desoutter.

NOTE: The external barcode reader must be configured with start of text 02 (hexadecimal) and end of text 03 or 0D (hexadecimal).

- Connecting with CVI II / CVI3 / CVIC II for calibration.
- Export test results for SIMAP-Box.

WARNING: When using the SIMAP-Box interface, the serial port cannot be used for the CVI II / CVI3 / CVIC II calibration functions. To calibrate the CVI II / CVI3 / CVIC II, the SIMAP-Box interface must be left disabled. Refer to the paragraph "*Enabling the SIMAP-Box*" for further details about how to enable/disable the SIMAP-Box.

4 WORKING WITH “DELTA QC” SOFTWARE

DeltaQC is a PC software package developed to manage the Delta.

It offers easy user-friendly programming and real time monitoring of the instrument.

DeltaQC serves as an interface between the user and the Delta. With DeltaQC, users can configure the Delta, and receives the results and curves.

The main features that characterize the interaction between DeltaQC and Delta are as follows:

- Tools and Pset definition
- Review of results from the Delta
- Review of curves from the Delta
- Statistic calculation
- Settings of the Delta

NOTE: DeltaQC saves the tightening programs, results and curves in a local database.

4.1 Software Installation

NOTE: Do not install the software from a shared folder/drive. Install the software from the supplied CD/USB key; if the CD/USB key content is copied into a PC folder, it must be a PC local folder.

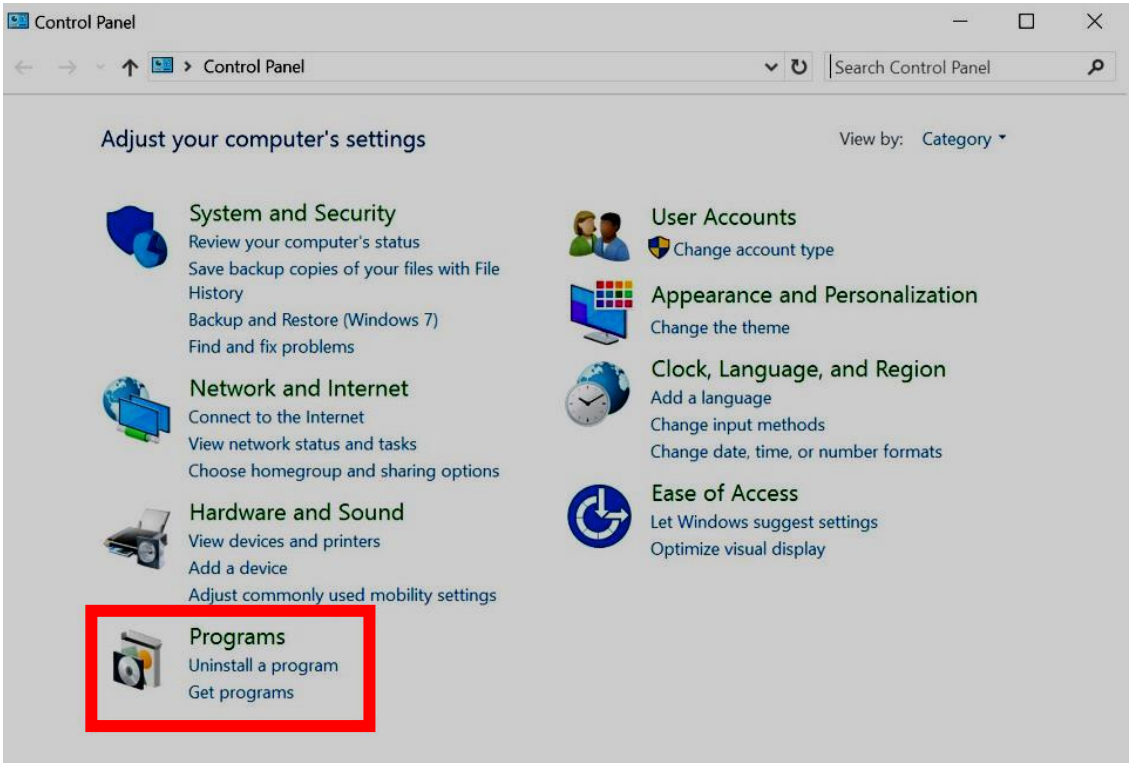
NOTE: If a version equal to 3.9.0 (or previous) is upgraded to a version equal to 4.0.0 (or later), it is recommended to perform the migration of data from SQL Server database to SQLite database before launching DeltaQC.

NOTE: Make sure to read the Installation Instructions contained in the ***ReadMe*** file before starting DeltaQC installation.

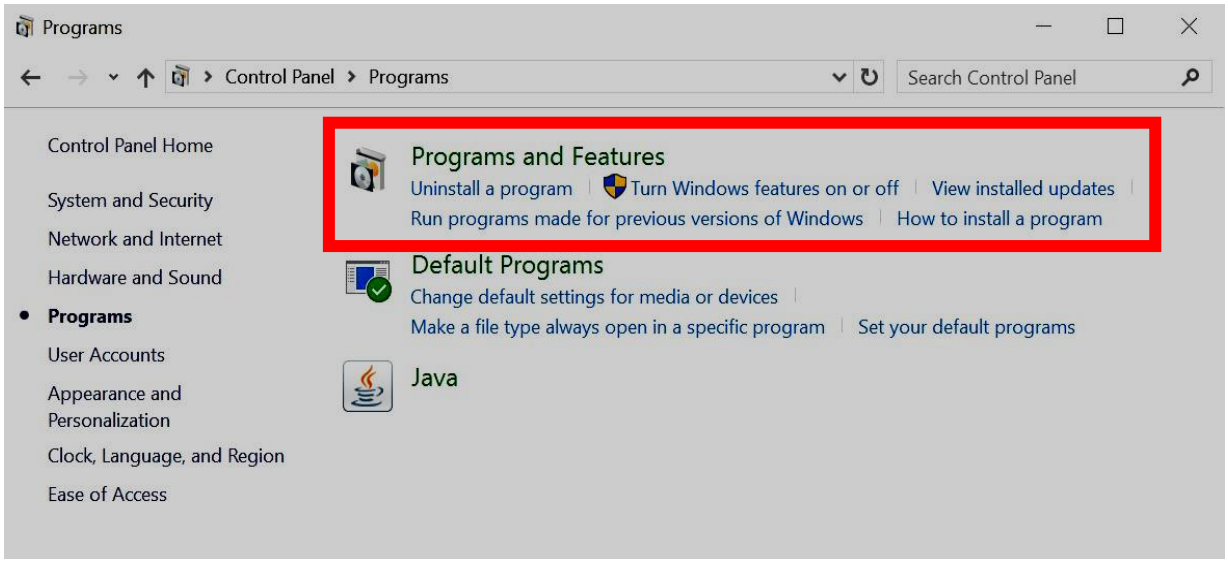
If DeltaQC is already installed on the PC and it is characterized by a version equal to 3.9.0 (or previous), it is MANDATORY to uninstall it BEFORE executing the new setup.

To uninstall previous versions, act on the control panel as explained in the following procedure:

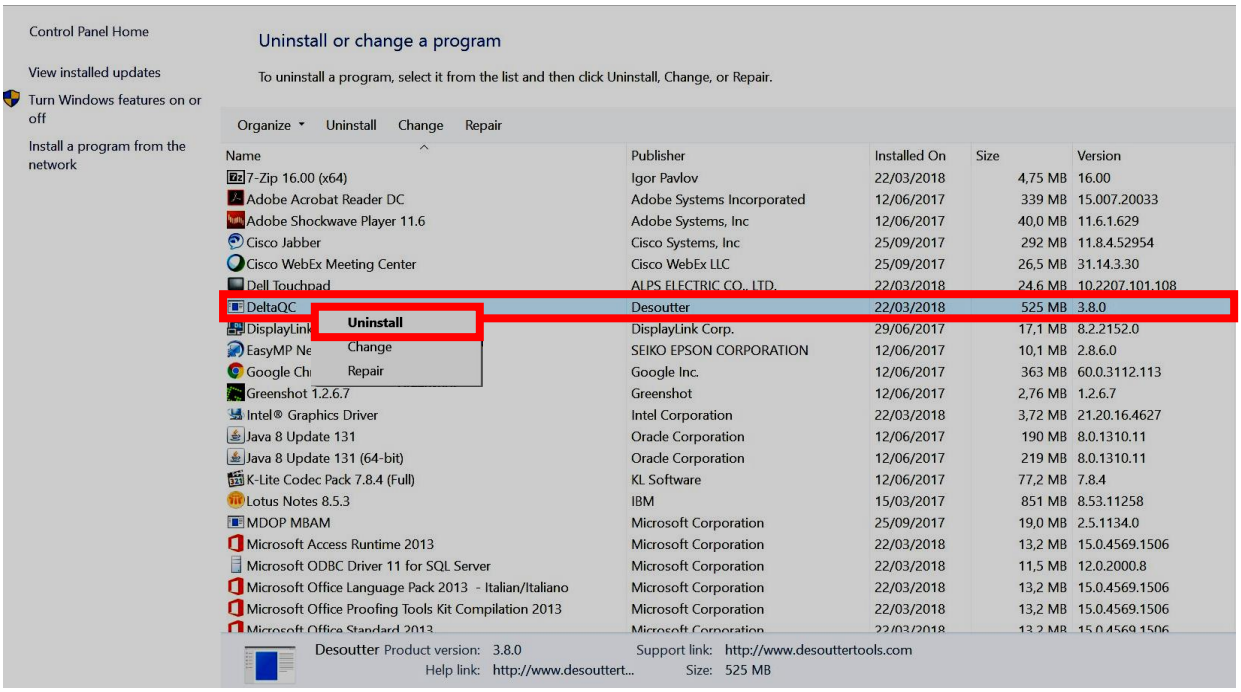
- Open the "***Control Panel***" and click on "***Programs***":



The following screen is shown:

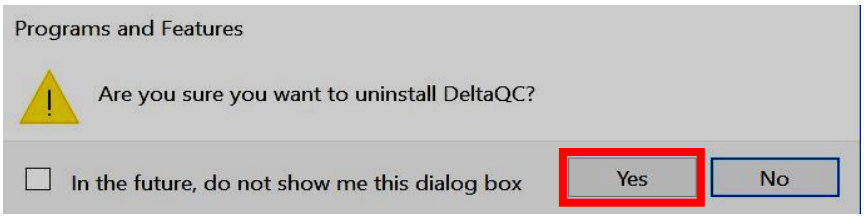


- To uninstall (or change) programs on the PC, click on "***Programs and Features***" (refer to the above screen). The following screen is displayed:



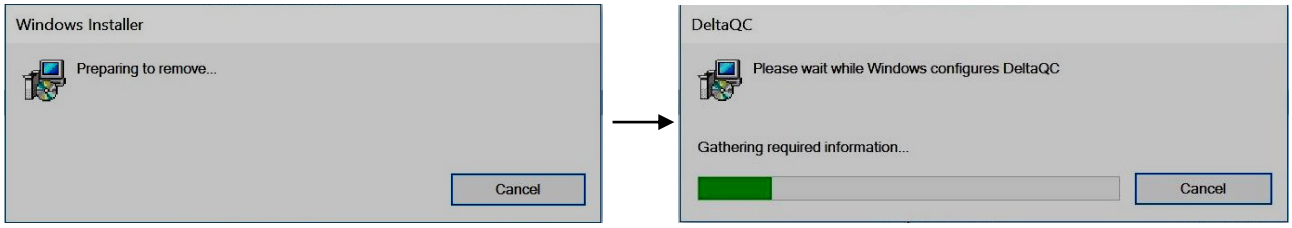
Select "DeltaQC" from the list. Click on the right button of the mouse and finally select "Uninstall" in order to uninstall DeltaQC from the PC.

- After clicking on "Uninstall", the following pop-up is shown:



Click on *Yes* to confirm uninstalling the DeltaQC.

- After clicking on *Yes* (refer to the above pop-up), *Windows Installer* is preparing to remove DeltaQC. The following pop-up are shown until DeltaQC is completely removed:



If DeltaQC is either not installed, or already installed on the PC and it is characterized by a version equal to 3.9.0 (or previous), execute the new setup.

NOTE: For the operating systems *Windows 7*, *Windows 8*, *Windows 8.1* and *Windows 10*, run the executable file by clicking on the right button of the mouse and selecting "*Run as administrator*".

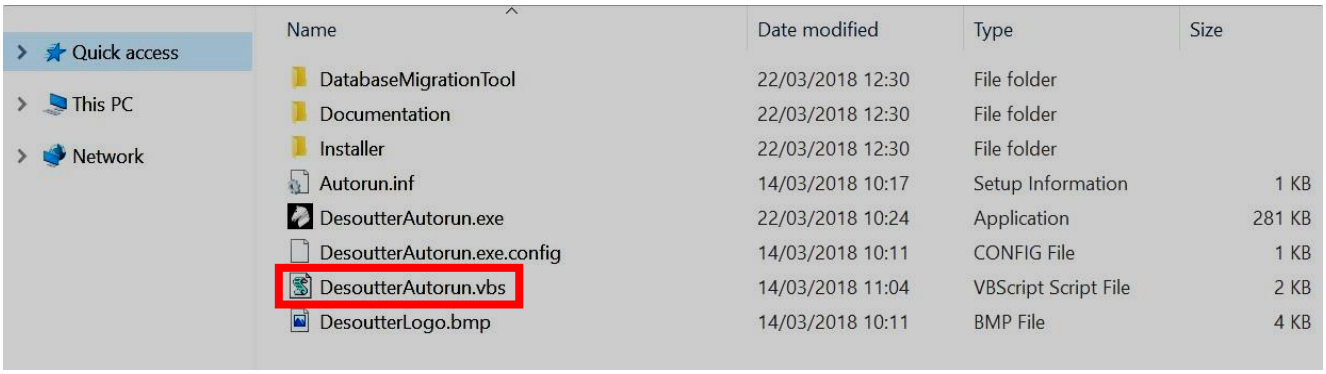
To install DeltaQC Software, insert either the *CD* or the *USB key* in the PC.

If the CD is inserted in the PC, the following pop-up is shown (according to *Autoplay Settings* set on the PC):

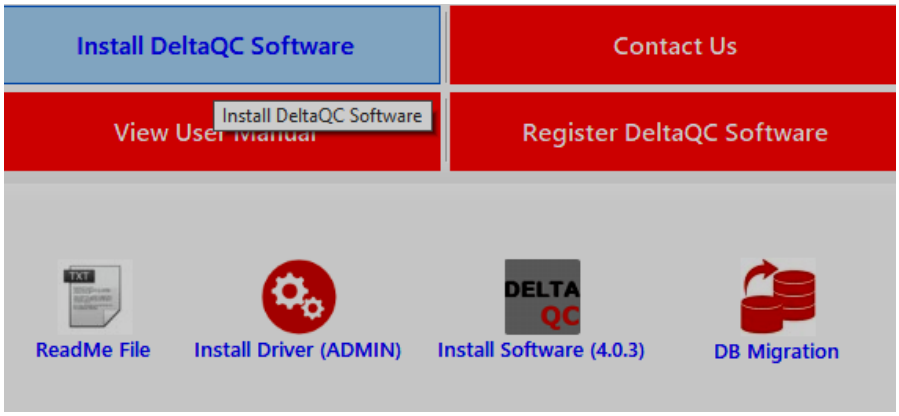
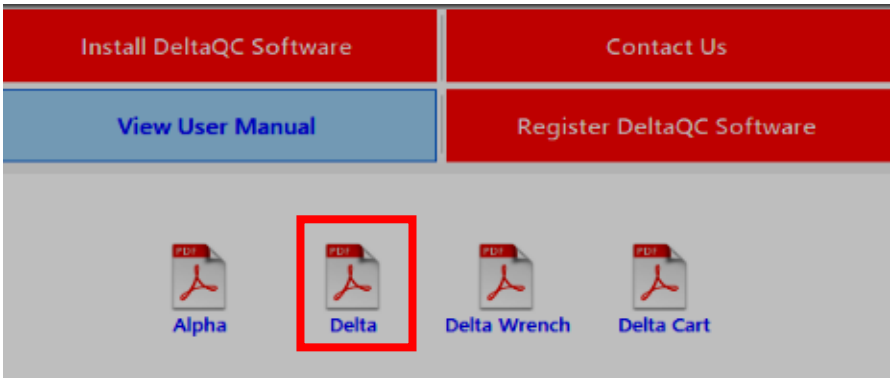
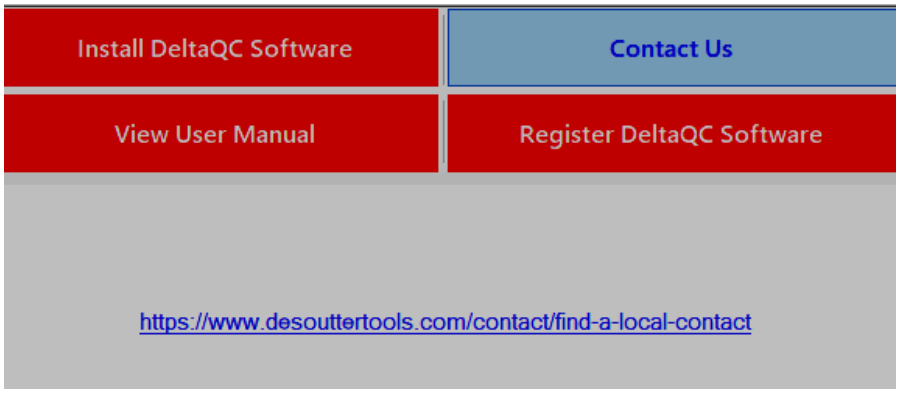
Click on "***Run DesoutterAutorun.vbs***" and wait for the following window:

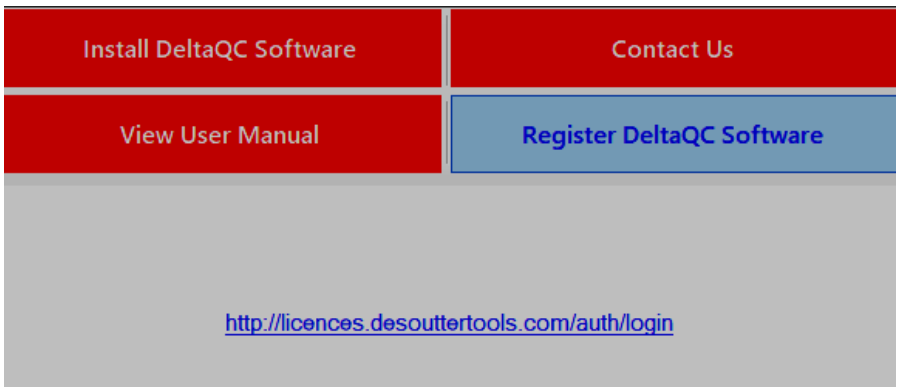
If a *USB key* (refer to the figure on the right) is inserted in the PC, the following pop-up is shown (according to *Autoplay Settings* set on the PC):

Double-click on "***Open folder to view files***". The following folder is shown:

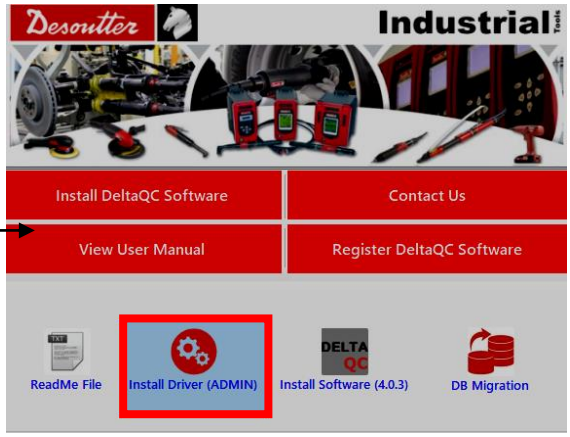


Double-click on "***DesoutterAutorun.vbs***" and wait for the following window:

Install DeltaQC Software	 Firstly, click and read the ***ReadMe*** file containing information about the installation. Then, click on the button ***Install Driver (ADMIN)*** to start the device driver installation. Click on the ***Install Software*** button to start DeltaQC installation. Finally, click on the ***DB Migration*** button to start the database migration.
View User Manual	 Open the "***Delta User Guide***" in PDF.
Contact Us	 It provides the website link to Desoutter contact details.

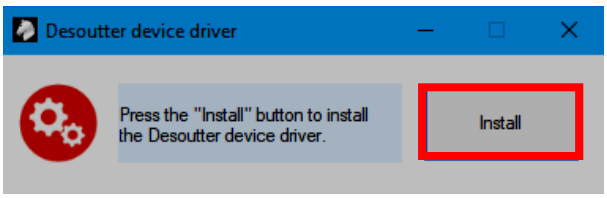
Register DeltaQC Software	 It provides the website link to register the DeltaQC Software. Registration must be executed after the installation. Refer to the paragraph "*Software registration*" for further details.

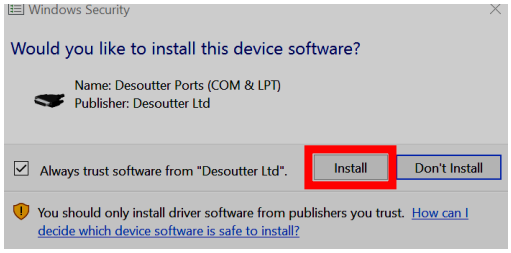
To start the device driver installation, click on the ***Install Driver (ADMIN)*** button and follow the steps described below:



NOTE: If the device driver installation is executed on a PC without administrator rights, a dialog box for the "*User Account Control*" opens.
Enter the administrator username and password in the related fields to continue.

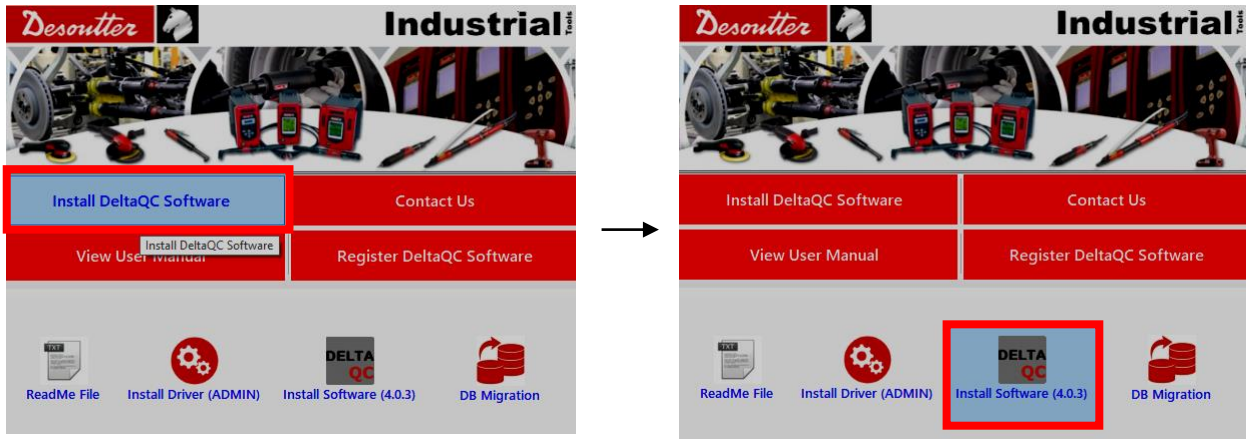
Click on the ***Install*** button (refer to the figures below):



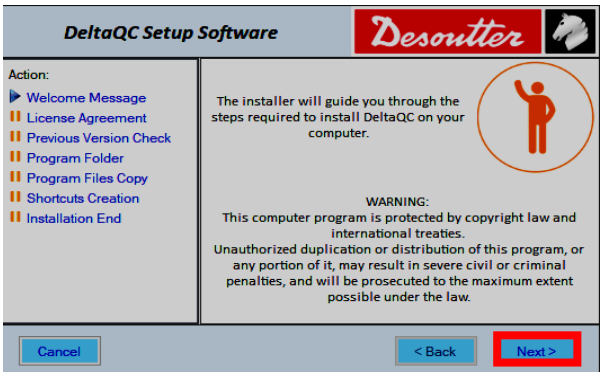


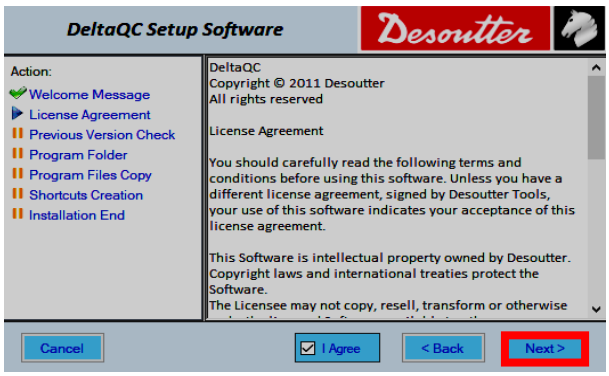
At the end of the process a message confirms that the device driver are installed with success.

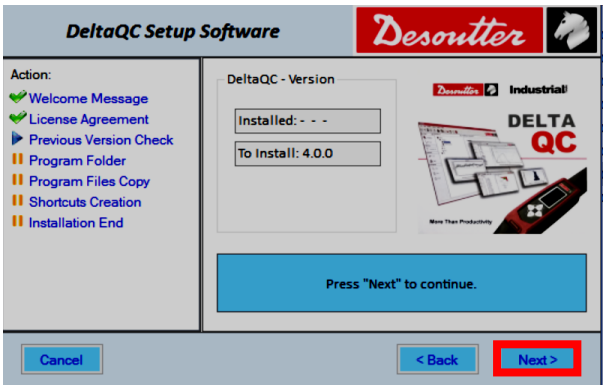
To install DeltaQC Software, click on the button ***Install Software*** (refer to the following figures):

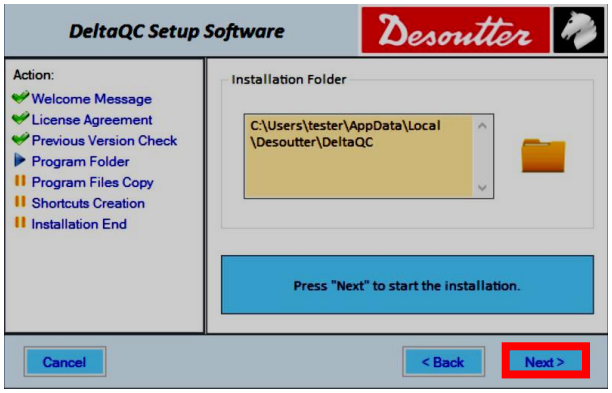


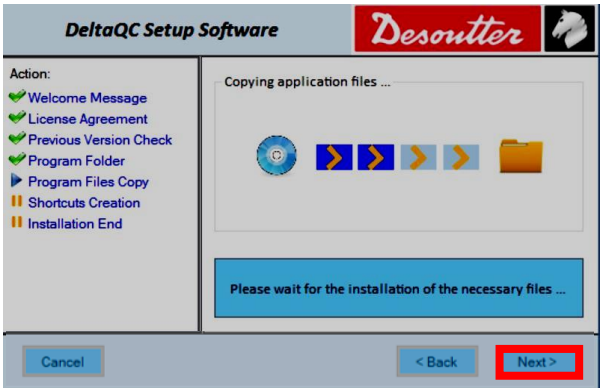
Then, follow the installation steps described below:

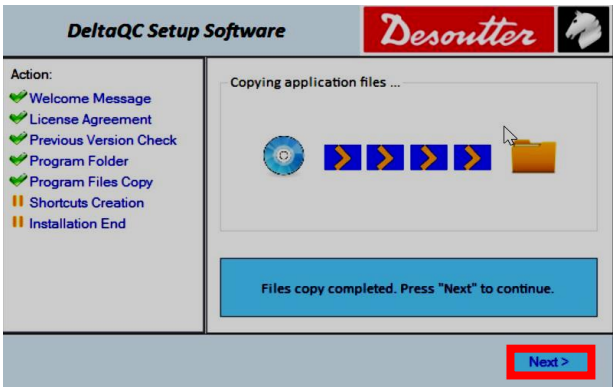


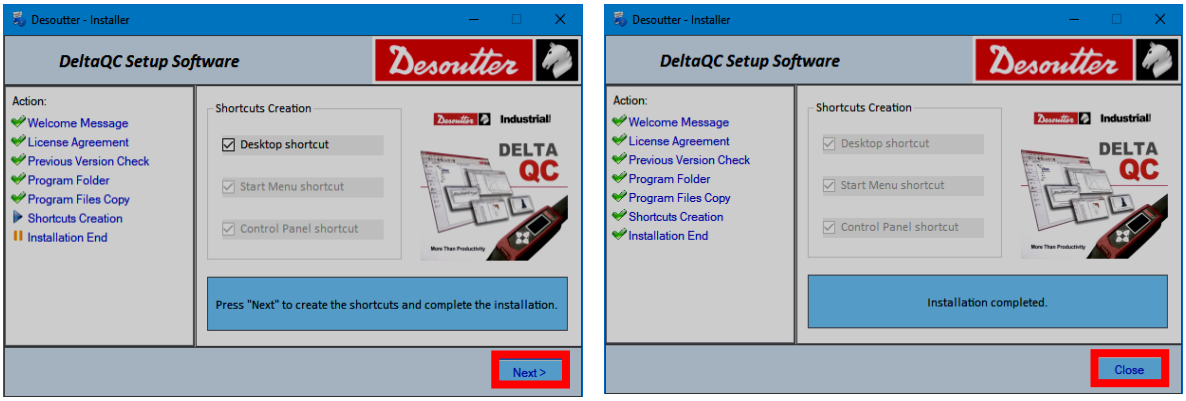












After installing DeltaQC Software, the program is automatically added to ***Start Menu*** → ***Desoutter*** → ***DeltaQC*** and to ***Start Menu*** → ***Control Panel*** → ***DeltaQC***.

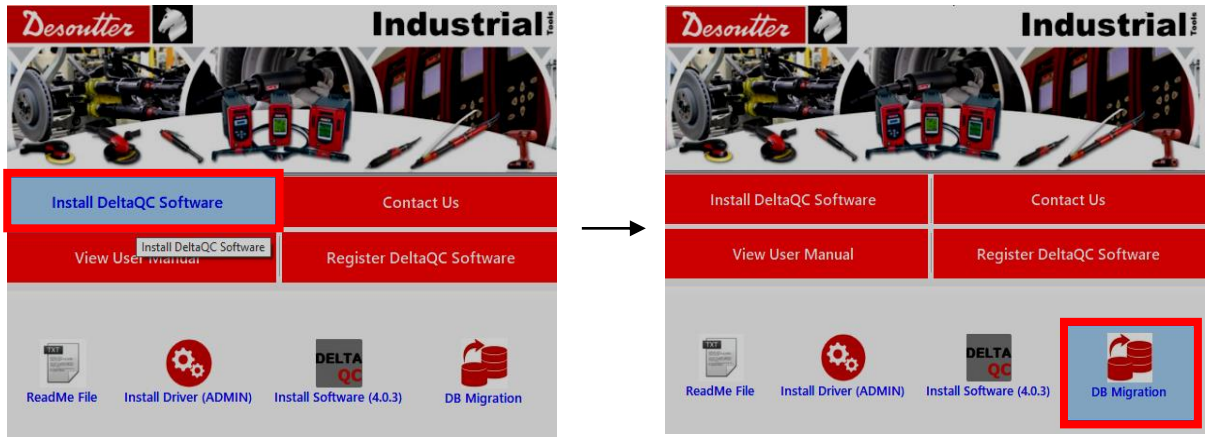
If not deselected during the installation procedure, a Desktop shortcut will be created by default too.

NOTE: The first time DeltaQC Software is executed, it is MANDATORY to register it (refer to the paragraph "*Software registration*" for further details).

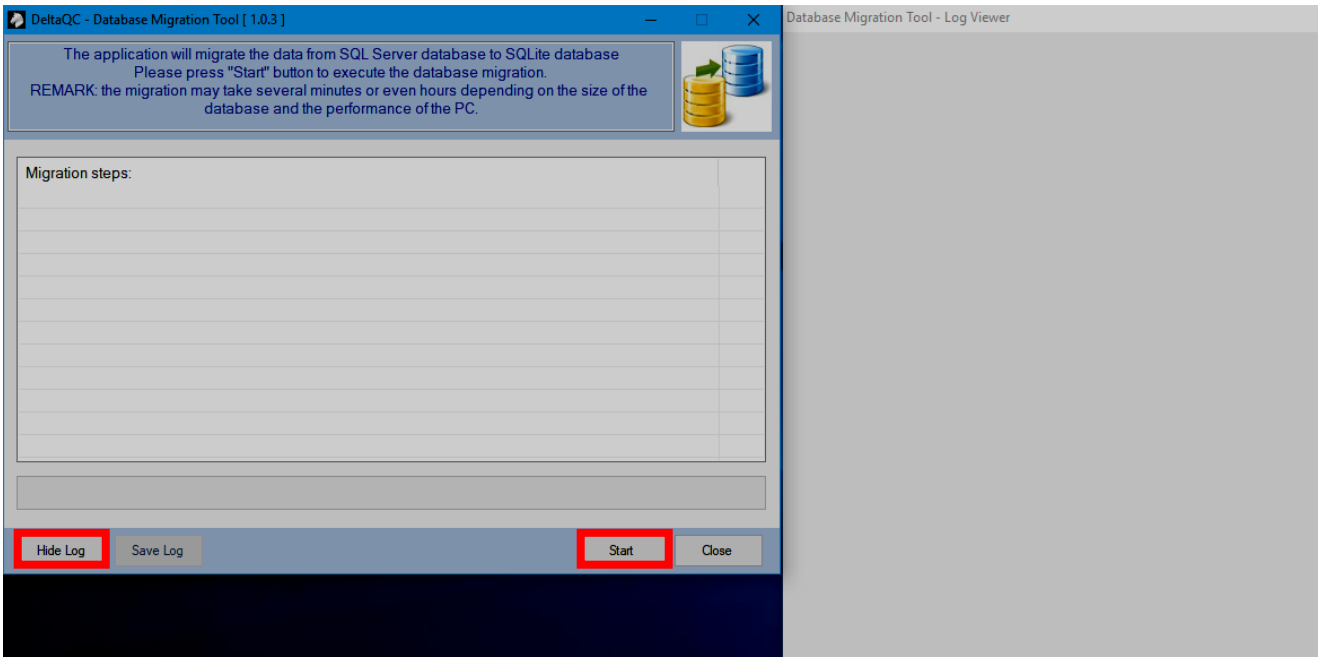
If a version equal to 3.9.0 (or previous) is upgraded to a version equal to 4.0.0 (or later), it is recommended to perform the migration of saved data from SQL Server database to SQLite database.

NOTE: If the database migration is not performed before launching DeltaQC, data possibly present in the new database are deleted.

To start the database migration, click on the button ***DB Migration*** (refer to the following figures):

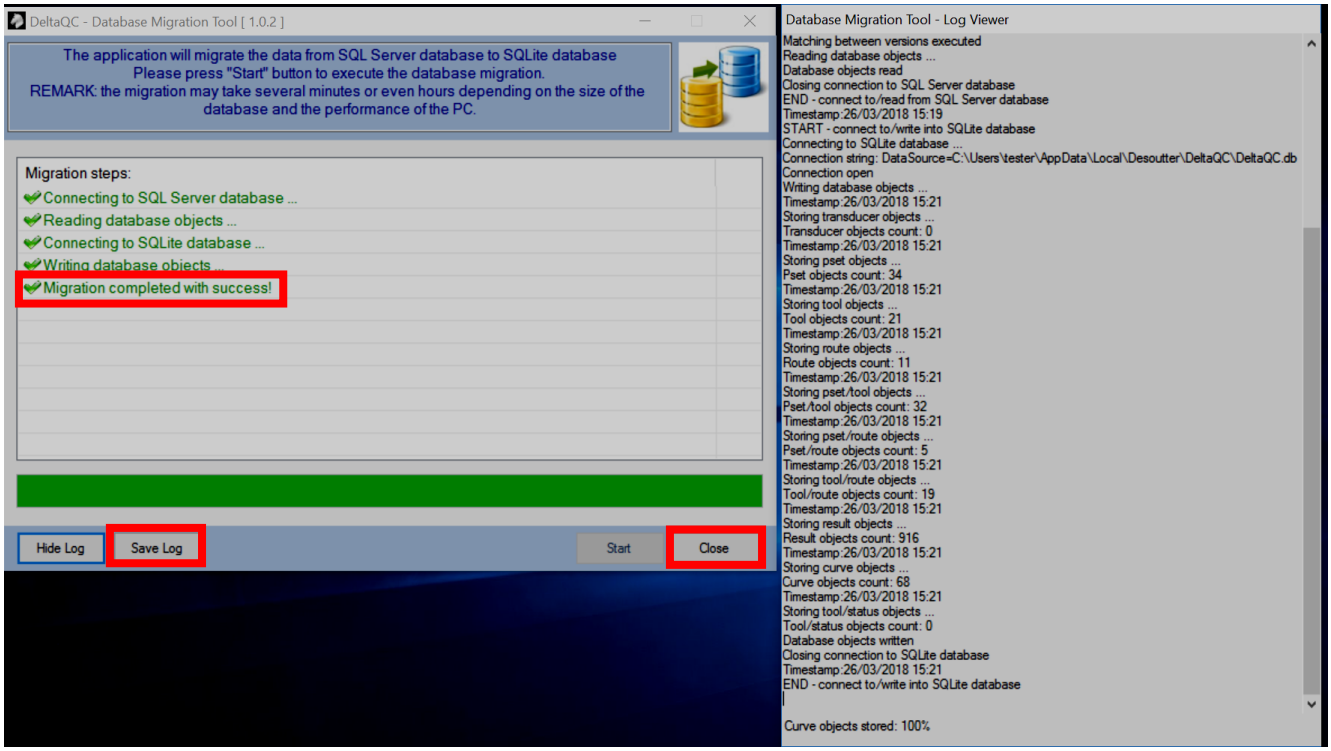


The following windows are shown:



Click on ***Start*** to execute the database migration (the operation may take a few minutes, depending on the size of the database).
Click on ***Hide Log*** to hide the *Database Migration Tool – Log viewer* window.

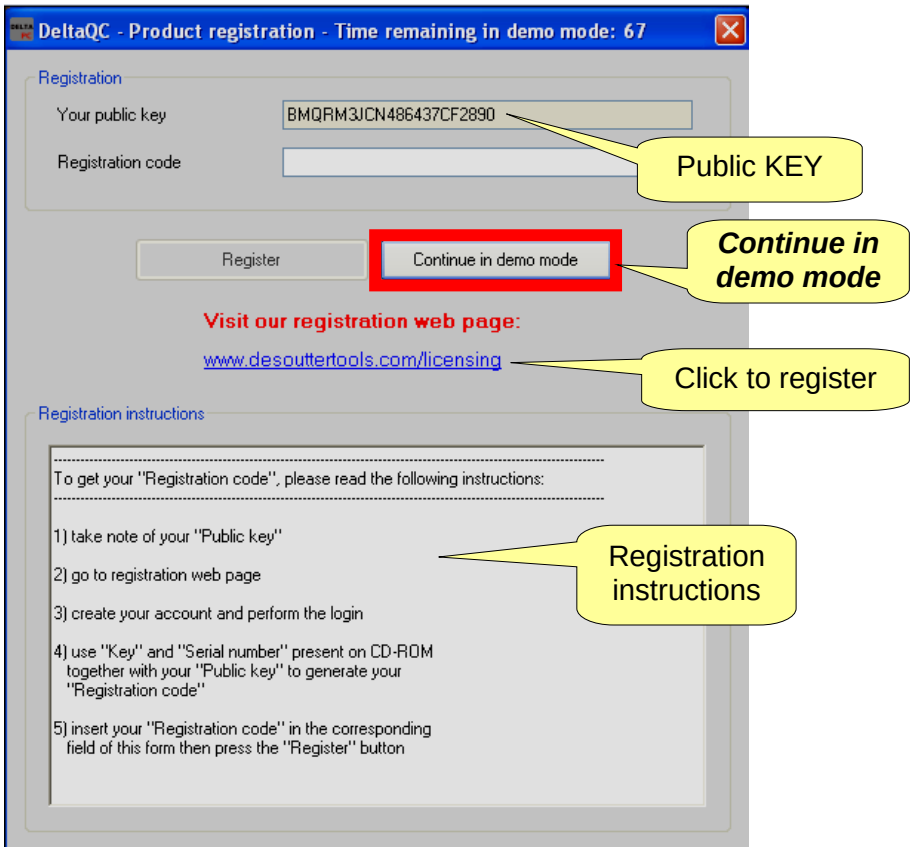
At the end of the process, the message "***Migration completed with success!***" is shown (refer to the figure below):



Click on ***Save Log*** to save the log before closing, otherwise click on ***Close***.

4.1.1 Software registration

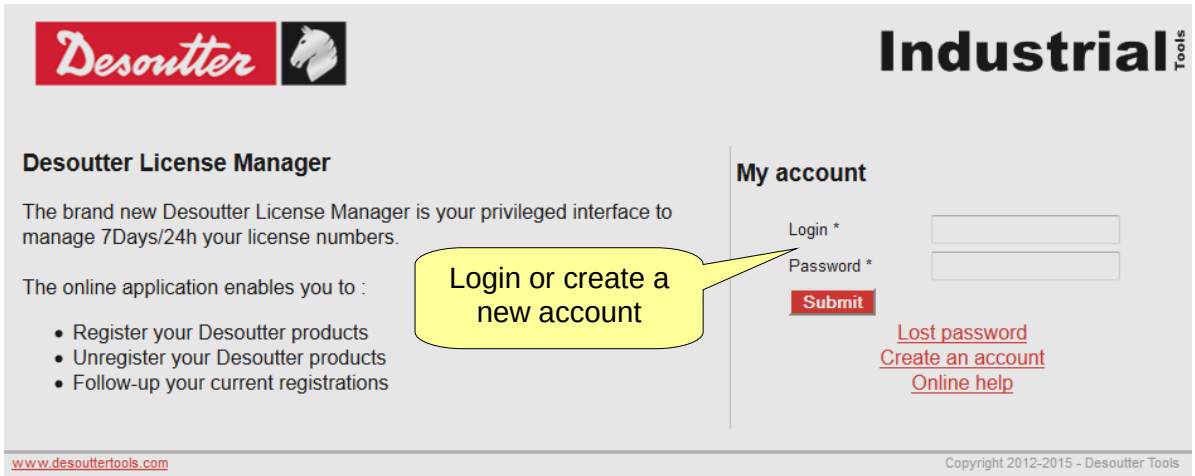
The first time DeltaQC Software is executed, the following window is shown:



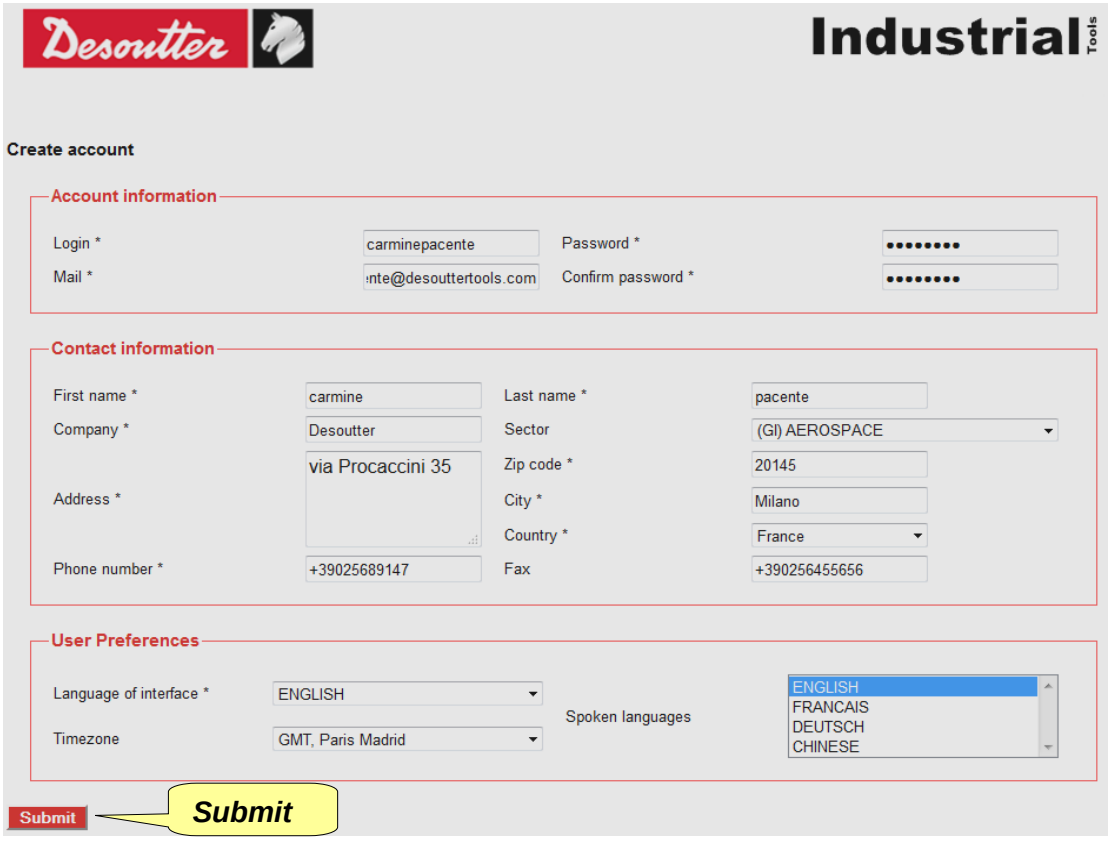
Click on ***Continue in demo mode*** to skip the registration and working in demo mode (the registration can be done later).

To proceed with the registration, take note of the ***Public KEY*** given in the form above, and click on the link www.desouttertools.com/licensing

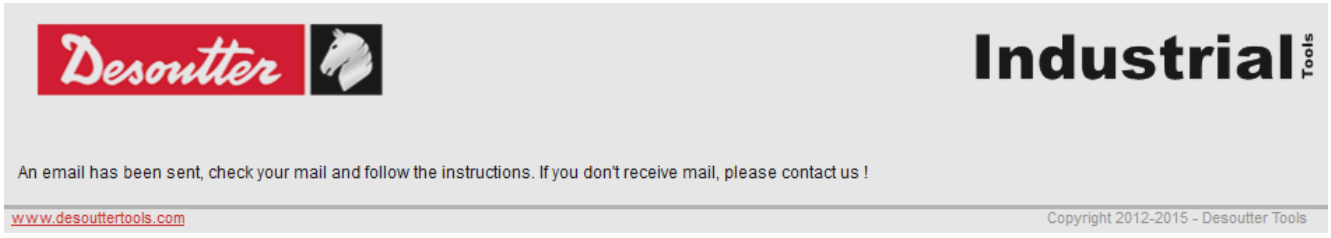
The following window is shown:



Create a new account, if it is not created yet:

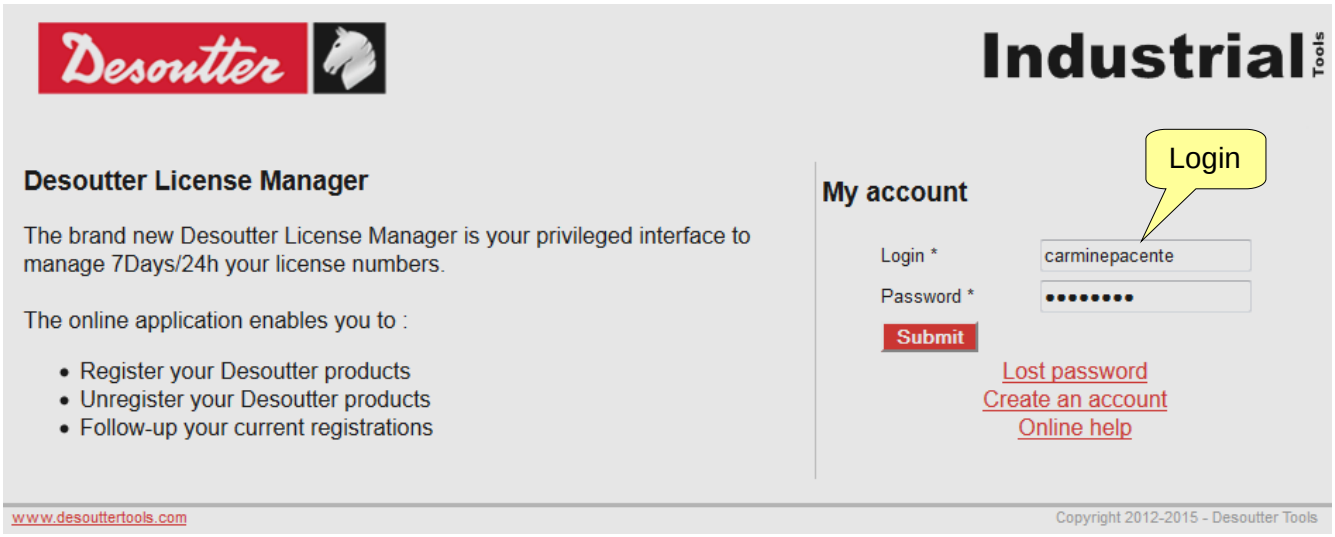


Enter the own information and click ***Submit***. The following confirmation message is shown:

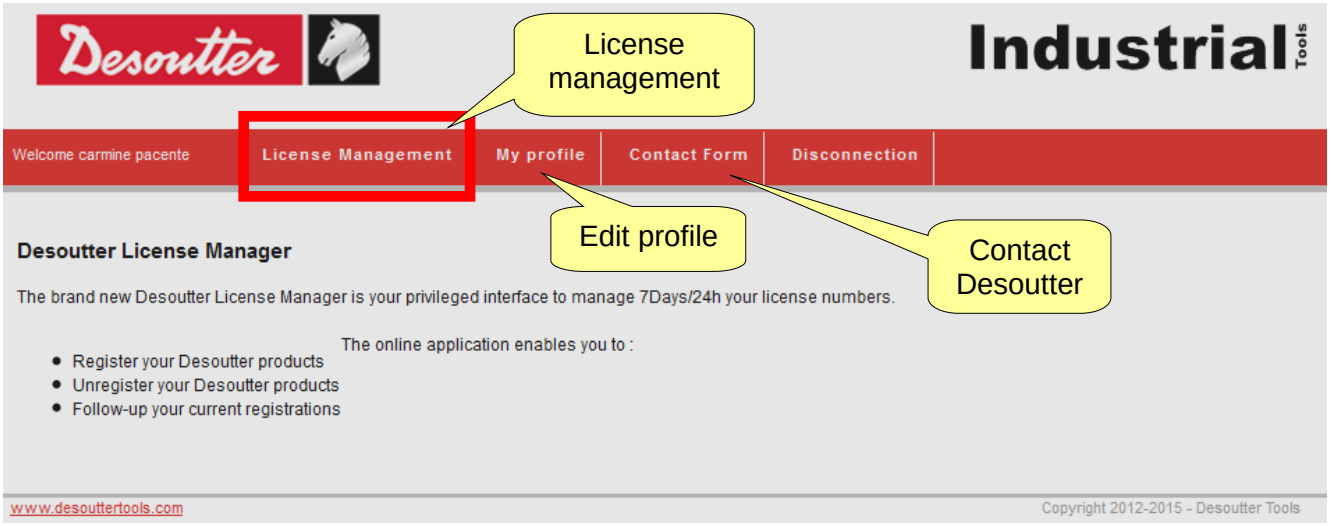


On the email address given in the account above, a link is sent. Click the link provided.

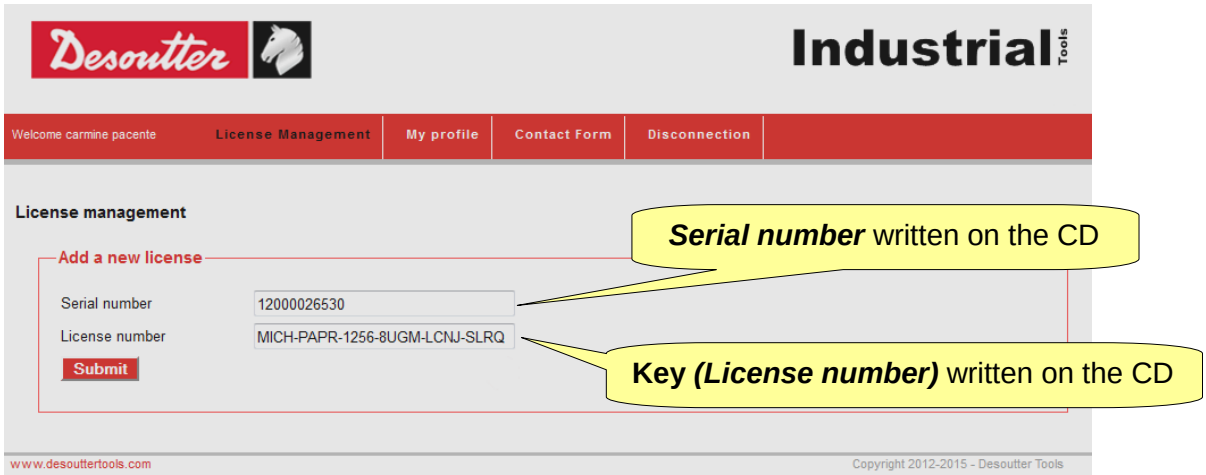
Click "***home***"; now it is possible to login:



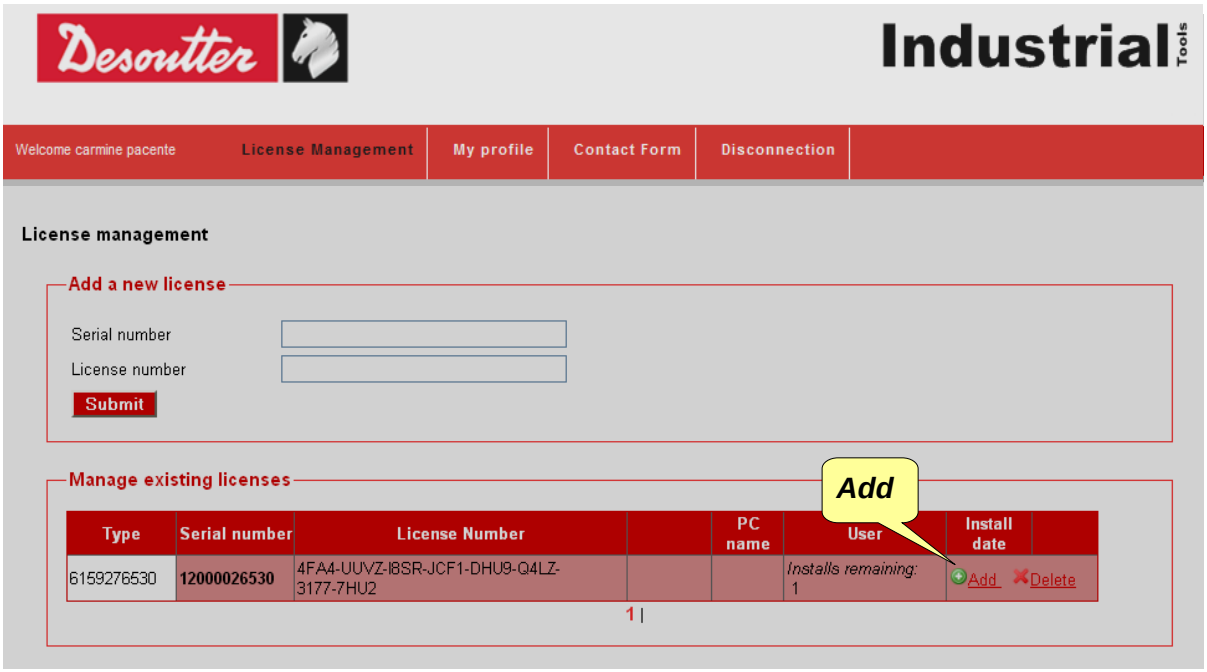
On the following window, select ***License Management*** (from the same window it is possible either to edit the profile information or to open the Desoutter contact form):



Enter the ***Serial number*** and the ***Key (License number)*** provided on the installation CD:

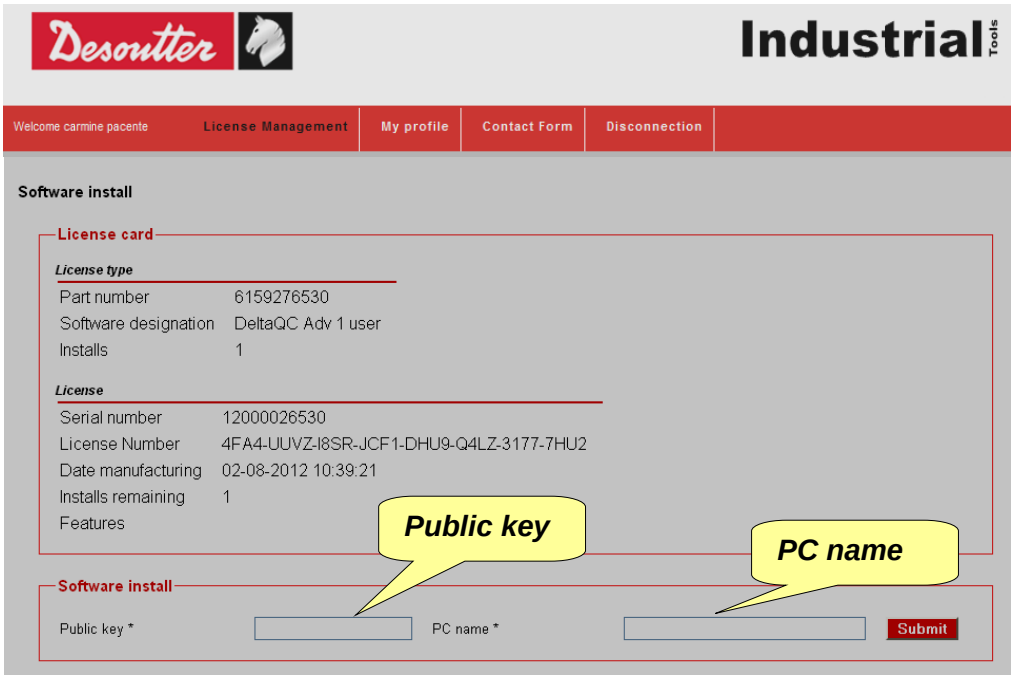


Click ***Submit***; the following window is shown:

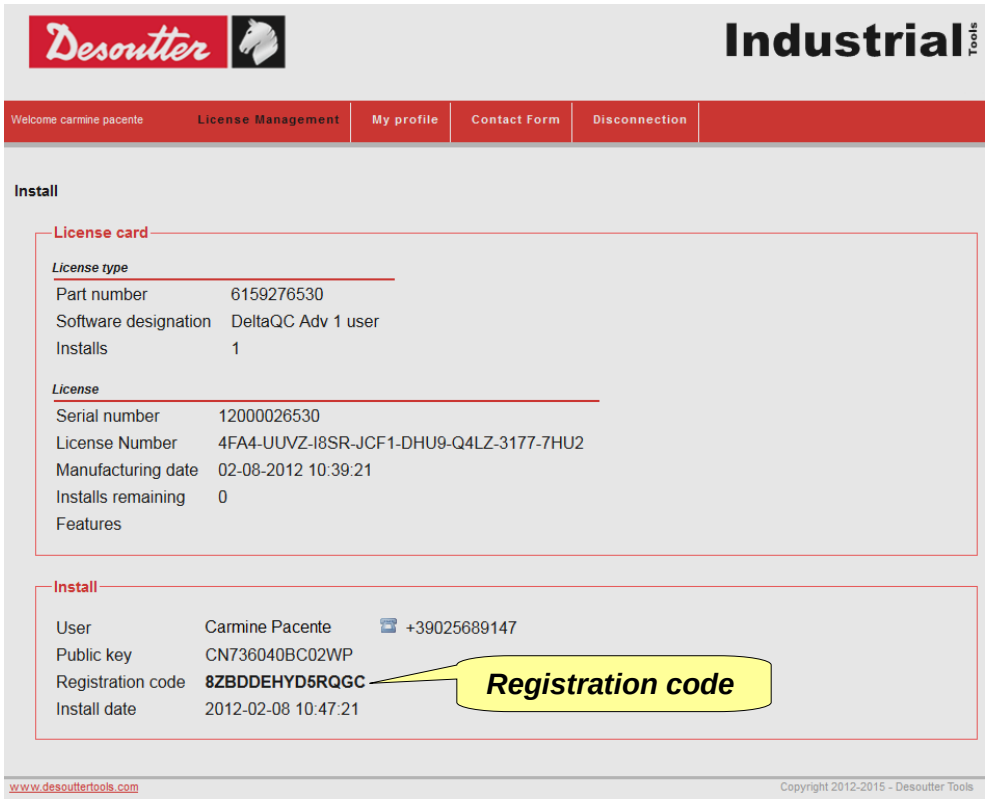


Click either on ***Add*** to proceed with the registration or on ***Delete*** to delete the serial number and key already entered.

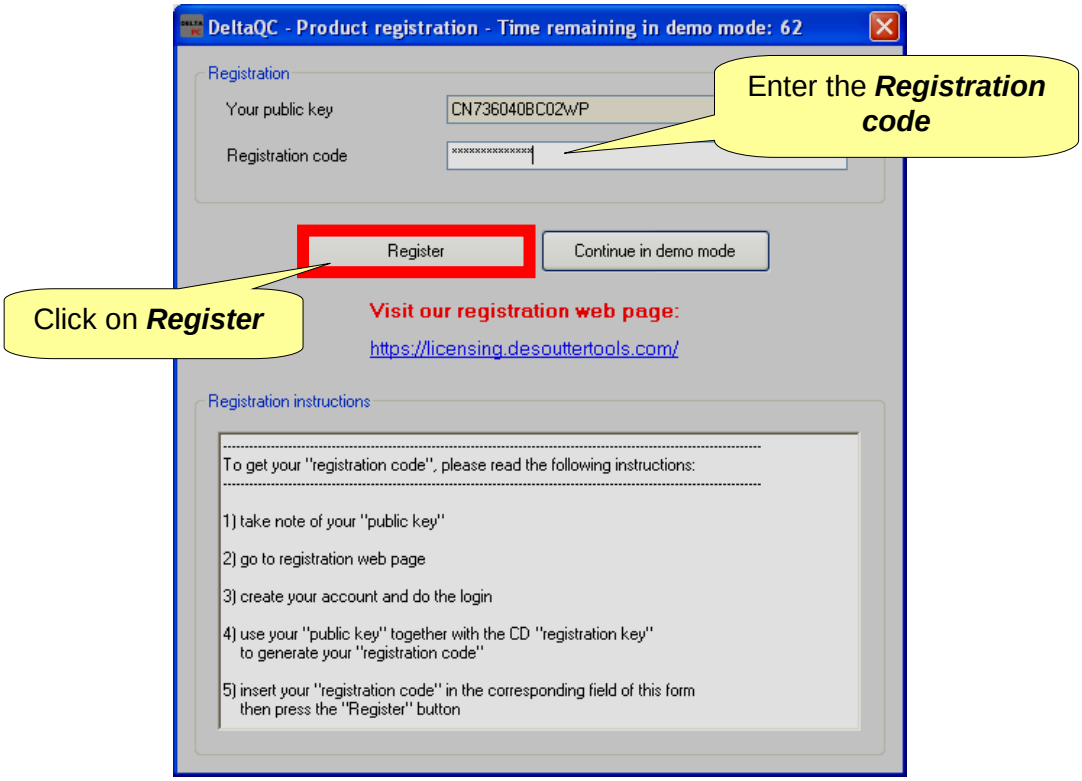
After clicking on ***Add***, the following screen is shown:



Enter the ***Public key*** generated by the DeltaQC Software registration form and the ***PC name*** (choose any name) and click on ***Submit*** to get the registration code:

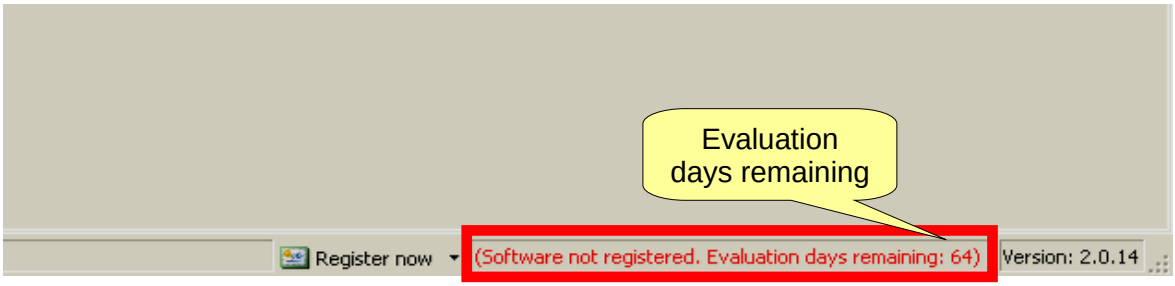


Copy the above *Registration code* in the DeltaQC registration form and click on ***"Register"*** to complete the registration:



4.1.2 DeltaQC "*Evaluation* version"

If DeltaQC Software is not registered after the installation, it works as *Evaluation* for 90 days; the *Evaluation* version provides all the functionalities of the registered version. When the trial period expires, the software turns into "*Free"* version.
The number of days that remain for the trial period is shown on the bottom part of the software page (refer to the picture below):



4.1.3 DeltaQC "Free version"

When the trial period expires, the software turns from "*Demo*" into "*Free*" version.

The *Free* version has a limited set of function. It is possible only to define tightening programs (Pset, Tools and Routes) in online mode (*offline programming is not available*), review the results from the Delta (exporting them in an Excel file) and define the settings of the instrument; all the other features are not available.

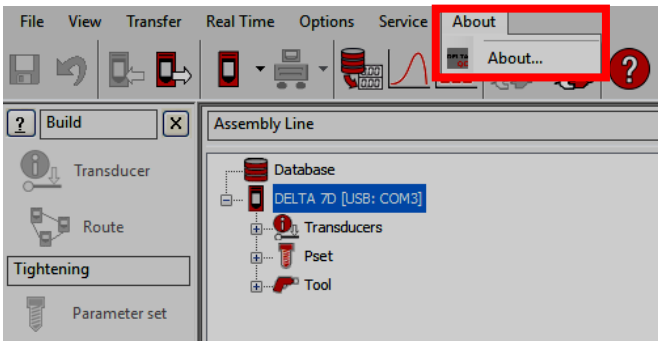
4.1.4 DeltaQC *Licensed* and *Advanced* versions

It is possible to register DeltaQC Software in two different versions: *Licensed* or *Advanced*.

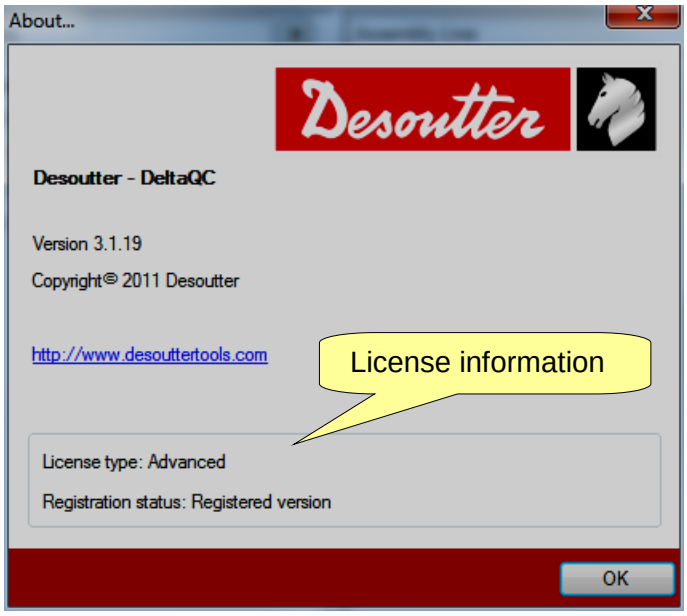
The *Advanced* version can manage all the functionalities described in this User Guide.
The *Licensed* version does not save the results and curves on the database (they can be viewed online) and does not provide offline statistics on the results downloaded from the Delta.

4.1.5 License Verification

To verify the license installed, enter the DeltaQC Software and click on "***About"*** placed in the Menu List:



The DeltaQC version information is shown:

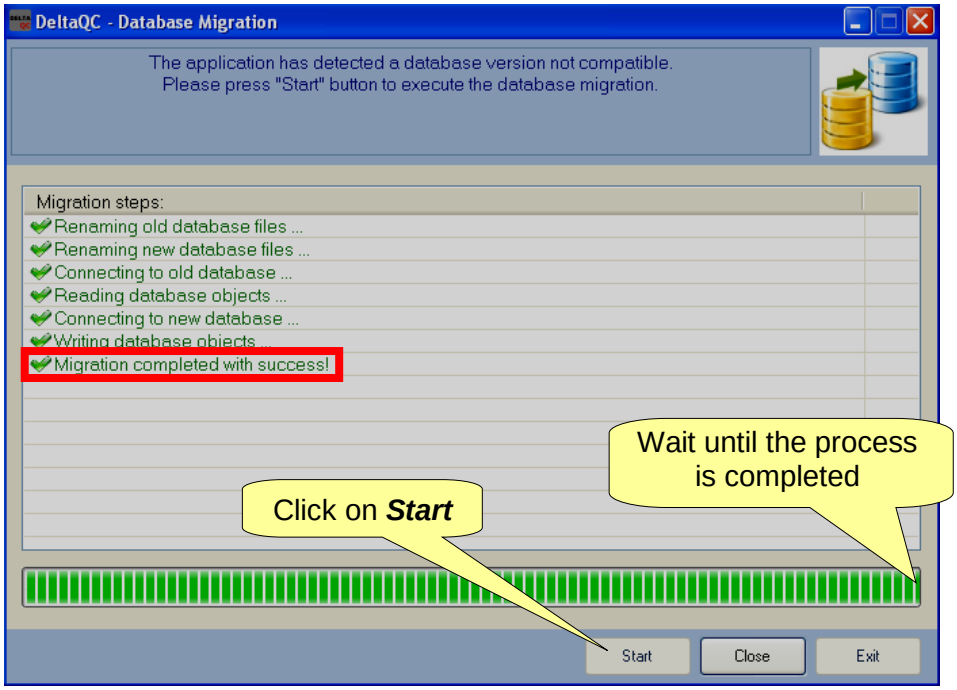


4.1.6 DeltaQC software upgrade

In case a new version of DeltaQC Software is available, the new installation wizard automatically overwrites and upgrades the previous one.

If the new version features a new database structure, the first time the new version is launched a database migration wizard is automatically started.

Click on ***Start*** and wait until the process is completed:

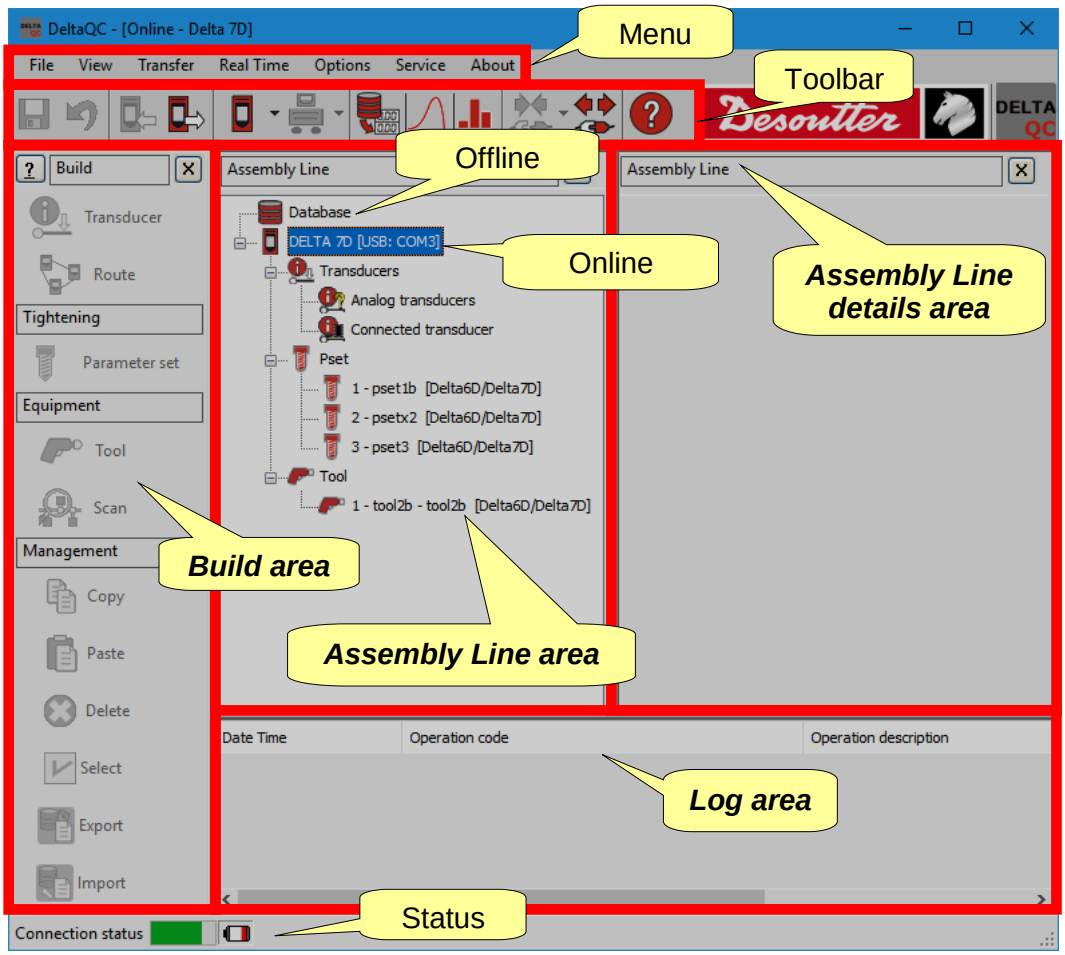


Ensure that the message "***Migration completed with success!***" is shown in the window above; then click on ***Close***.

4.2 DeltaQC Overview

Click on the DeltaQC icon to launch the software.

The following main menu is shown:



NOTE: The DeltaQC adapts automatically to the Delta type and firmware version and DeltaQC license; therefore, some menus or commands may be hidden or disabled, if not supported by your version of the Delta or DeltaQC License.

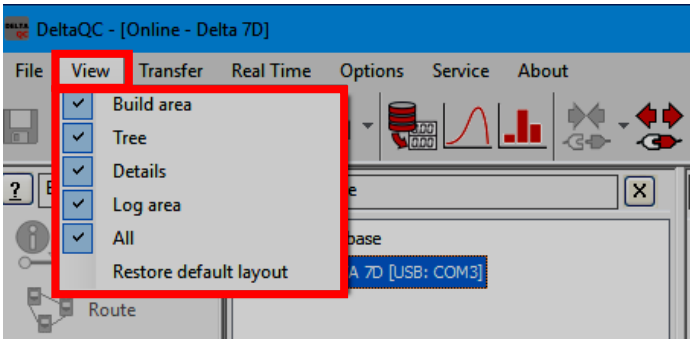
Working in the Delta Map area (***Online mode***), the Delta is connected to the DeltaQC Software and all the data are directly written in the Delta connected.

Working ***Offline***, it is possible to define the test programs and transfer them to the Delta at a later time. The DeltaQC stores the following data in a local database:

- Test programs (Psets)
- Tools
- Test results
- Test curves
- Analog transducers

NOTE: Refer to the paragraph "*Offline mode*" for further details.

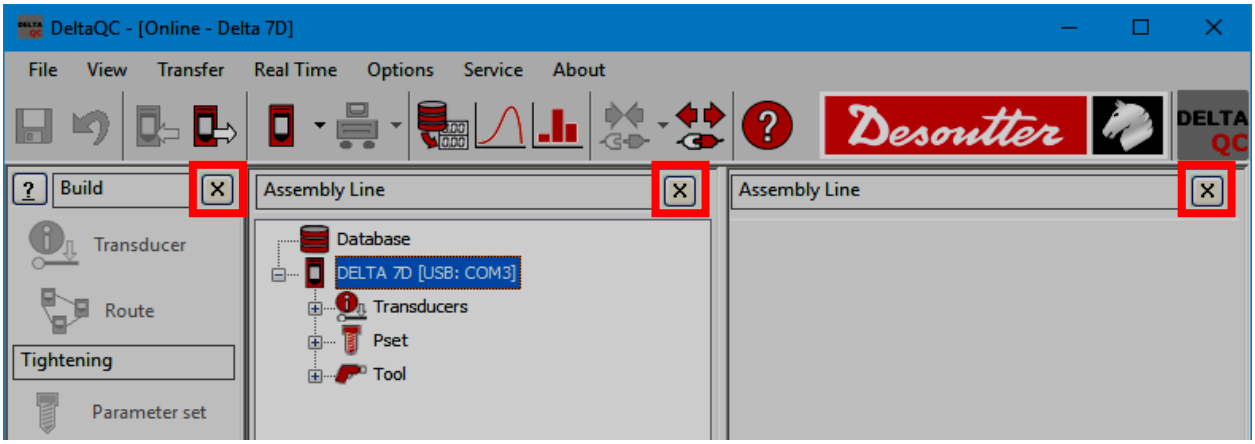
The *areas* shown in the main menu (refer to the above picture) can be customized; select ***View*** to define which areas enable or disable:



The *areas* listed in "***View***" are as follows:

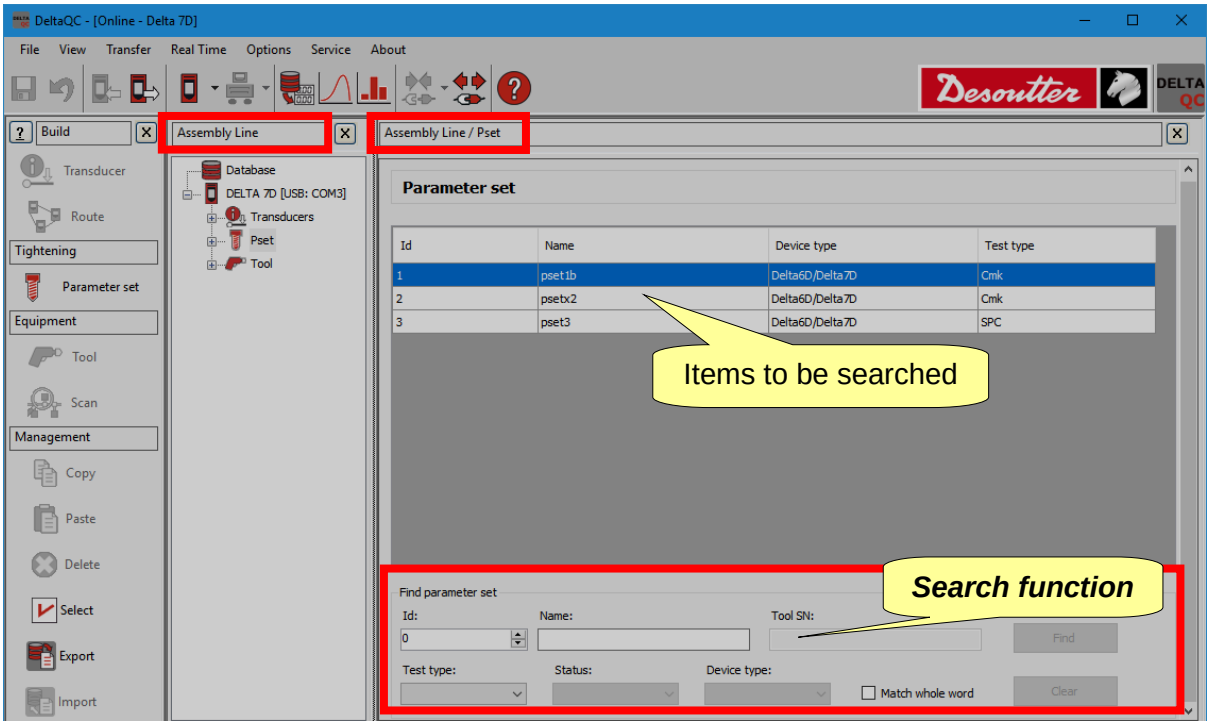
Build area	Enable/disable the *Build* area. It contains the commands to create tightening and test programs, tools, route of test.
Tree	Enable/disable the *Assembly line* area. It contains the list of the tightening programs and tools created in *Online / Offline mode*.
Details	Enable/disable the *Assembly line details* area. It details the items selected in the *Assembly line* area.
Log area	Enable/disable the *Log* area that lists the list of the log messages.
All	Enable/disable all the possible items in the main menu.
Restore default layout	Restore the default layout that enables all the items except the *Log* area.

To hide one *area* directly from the main menu, click on the ☒ icon (refer to the screen below):



4.2.1 Search function

The DeltaQC is characterized by a search function, available to search the various items (*Psets, Tools, Transducers and Routes*) displayed in the ***Assembly Line*** area; in the following example, it is shown the ***Assembly Line/Pset*** area with the relative Search function:

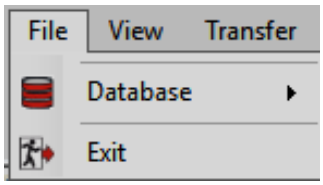
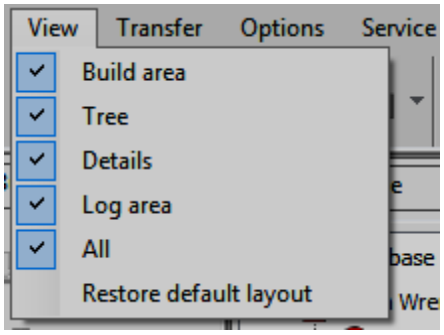
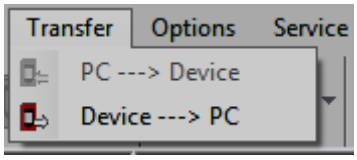
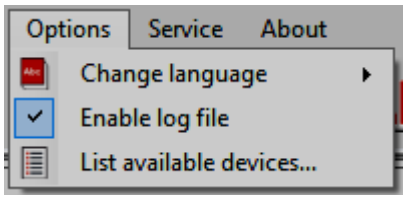
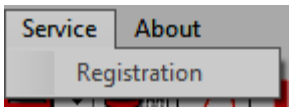
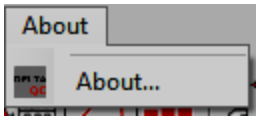


Enter the search criteria and click on ***Find*** to filter the items displayed according to the criteria entered. Click on ***Clear*** to reset the filter and display all of the items.

This function searches also strings partially included in the items (for example, searching the word “tight” will produce items containing the word “tightening” or “tighten”); the ***Match whole word*** *option* disable this function.

4.2.2 Menu list

The following options are available in the *DeltaQC Menu List*:

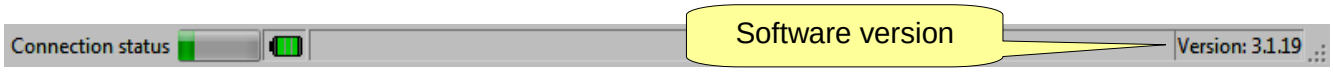
Illustration	Name	Description
	File	The *File* option allows to: - create and restore a database backup file (see paragraph "*Database backup*"). - exit from the DeltaQC software.
	View	The *View* option selects the areas to show/hide in the main menu.
	Transfer	The *Transfer* option transfers data either from the PC to the Delta Wrench or from the Delta Wrench to the PC.
	Options	The *Options* tab sets the DeltaQC language and enables/disables the log file. Furthermore, a list of available devices can be viewed.
	Service	The *Service* option allows to register the software.
	About	The *About* tab gives software information, including registration details.

4.2.3 Toolbar

The toolbar icons are shortcuts to the basic functions in DeltaQC.

Icon	Icon name	Description
	Save	This icon saves the items (for example *Pset* or *Tool*) that are defined in the *Assembly Line* area.
	Undo	The icon "*Undo*" deletes the operations executed on the item (for example *Pset* or *Tool*) that are defined in the *Assembly Line* area.
	Transfer PC → Device	This icon transfers the data defined offline to the Delta connected with the PC.
	Transfer Device → PC	This icon transfers the data defined online from the Delta to the PC.
	Controller	Click on the arrow of this icon to open the Controller programming menu. *Controller* icon contains information and settings for Delta. Refer to the paragraph "*Delta Settings*" for further details.
	Bench programming	This icon is reserved for the use of the DeltaQC with the Delta Cart; thus it is not used for the Delta.
	Results Viewer	This icon opens the Results Viewer page. Refer to the paragraph "*Results Viewer*" for further details.
	Curves Viewer	This icon opens the *Curves Viewer* page. Refer to the paragraph "*Curves Viewer*" for further details.
	Statistics	This icon opens the Statistic window. Refer to the paragraph "*Statistics*" for further details.
	Connect	This icon establishes the connection between the Delta and the PC (the icon is disabled when the device is already connected). Refer to the paragraph "*Connecting with the Delta*" for further details.
	Disconnect	Once a connection is established, this icon gets active. Click to disconnect the PC from the Delta.
	Help	This icon opens the *Help* section (not active in this software version).

4.2.4 Status bar



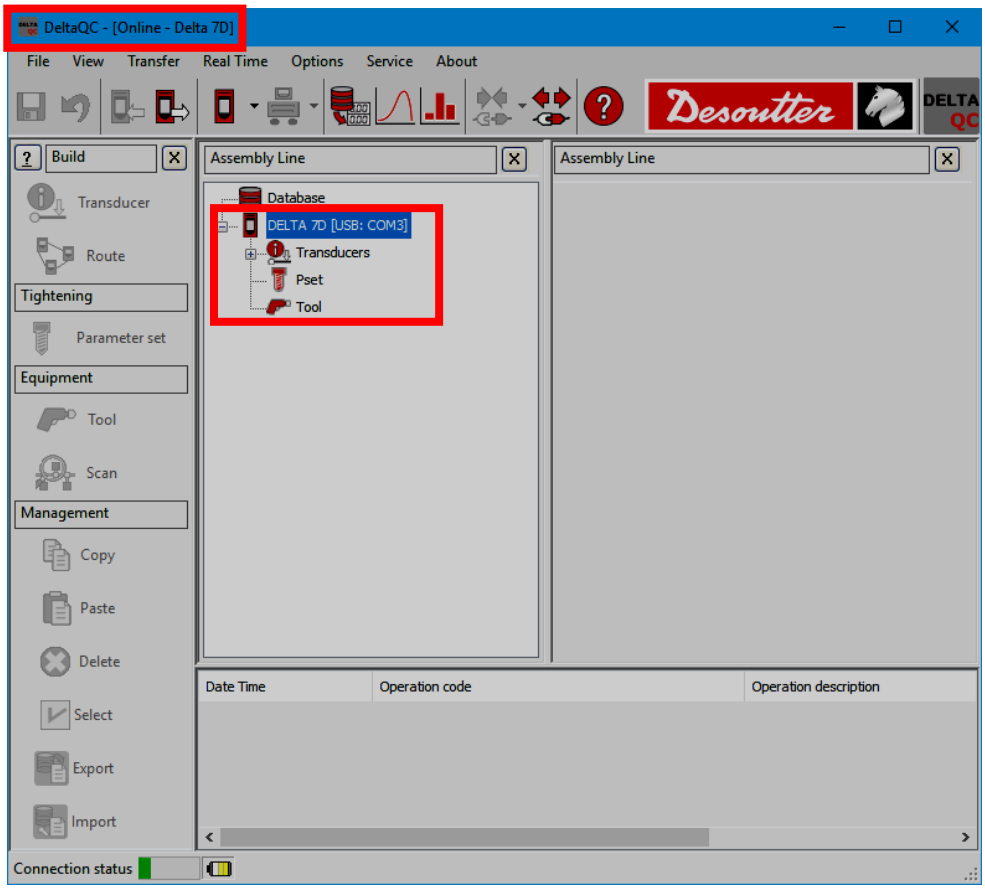
The status bar provides the connection status between the PC and the Delta.
The battery icon shows the battery level:

- ***Green***: Battery level over 50%
- ***Yellow***: Battery level between 30% and 50%
- ***Red***: Battery level under 30%

On the right, the software version is shown.

4.2.5 Online mode

The ***Online mode*** is active only when a Delta is connected to the PC. For Delta 6D/7D, it defines the tests programs directly on the instrument; therefore, the items defined in the *Assembly Line* area are available on the Delta menu.

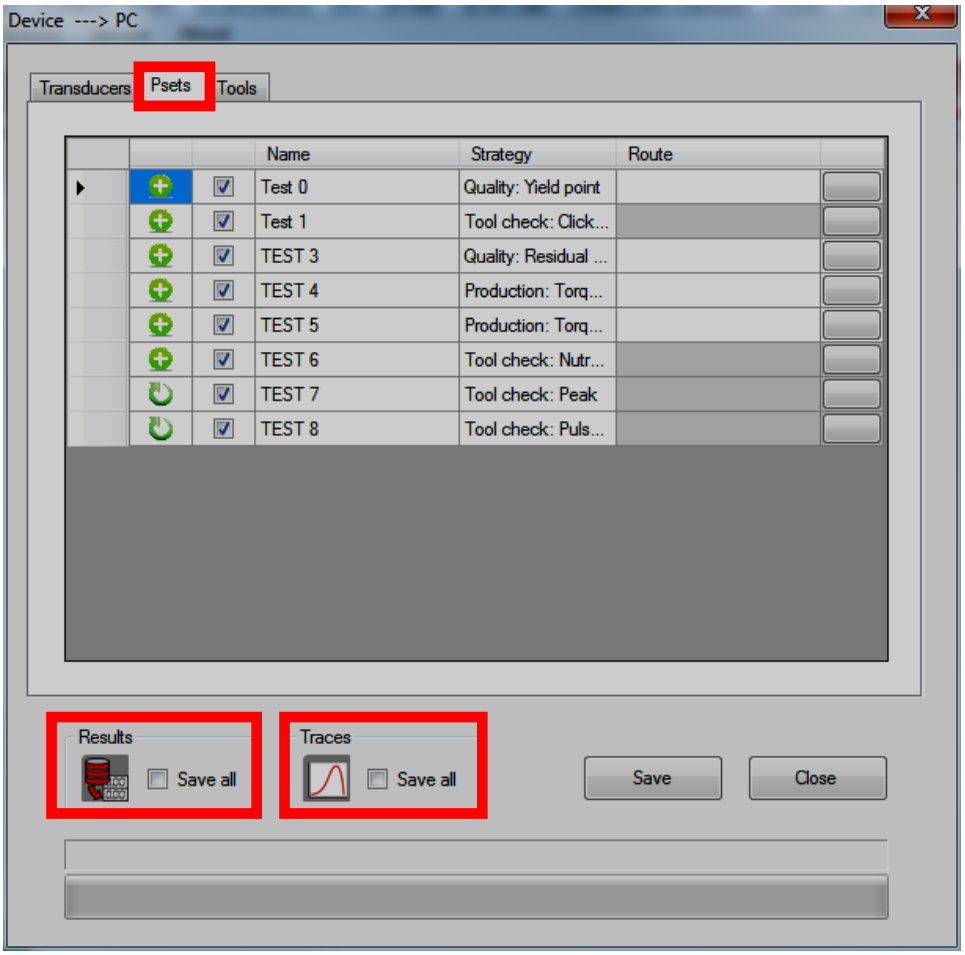


Click on the minus or plus symbols to close and open menus, and double click on function names to open the corresponding function.

NOTE: Refer to the paragraph "*Use of Delta 6D and 7D*" to view in detail how to create and setup a test program for Delta 6D/7D.

4.2.5.1 Transfer online data to the database

All the information defined online can be saved in the local database file (including test results and curves), by selecting ***Transfer*** → ***Device ---> PC*** in the toolbar of the main DeltaQC screen.
The following window is shown:



Select the items (*Psets, Tools, Results* and *Curves*) to be transferred from the Delta to the local database (placed on the PC) and click on ***Save*** to confirm.
Right-click to select/unselect all of the items in the list.

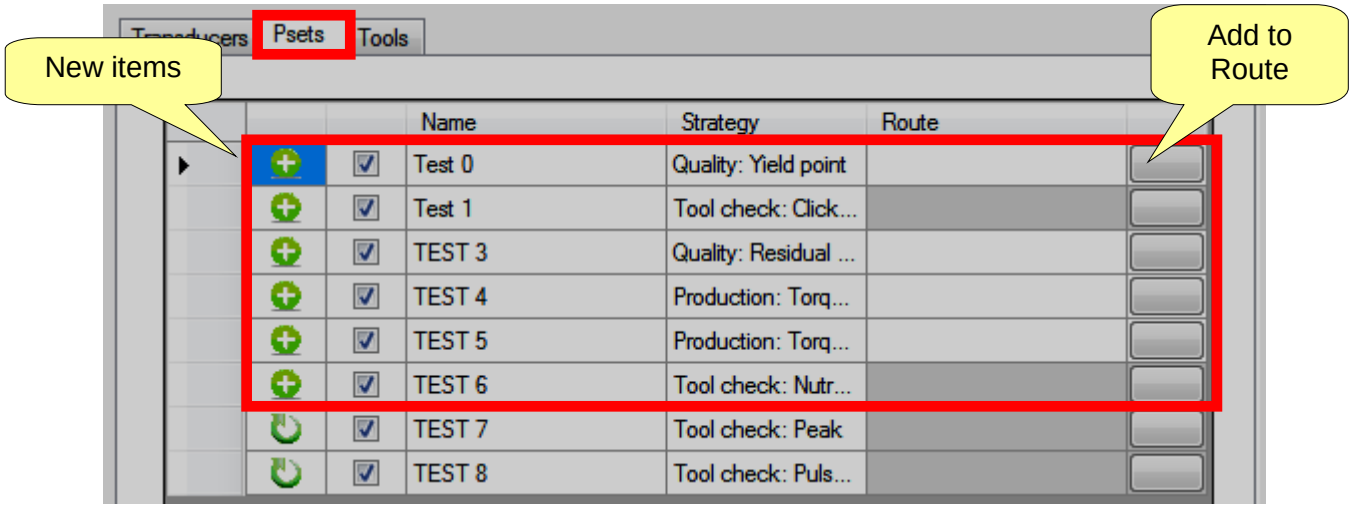
Psets and Tools are marked with three different icons:

The Pset or Tool is already present in the database and it is updated if some of its parameters have been changed.

The Pset or Tool has been created directly on the Delta and it is added to the database.

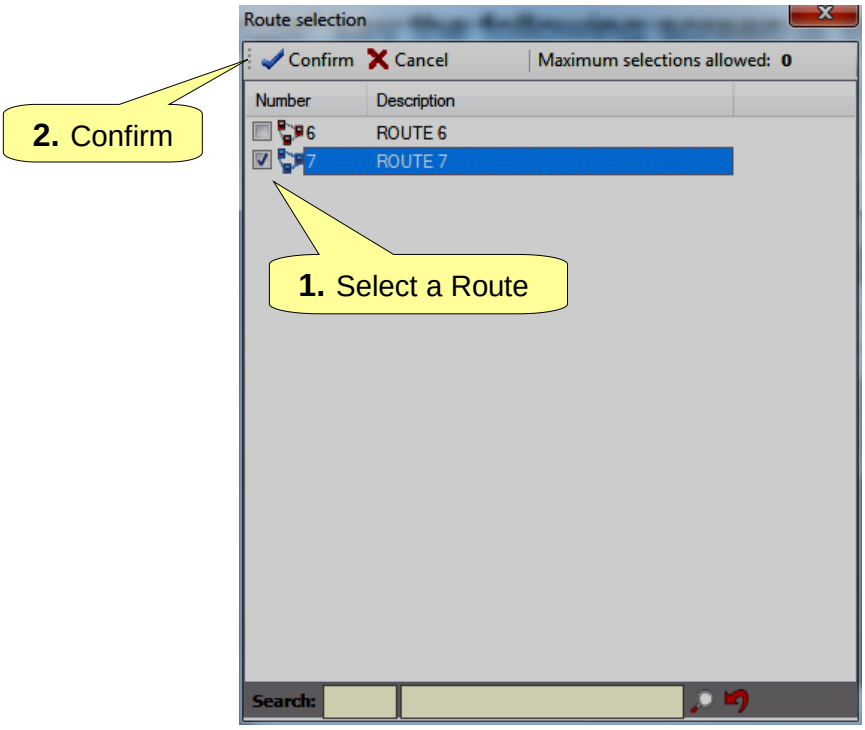
In the database there is already a Pset with that name, but created for another device and not for the Delta; the Pset cannot be saved (it should be renamed).

Psets and tools marked as ***new*** can be added here to a Route (refer to the paragraph "*Offline mode*" for further details):



The "*Add to Route*" command is available only if there is a relevant Route for the new Pset/Tool. In the figure above only the first six Psets can be added to a Route.

When clicking on the "Add to Route" key the following screen is shown:

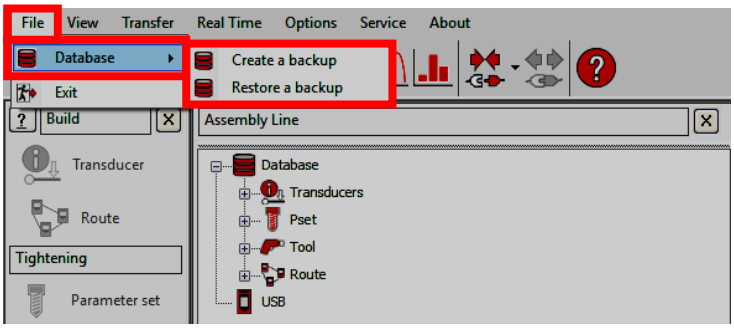


NOTE: The route must be defined ***offline*** with at least one item already linked. Empty routes are not shown here.

Select the Route and click on ***Confirm*** to save.

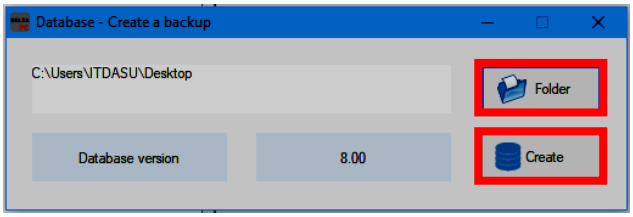
4.3 Database backup

From the ***File*** tab it is possible to create and restore a database backup.



To create a database backup file, click on the tab ***File*** → ***Database*** → ***Create a backup***.
From the dialog box that opens (see the figure below):

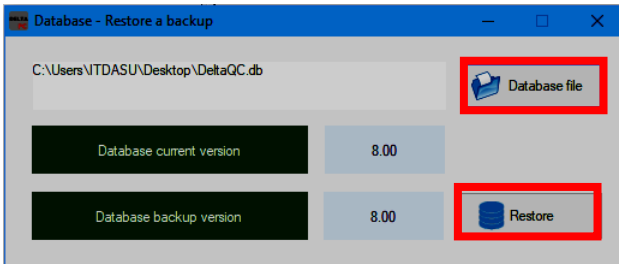
1. Click on the ***Folder*** button to select the destination folder.
2. Click on the ***Create*** button.



At the end of the process, a confirmation message informs that the database backup file is created with success.

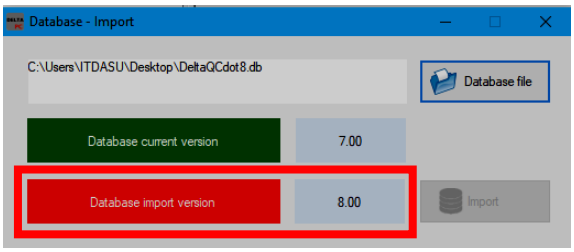
To restore a database backup, click on the tab ***File*** → ***Database*** → ***Restore a backup***.
From the dialog box that opens (see the figure below):

1. Click on the ***Database file*** button to select the database to import.
2. Click on the ***Restore*** button.



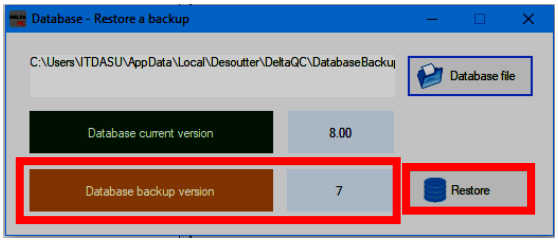
At the end of the process, a confirmation message informs that the database backup file is restored with success.

NOTE: If the database to restore is characterized by a version higher than the destination database, it is marked in red and it is not possible to restore it (see the figure on the right):



Upgrade DeltaQC Software to the latest version in order to complete the operation. For further information, refer to the paragraph "*DeltaQC software upgrade*".

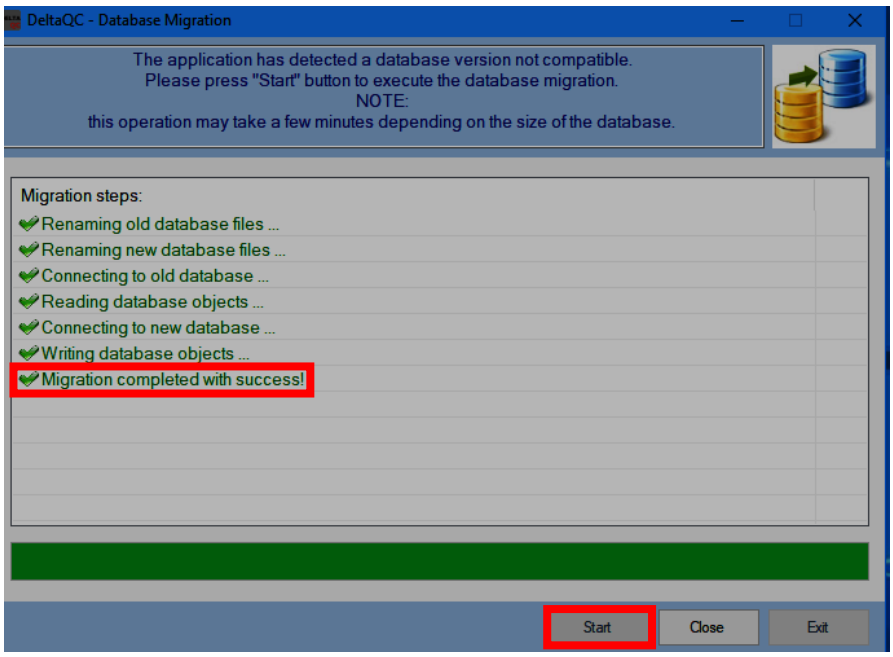
NOTE: If the database to restore is characterized by a version lower than the database current version, it is marked in yellow (see the figure on the right):



Click on the ***Restore*** button, and then on ***Yes*** in the dialog box that opens.

From the *DeltaQC - Database Migration* window (see figure below), click on ***Start*** to execute the database migration and wait until the process is completed.

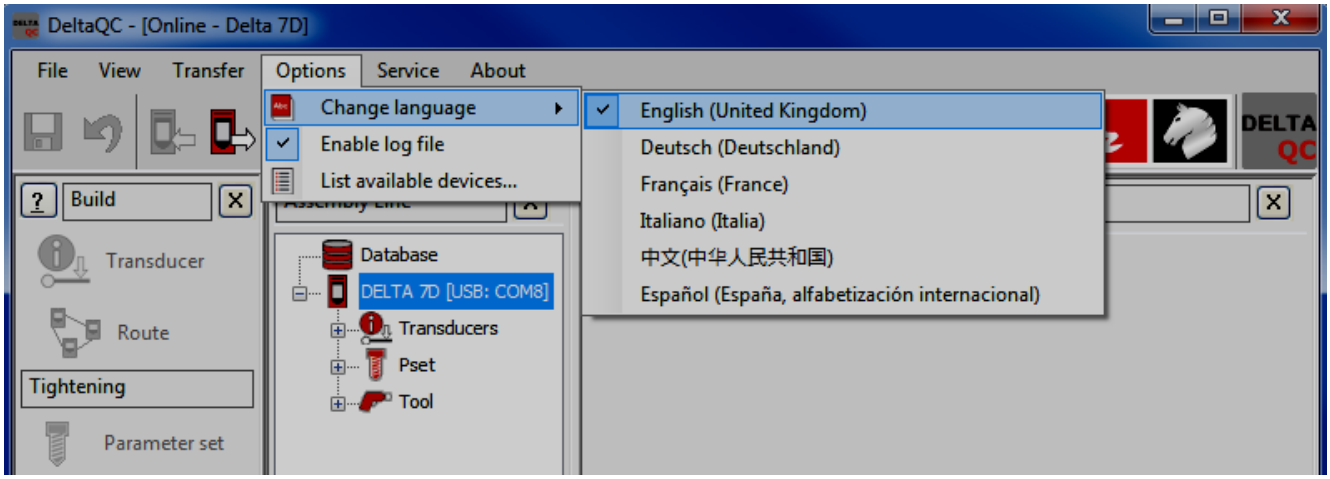
The operation may take a few minutes, depending on the size of the database; a green progress bar indicates the status of the operation.



At the end of the process, the message "***Migration completed with success!***" is shown in the window.

4.4 Settings in DeltaQC

It is possible to set the language from the ***Options*** → ***Change language*** menu:



NOTE: After changing the language, restart the software to make the change effective.

4.5 Connecting with the Delta

The connection between the DeltaQC and the Delta can be done either via USB or Ethernet (*Ethernet is not available for Delta 1D model*).

The USB connection can be done easily with the USB cable between the PC and the instrument.

The Ethernet connection gives the following advantages:

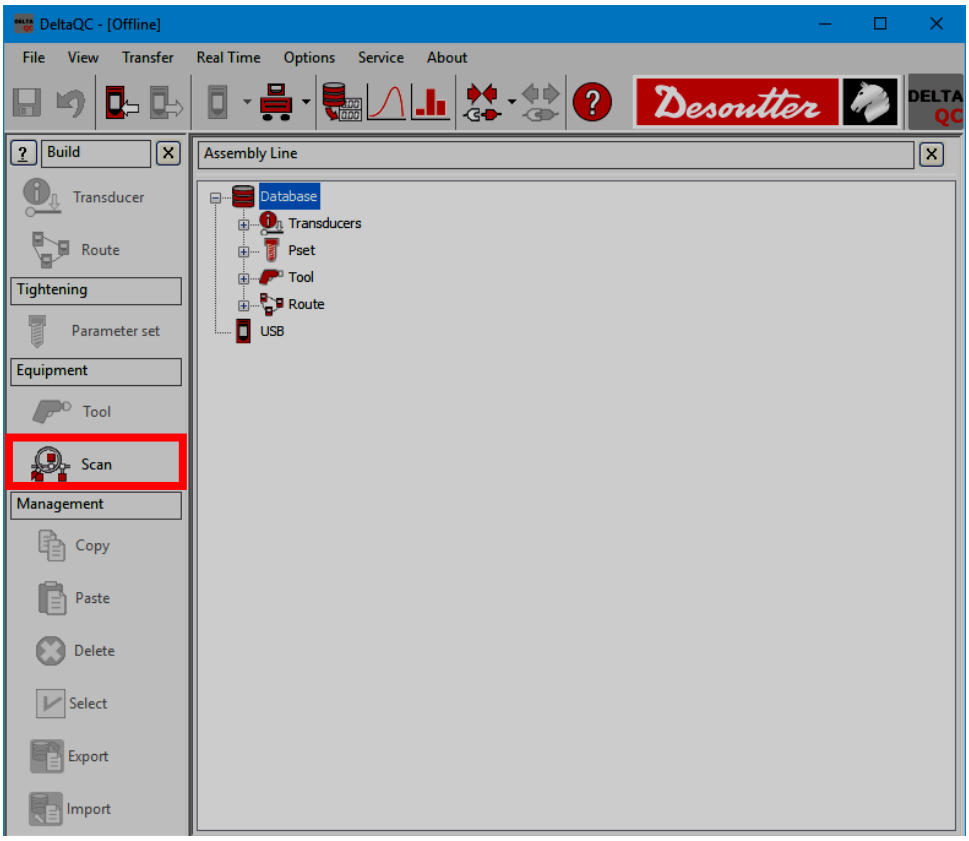
- Higher data transfer speed.
- Chance to connect more than one device to the DeltaQC.
- Chance to connect a Delta to the PC with DeltaQC even if they would be in different location of the company.

Note that before being able to use the Ethernet connection the Delta must be properly configured, by connecting the device to DeltaQC via USB.

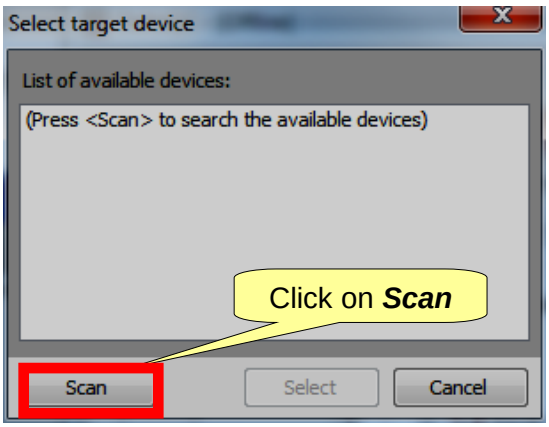
4.5.1 USB connection

WARNING: When the external power supply is used, connect the power supply to the Delta before connecting the USB cable from the Delta and the PC.

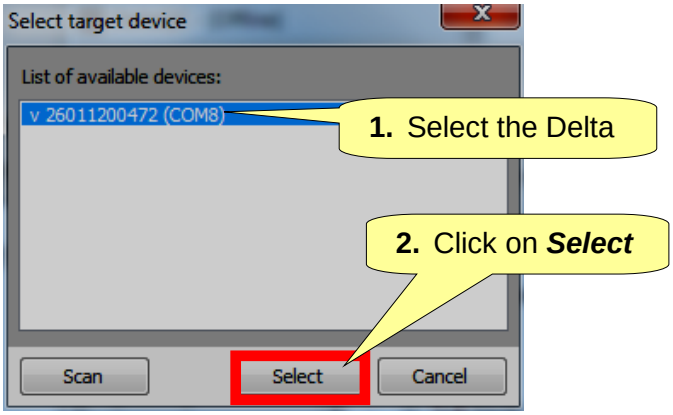
After connecting the Delta to the PC with the DeltaQC software for the first time, select ***Scan*** (refer to the screen below):



After clicking on ***Scan***, the following screen is shown:



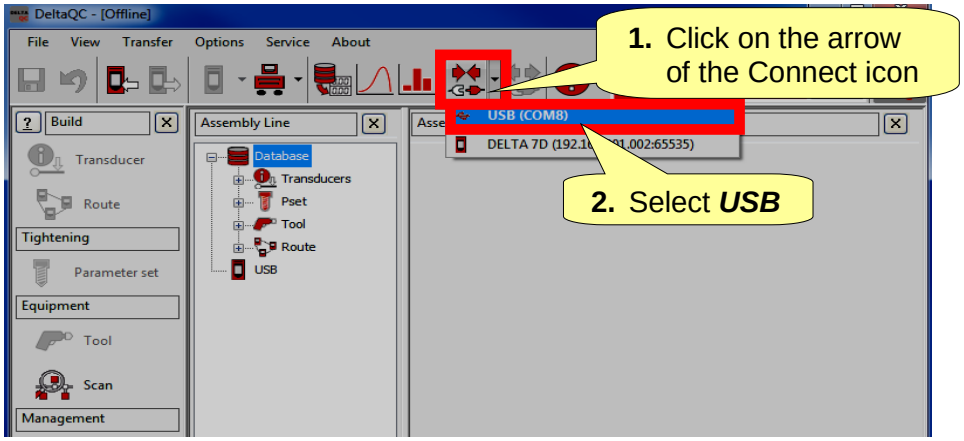
After clicking on ***Scan***, select the available Delta from the list; then click on ***Select***:



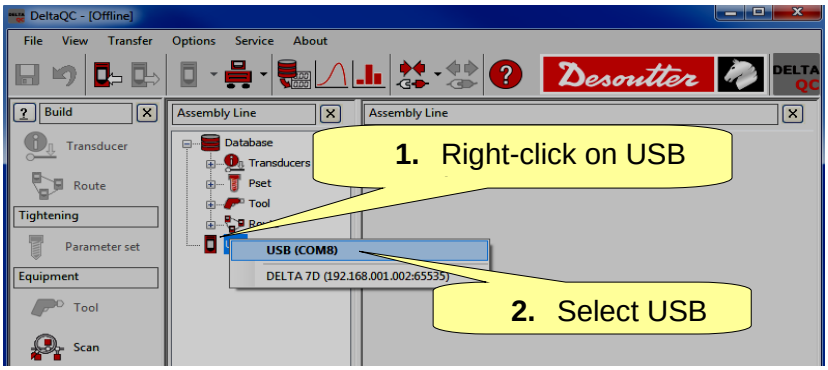
NOTE: This operation is necessary only once.

After the first time, perform the following steps:

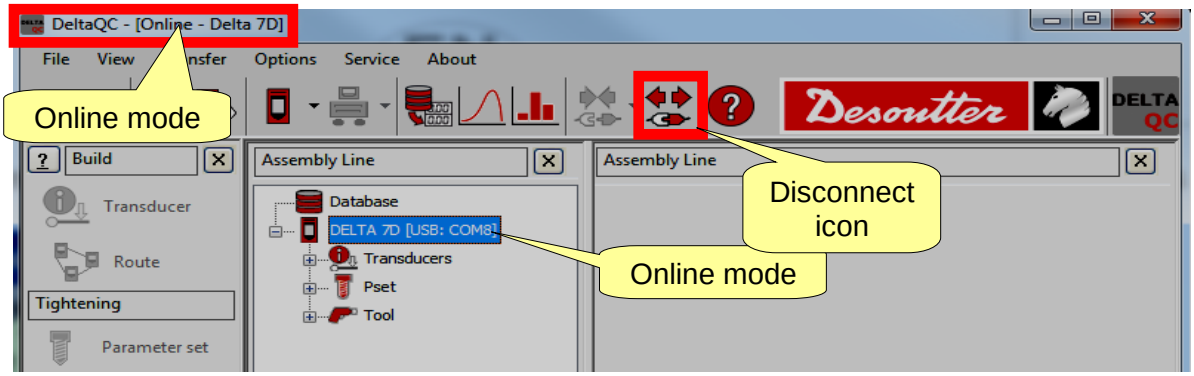
- Launch the DeltaQC software.
- Turn on the Delta and wait for the Delta for its startup (the main menu is shown on the display).
- Connect the Delta to the PC through USB cable (with the Delta already turned on).
- Click on the arrow of the ***Connect*** icon placed on the main toolbar and select USB to establish the connection between the Delta and the PC:



NOTE: To establish the connection between the Delta and the PC, it is also possible to right-click on *USB* icon in the *Assembly Line* area (refer to the following screen):



When the Delta is connected, the ***Connect*** icon is disabled and the ***Disconnect*** icon is active:

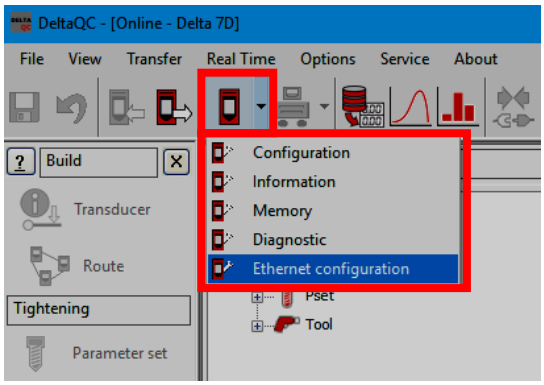


4.5.2 Ethernet connection

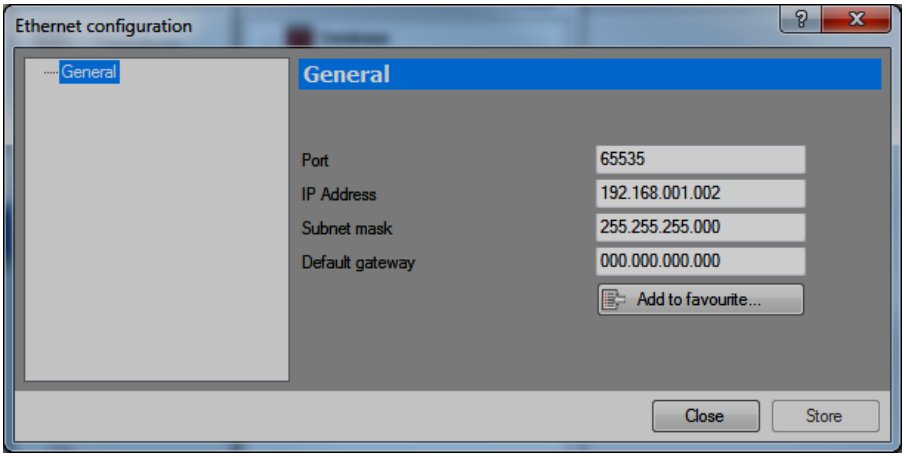
The Ethernet connection can be done either by using a network cable between the PC and the Delta 6D/7D or by connecting both of them to the same network.

NOTE: The Ethernet connection is not available for the Delta 1D.

The Delta must be configured with the network parameters.
If not already done, connect the Delta to the PC with DeltaQC software via USB cable (as described in the previous paragraph "*USB connection*"), and select ***Controller*** → ***Ethernet configuration***:



After clicking on "***Ethernet configuration***" option, the following screen is shown:

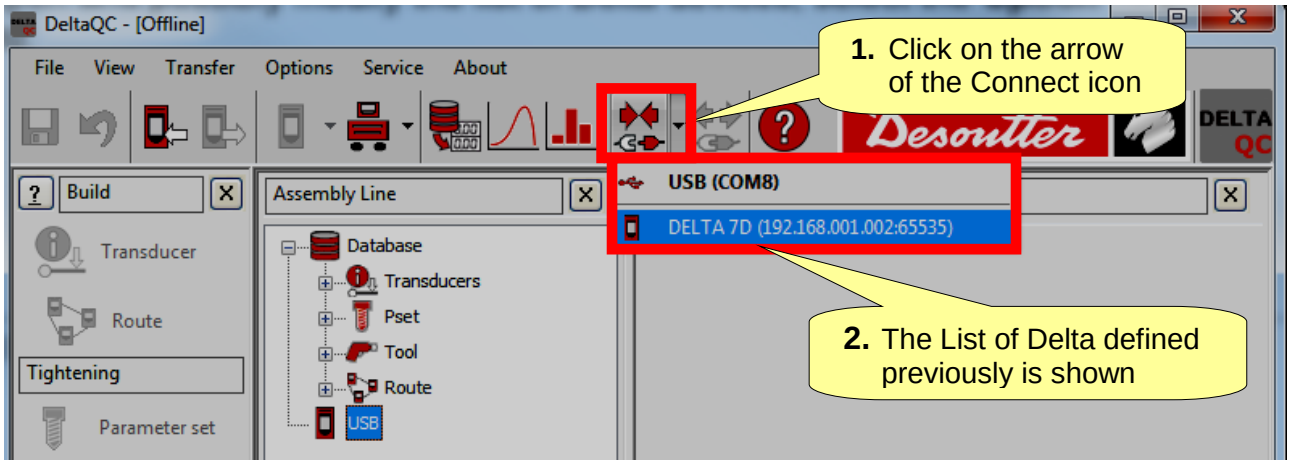


Set the parameters as follows:

Port	Set any port available in the own system.
IP Address, ***Subnet mask*** and ***Default gateway***	Set valid parameters according with the own network (or *PC network parameter* if the Delta is directly connected to the PC).

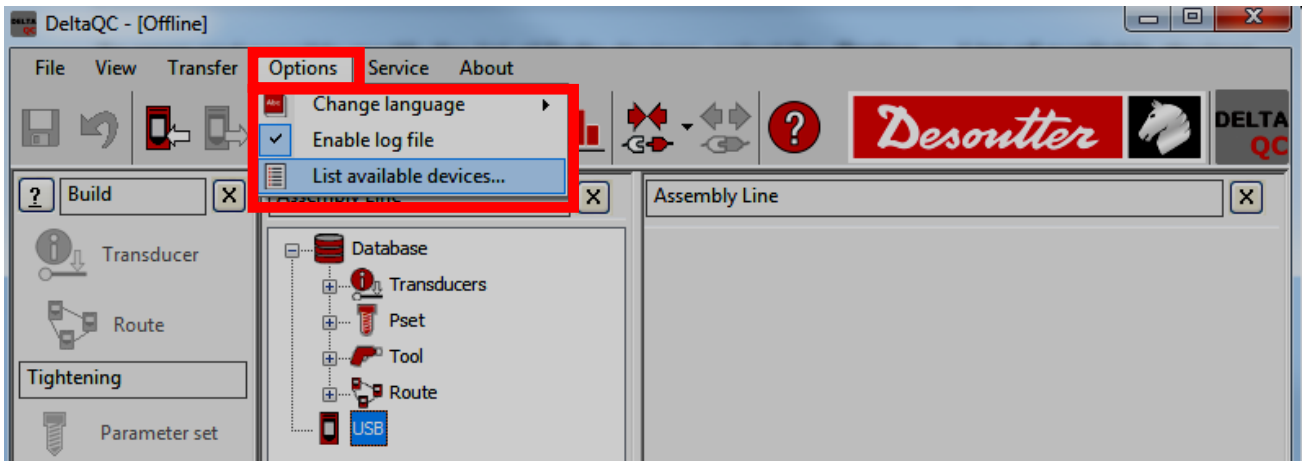
After setting the above parameters, click on "***Add to favourite…***" option to save them into a local archive; then click on ***Store*** to save the configuration.

The list of the devices added to the "*Favourite List*" is shown under the ***Connect*** icon menu:

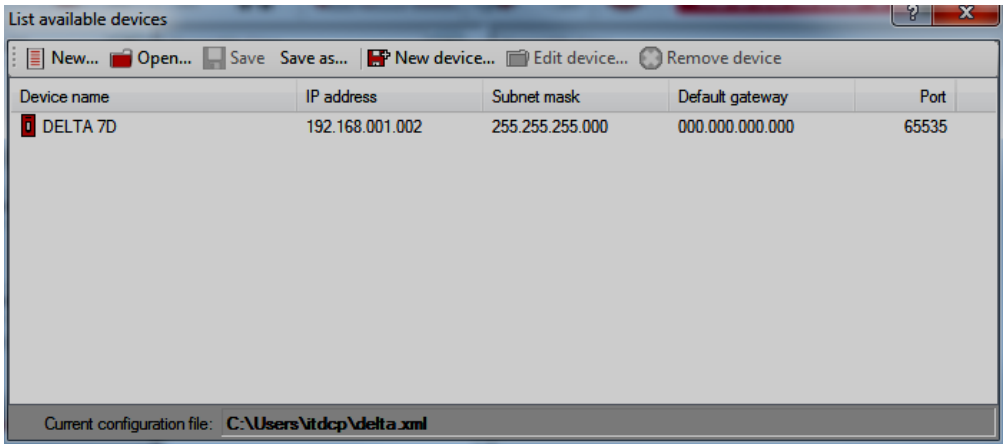


Connect the network cable to the Delta and select it from the list.

To open and possibly modify the list of Delta devices, select the ***Option*** → ***List of available devices…*** menu:

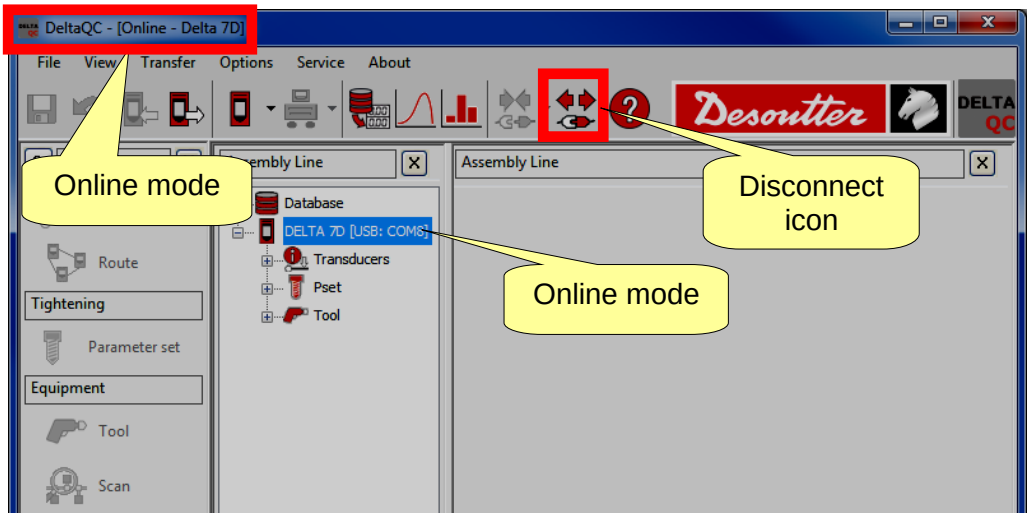


After clicking on "***List of available devices…***", the following screen is shown:



New	Create a new file containing a list of devices.
Open	Open a file containing a list of devices.
Save / Save as	Save the current list of devices to a file.
New Device / Edit device	Create/edit a device.
Remove device	Remove the selected device.

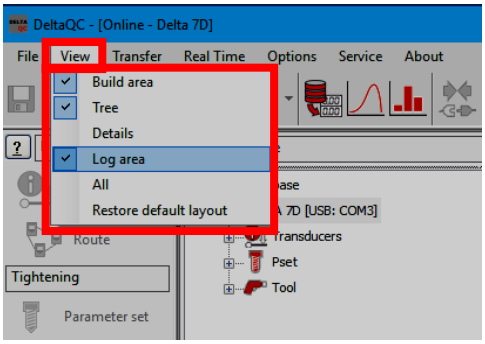
When the Delta is connected, the ***Connect*** icon is disabled, the ***Disconnect*** icon is active, and the Delta data are shown:



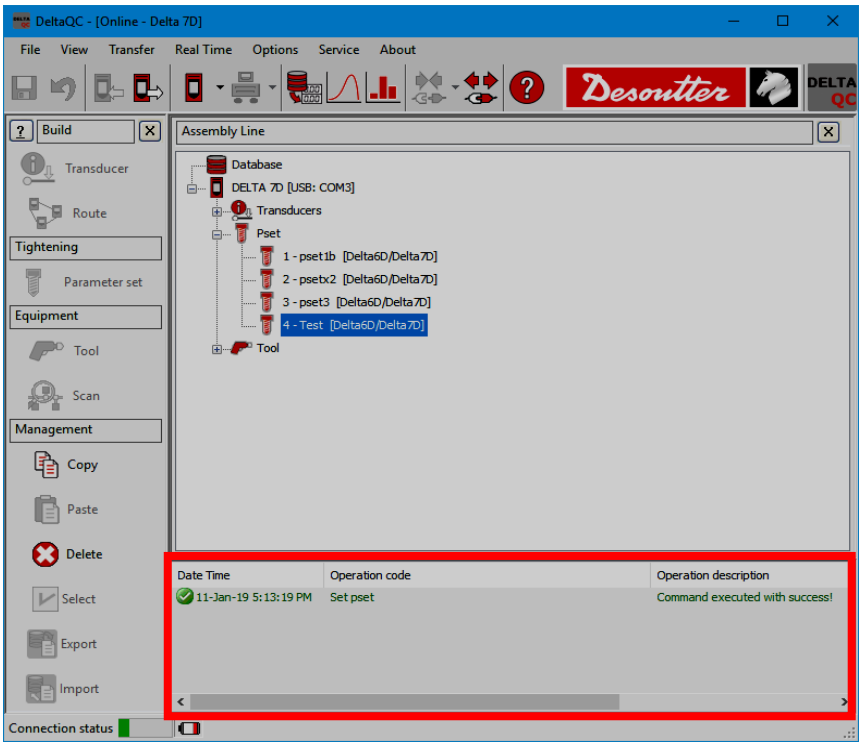
4.6 Delta LOG file

The ***Log viewer*** function displays information about the Delta – DeltaQC software communication. This can be helpful for troubleshooting activities.

To enable the ***Log area*** click on "*Log area*" command placed in *View* option of the toolbar (refer to the paragraph "*Menu list*" for further details):



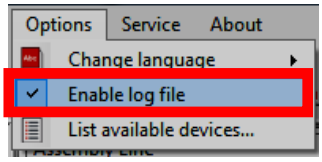
All the messages related to Delta – DeltaQC communication are displayed in the log area:



A "*Log file*" is automatically created in a subfolder of the installation directory of the DeltaQC software (typically: ***C:\Program Files\Desoutter\DeltaQC\Log***).

NOTE: A new file is created each day the software is used; the old files can be deleted.

NOTE: The "Log file(s)" option can be enabled or disabled in the menu ***Options*** → ***Enable log file***.

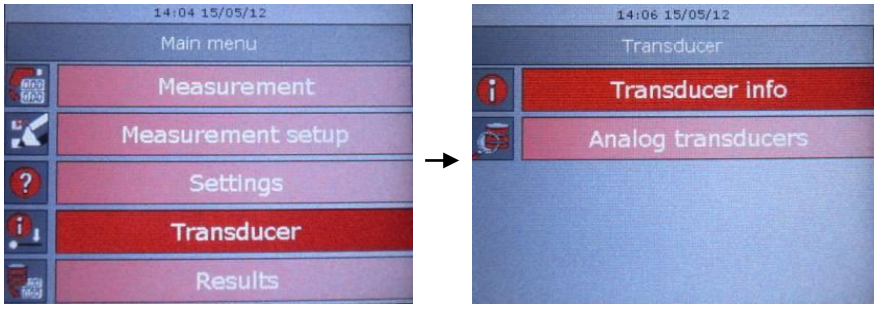


5 TRANSDUCERS

Connect the Delta to one of the following transducers:

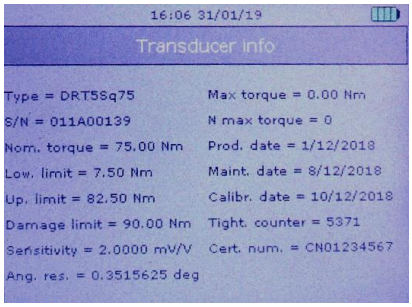
When connecting a transducer, the Delta automatically detects it, and executes the proper zeroing.

By selecting the ***Transducer*** → ***Transducer info*** from the main menu of the Delta, the transducer information is shown on the display:



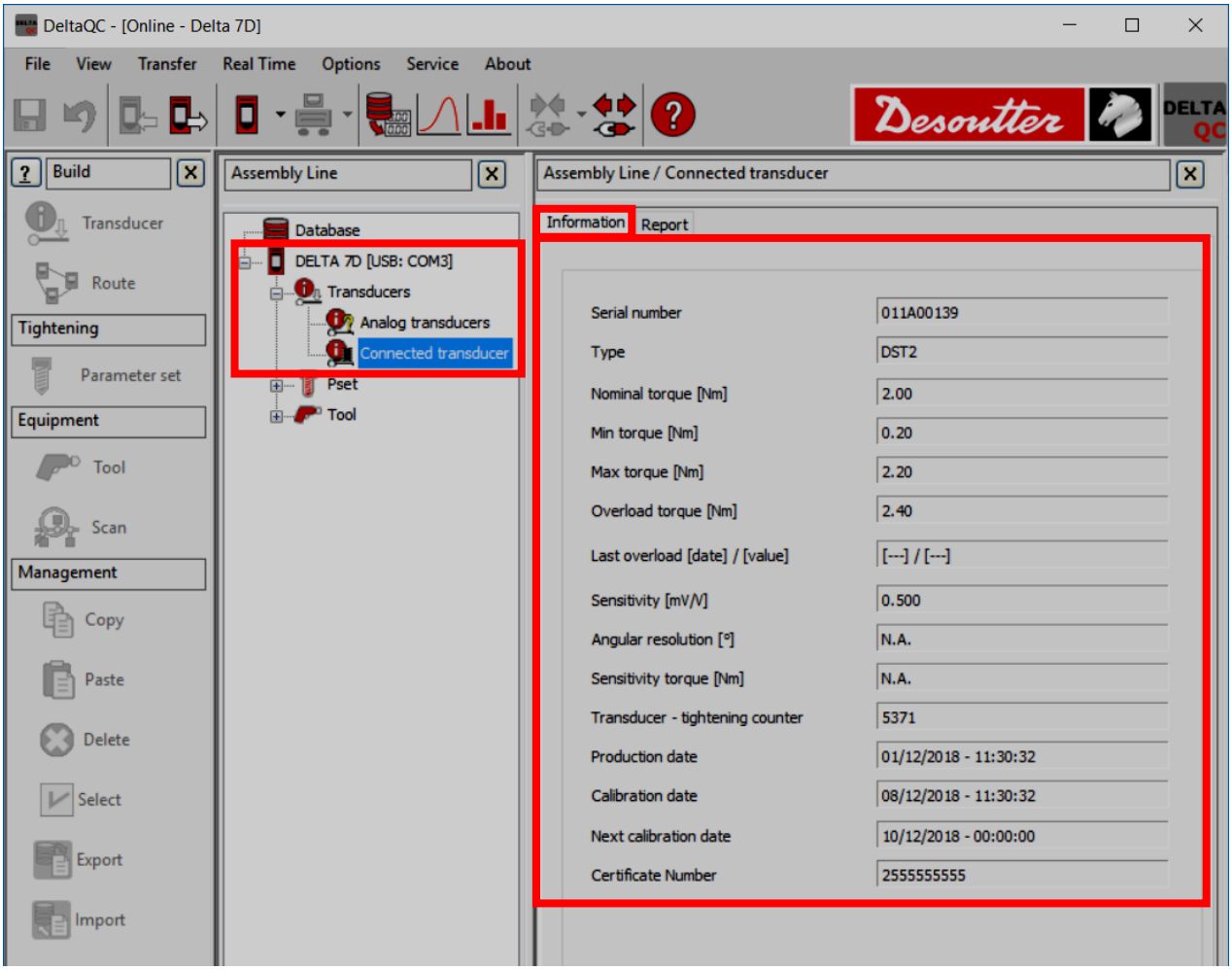
In the case a ***FCT*** is connected, the Transducer screen has the following items:

In the ***Transducer info*** are detailed the transducers characteristics:



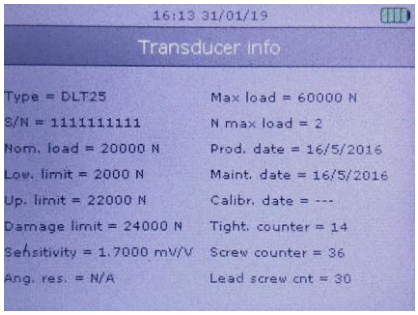
Type	Name of the transducer.
S/N	Serial Number of the transducer.
Nom. torque	Capacity (Nm) of the transducer.
Low. limit	Lower torque limit.
Up. limit	Upper torque limit.
Damage limit	Torque overload limit at which the transducer gets damaged. When the transducer reaches this limit, a warning message is shown for a few seconds when it is connected to the Delta. To reset this message and to ensure that the transducer is still working properly, the transducer must be inspected and re-calibrated by the *Customer Center*.
Sensitivity	Sensitivity in mV/V.
Ang. res.	Angular resolution of the encoder in degrees.
Max. torque	Maximum torque applied to the transducer during the use with the Delta.
N max torque	This field contains a counter incremented every time the torque measured by the transducer exceeds the ***Up. limit*** during the use with the Delta. For a transducer working properly it should always be zero.
Prod. date	Date of production of the transducer.
Maint. date	Date of the last transducer calibration.
Calibr. date	Date of the next transducer calibration.
Tight. counter	Number of tightenings performed by the transducer connected to the Delta.
Cert. num.	Number of the calibration certificate.

Information on the connected transducer are displayed also in the ***Transducers → Connected transducer*** menu of the DeltaQC *online mode*:



The additional information ***Last overload*** indicates the date, time, and value of the last overload detected by the Delta.

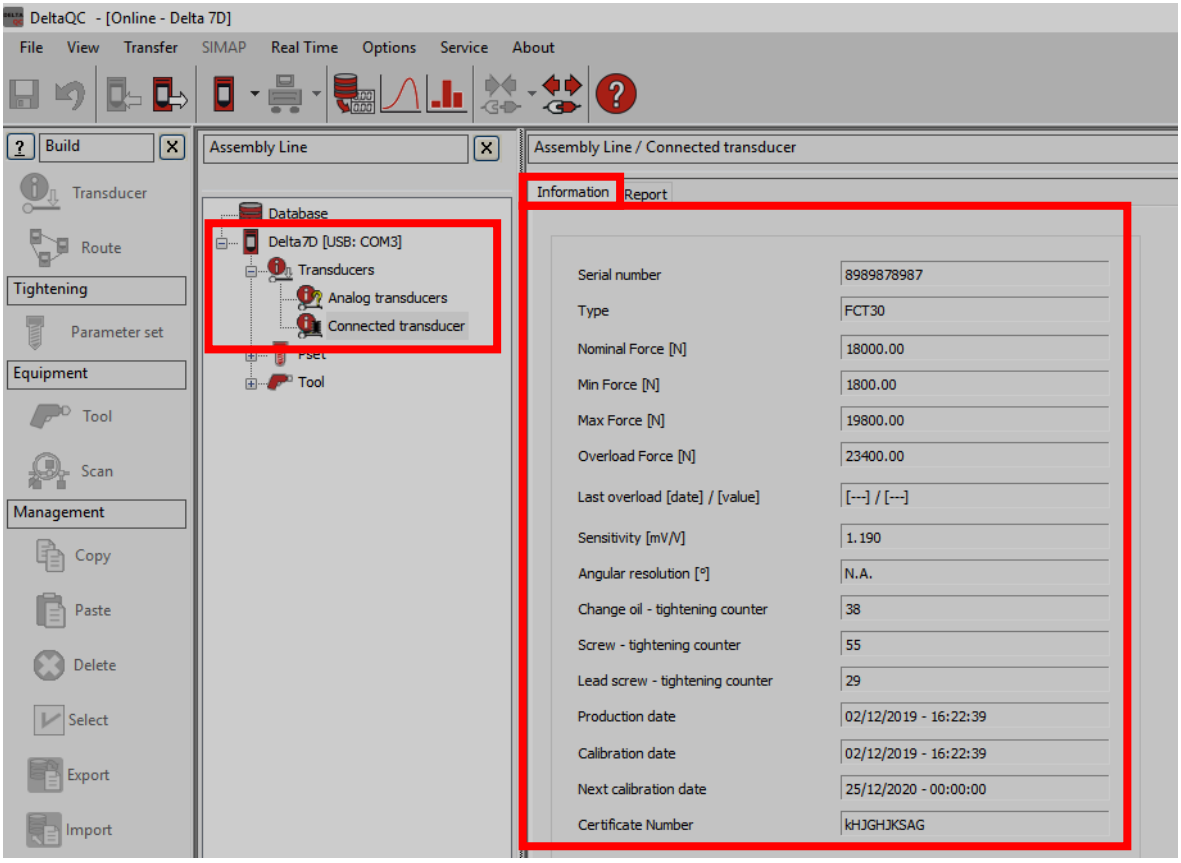
If the ***FCT*** is connected to the Delta, the following ***Transducer info*** are displayed:



The measurement unit is Newton (N).

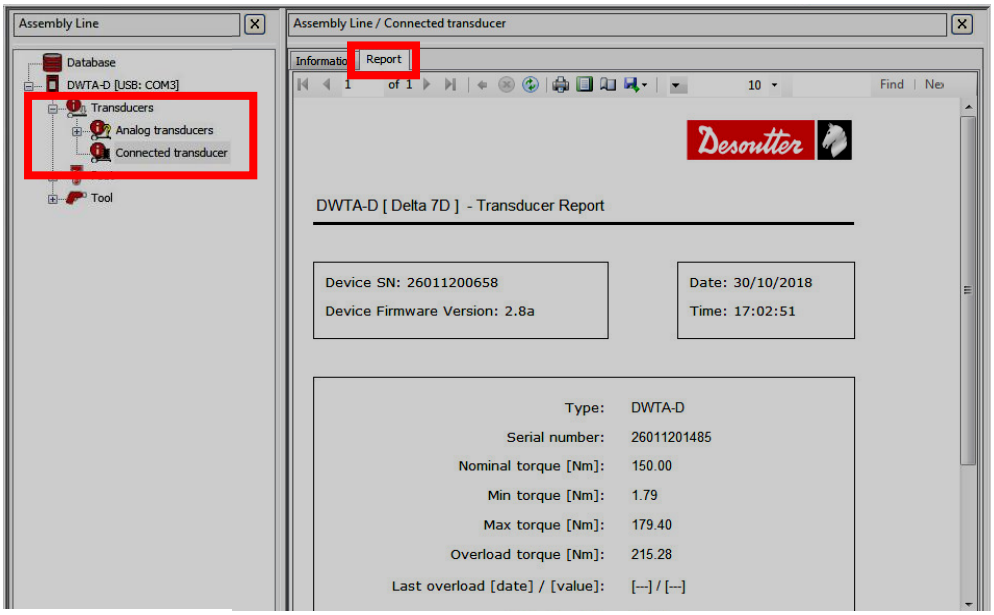
Type	Name of the transducer.
S/N	Serial Number of the transducer.
Nom. load	Capacity of the transducer.
Low. limit	Lower load limit.
Up. limit	Upper load limit.
Damage limit	Overload limit at which the transducer gets damaged.  When the transducer reaches this limit, a warning message is shown for a few seconds when it is connected to the Delta. To reset this message and to ensure that the transducer is still working properly, the transducer must be inspected and re-calibrated by the *Customer Center*.
Sensitivity	Sensitivity in mV/V.
Ang. res.	N/A
Max. load	Maximum load applied to the transducer during the use with the Delta.
N max load	This field contains a counter incremented every time the load measured by the transducer exceeds the ***Up Limit*** during the use with Delta.  For a transducer working properly it should always be zero.
Prod. date	Date of production of the transducer.
Maint. date	Date of the last transducer calibration.
Calibr. date	Date of the next transducer calibration.
Tight. counter	Number of tightenings performed by the transducer connected to the Delta. When the maximum number is reached, a warning message is shown and the FCT oil must be changed.
Screw counter	Number of tightenings performed by the transducer connected to the Delta. When the maximum number is reached, a warning message is shown and the FCT screw and washer must be replaced.
Lead screw cnt	Number of tightenings performed by the transducer connected to the Delta. When the maximum number is reached, a warning message is shown and the DLT lead screw must be replaced.
Cert. num.	Number of the calibration certificate.

If a ***FCT*** is connected to the Delta, the following information are displayed in the ***Transducers*** → ***Connected transducer*** menu of the DeltaQC *online mode*:



The additional field ***Last overload*** indicates the date, time, and value of the last overload detected by the Delta.

From the ***Transducers*** → ***Connected transducer*** menu of the DeltaQC *online mode* it is possible to create a report of the transducer connected to the Delta:

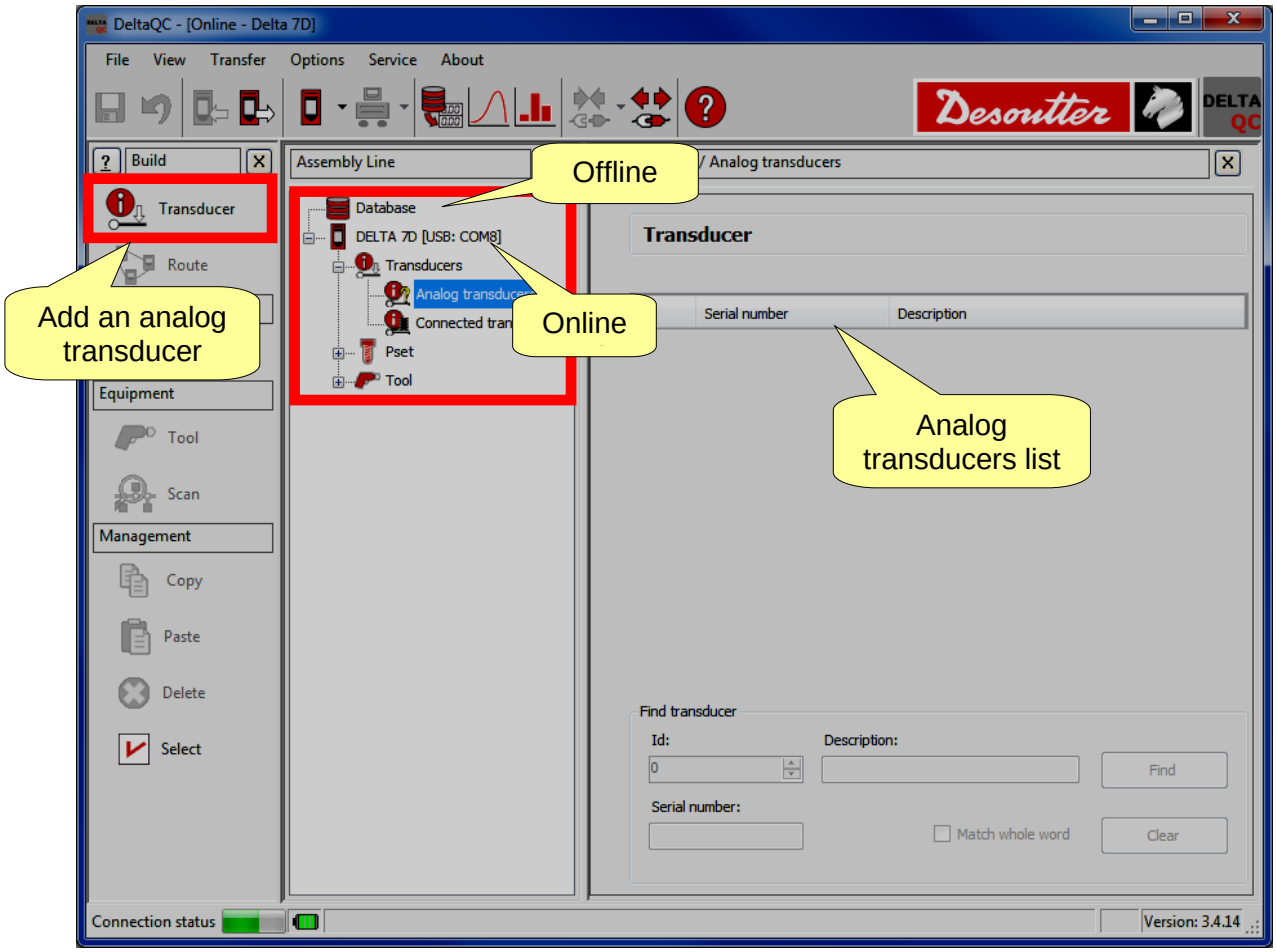


The commands on the top of the report window provide functions either to print the report or to export it in an Excel or PDF file.

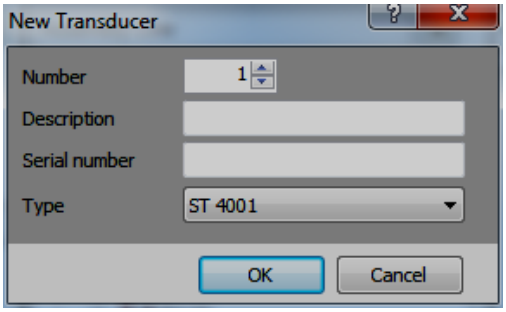
It is also possible to connect the following analog transducers through a proper adapter:

- ***ART***
- ***CMD***
- ***GSE***
- ***ST 4000***
- ***Custom transducers, torque or torque/angle*** (*Sensitivity range 0.4 mV/V to 2.5 mV/V, bridge resistance 350 to 1000 Ohm. For transducers with encoder, the input current must be less than 150 mA with +5V power supply*).

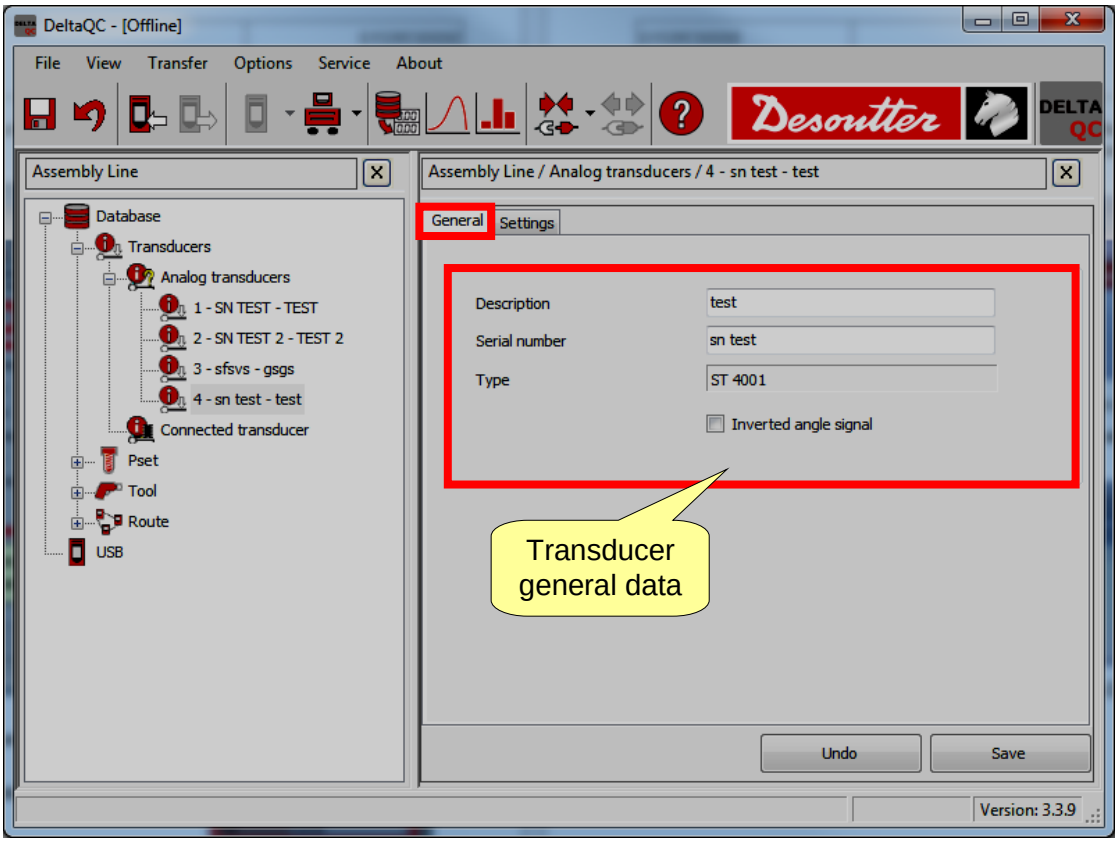
The analog transducer can be defined offline (refer to the following screen) and then transferred to the Delta, or directly online on the Delta:



After clicking on "*Analog transducers*" placed in the *Assembly Line area*, click on ***Transducer*** (*Build area*) to add a new analog transducer; the following screen is shown:

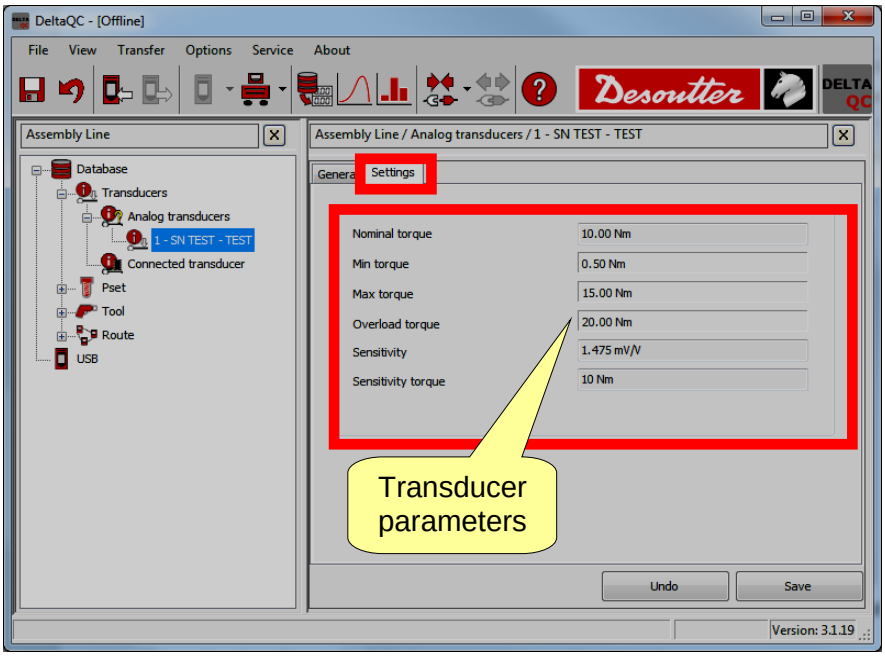


After entering the *Description* and *Serial number* (refer to the screen above) and clicking ***OK***, the following page is shown:



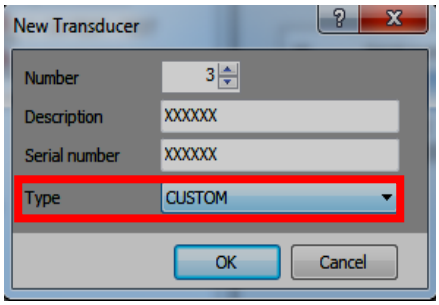
NOTE: In the ***General*** section, *Description* and *Serial number* are the only editable areas. Furthermore, by flagging the "***Inverted angle signal***" option, it is possible to solve those cases where the analog transducers give an inverted/negative angle reading.

Finally, after checking the transducer parameters, click ***Save***.



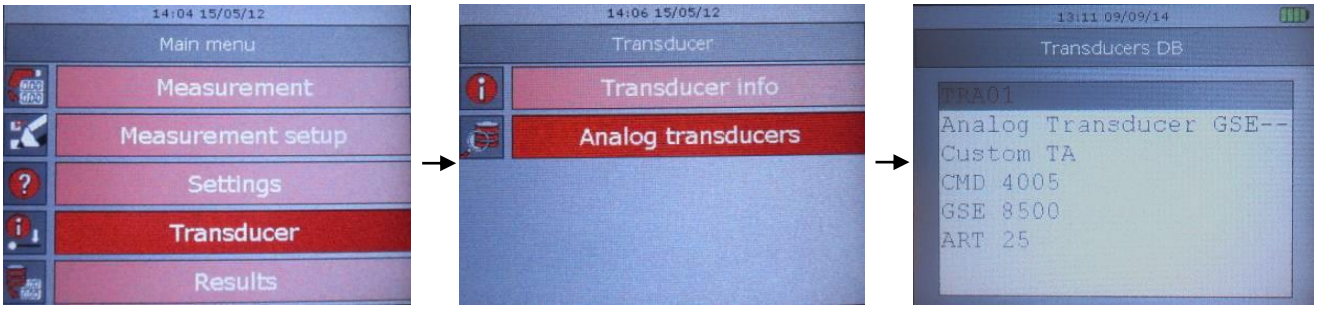
For *pre-defined transducers*, the parameters are set according to the type selected, and cannot be modified.

For *custom transducers*, the following parameters must be entered in the *Settings* section:



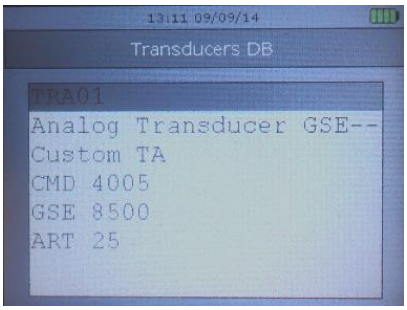
Nominal torque	Transducer capacity.
Sensitivity	Sensitivity in mV/V.
Sensitivity torque	Torque value at which the sensitivity is referred.
Angular resolution	For transducers with angle measurement, this specifies the angular resolution in degrees. The Delta measures the rising and falling edges of both the *phase A* and *phase B* (also called *Clock* and *Up/Down*) of the encoder. Therefore, the nominal impulses are multiplied by four. *Example:* *Torque/angle transducer with 450 impulses per revolution → angular resolution = 360 / (450 *4) = 0.2*

To select the analog transducer currently connected to the Delta, connect the CMD adapter to the Delta; then select the ***Transducer*** → ***Analog transducers*** from the main menu, and select the transducer from the list:



Select the transducer and press ***Valid*** to confirm or ***ESC*** to quit without selecting the transducer.

When the CMD adapter is connected to the Delta, the window to select the analog transducer is shown automatically:

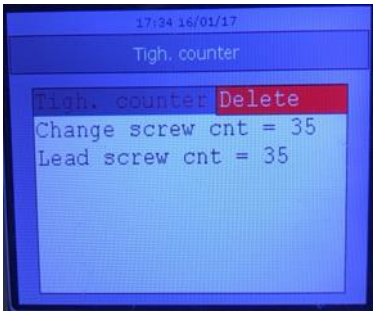


The list of transducers shown here is the list defined in the DeltaQC software, as explained above.

Select the transducer and click ***Valid*** to confirm.

In the ***Tigh. counter*** screen:

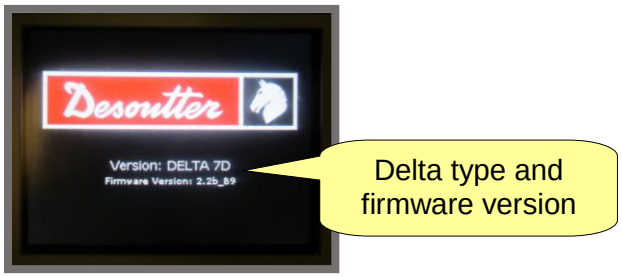
The values of ***Tigh. Counter***, ***Change screw cnt, Lead screw cnt*** values can be reset***:***



Tigh. counter	In order to reset the number of tightenings performed, select this item of the list, press ***Enter,*** then press ***Valid*** **NOTE:** It is possible to reset this parameter also when the Delta on measurement when a ***Tool check: Pulse Tool Preload*** Pset is selected. Press Both ***Left Arrow*** and ***Right Arrow*** buttons to do this. **NOTE:** Reset this counter after greasing FCT screw.
Change screw cnt	In order to reset the value of the number of tightenings performed before the ***Change screw*** message is shown, select this item of the list, press ***Enter*** then press ***Valid***. **NOTE:** Reset this counter after replacing FCT screw.
Lead screw cnt	In order to reset the value of the number of tightenings performed before the ***Change lead screw*** message is shown, select this item of the list, press ***Enter*** then press ***Valid***. **NOTE:** Reset this counter after replacing FCT lead screw.

6 GETTING STARTED WITH DELTA

To turn on the Delta press the ***Power*** button on the keyboard; to turn it off, press again the ***Power*** button and hold it down for few seconds. The power on screen is shown for few seconds; the Delta type and firmware version is displayed under the Desoutter logo:



After the power on screen, the following main menu is shown on the display:

NOTE: Even if the main menu is the same for the different Delta models, the functions inside the submenus are in general different. Refer to the next paragraphs for further details about the submenus for the different Delta models.

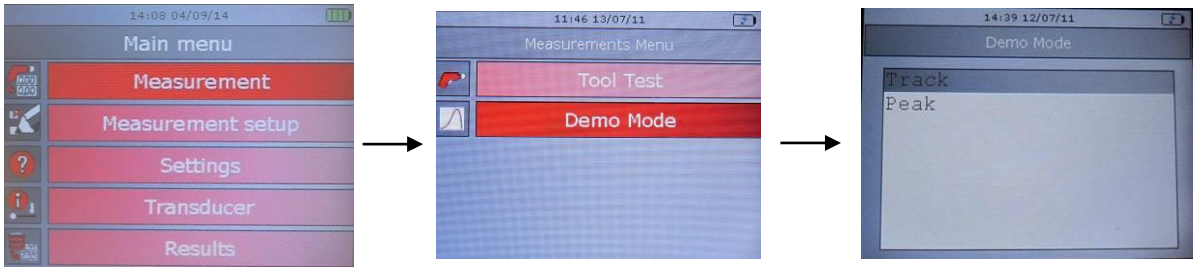
6.1 Executing a Demo Test

The demo test conducts a test by simply accessing the Delta from the keyboard, with no need to set the test.

NOTE: In this mode the results are not saved in the Delta memory. The LEDs and buzzer are not activated in this mode.

To conduct a demo test:

- **Delta 1D**: Select ***Measurement*** from the main menu; then select ***Demo Mode***:

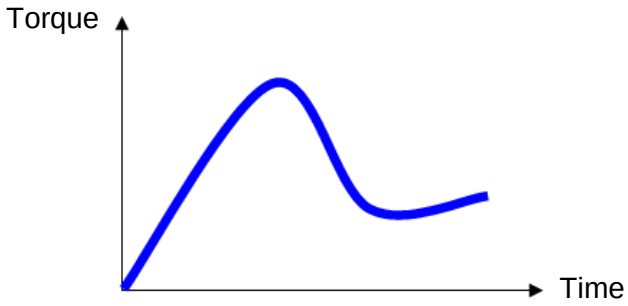


- **Delta 6D/7D**: Select ***Measurement*** from the main menu; then select ***Quick test***; finally select ***Demo Mode***:

Select ***Track***, ***Peak***, ***Tachometer*** or ***Tightening*** and click on the ***Enter*** button on the keyboard to start the test.

6.1.1 Track

"***Track***" mode can be used to track the torque in real time.

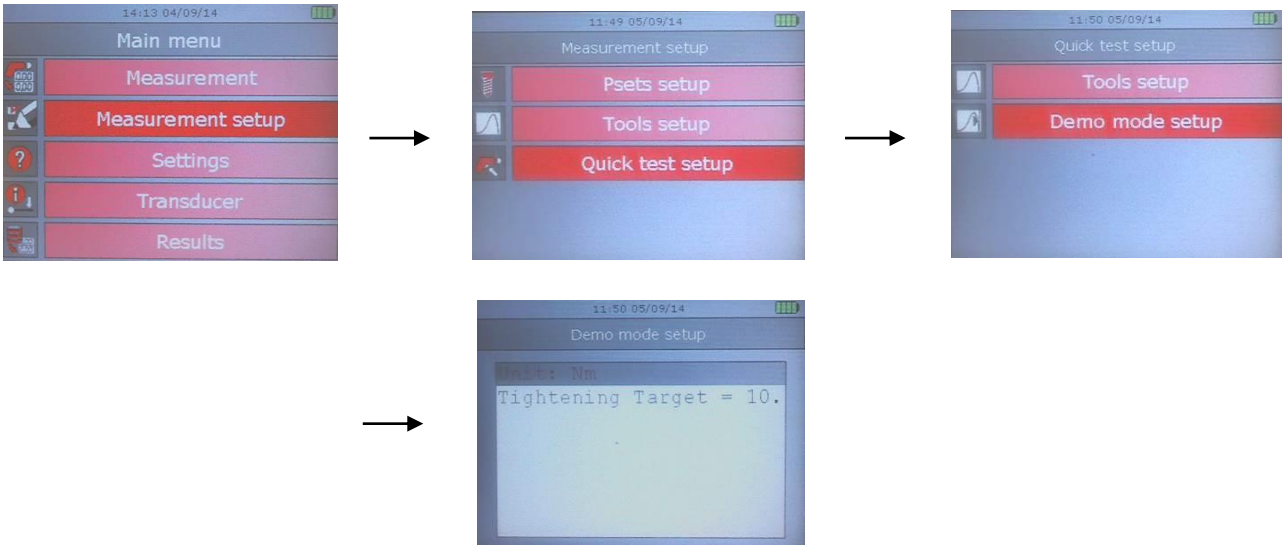


In ***Track*** mode, the Delta simply displays the applied torque in real time.

Torque can be applied in either clockwise (positive torque) or counterclockwise (negative torque) direction.

Click on the ***Enter*** button on the keyboard to execute a torque zero adjustment.
Note that this zero adjustment is applied only for this test and not applied as a global zero reference.

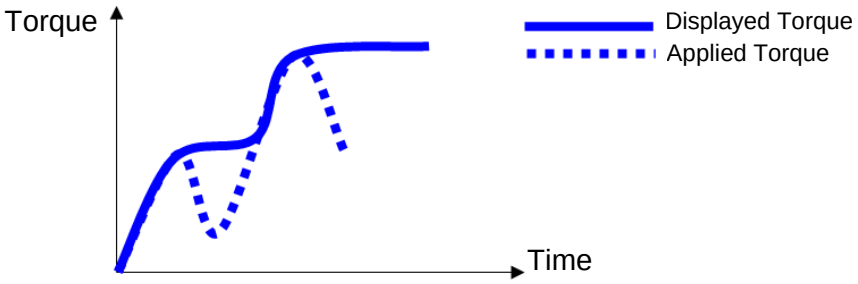
The torque measurement unit can be set from the ***Measurement setup*** → ***Quick test setup*** → ***Demo mode setup*** menu:



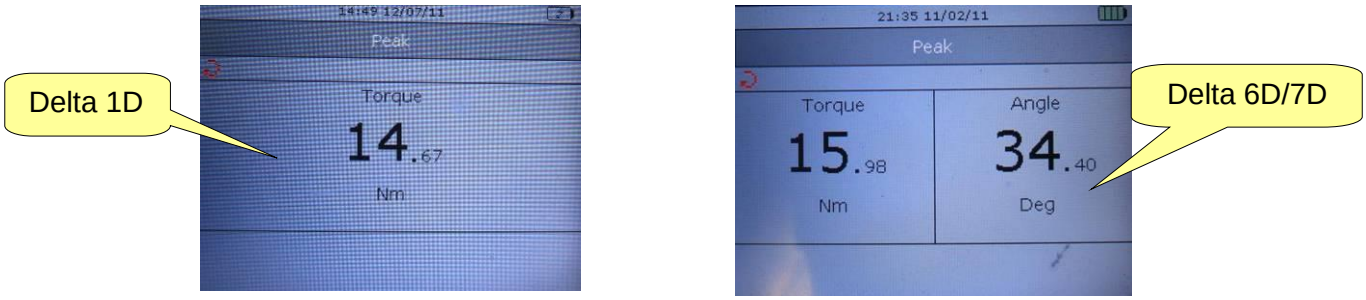
The filter frequency is 100 Hz.

6.1.2 Peak

In "***Peak***" the torque produced by the wrench or nutrunner is shown in real time, and the maximum value reached during tightening remains frozen on the Delta display.

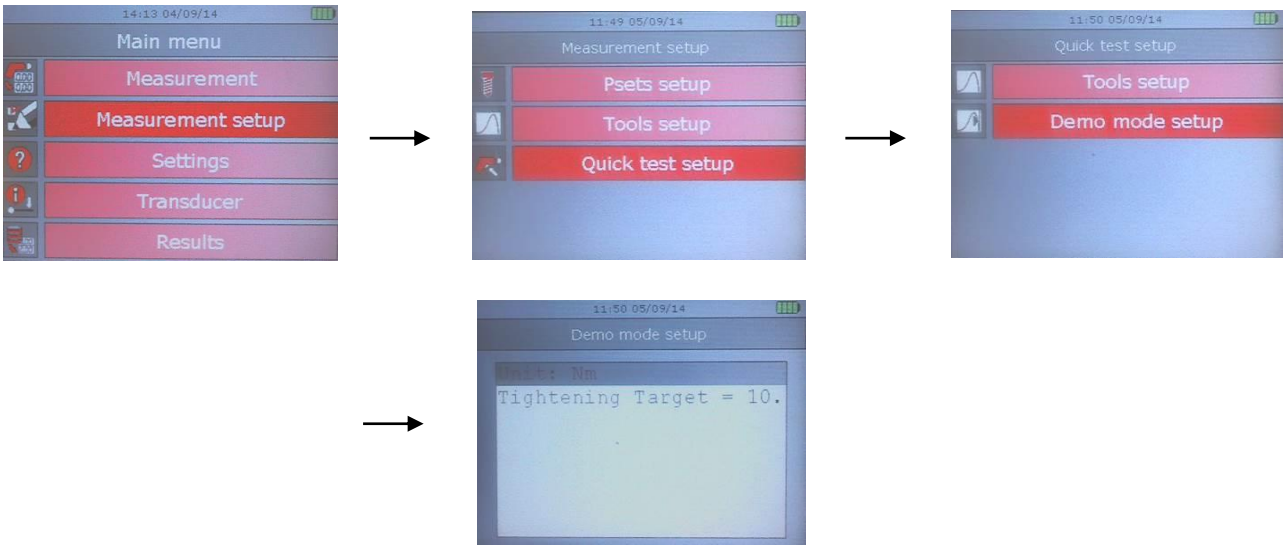


Generally, the Delta displays torque in real time (the ***Delta 6D/7D*** shows the angle as well), and the torque peak value is frozen on the display; the angle value is not frozen with the torque peak.



A new cycle starts when the applied torque is released, and applied again.
By clicking on the ***Enter*** button on the keyboard the torque value is reset.
The torque must be applied in the clockwise direction.

The torque measurement unit can be set from the ***Measurement setup*** → ***Quick test setup*** → ***Demo mode setup*** menu:



The filter frequency is 100 Hz.

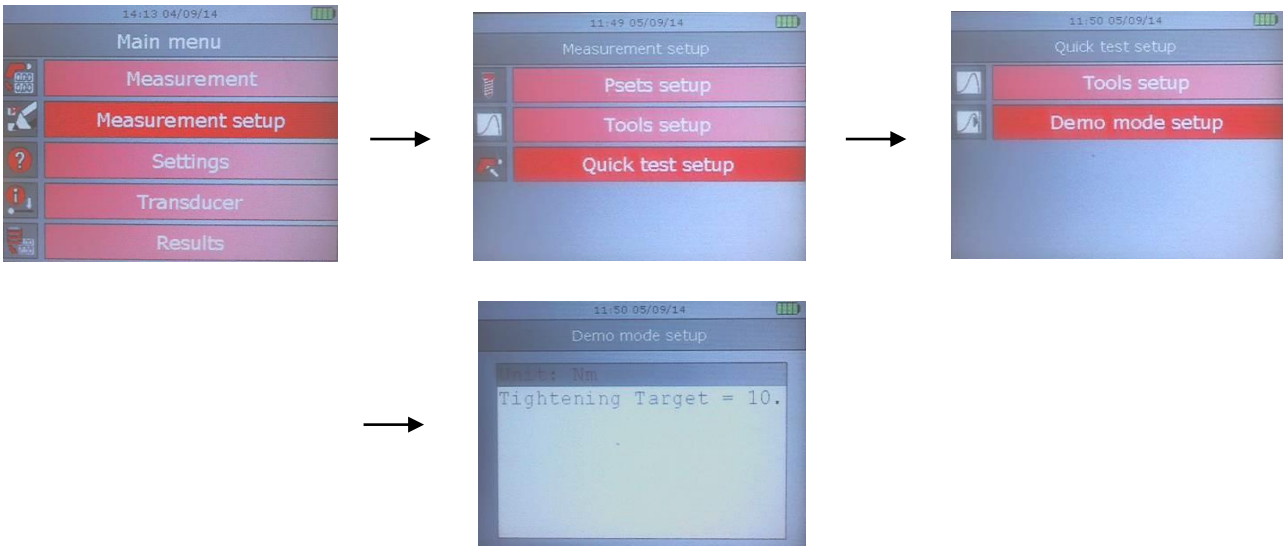
6.1.3 Tachometer

NOTE: "***Tachometer***" function is available only on the Delta 6D/7D.

"***Tachometer***" mode measures in real time the tool torque and angular speed:

The tool can operate clockwise (angular speed is positive) or counterclockwise (angular speed negative).

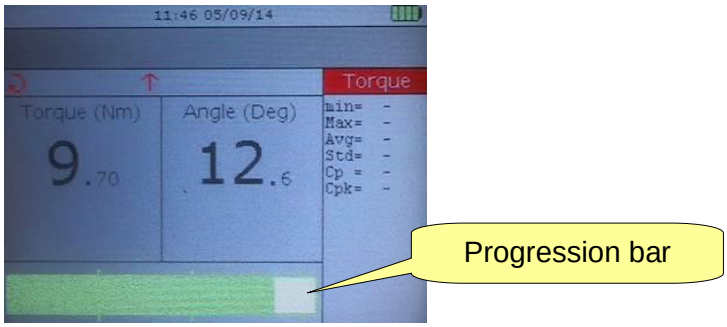
The torque measurement unit can be set from the ***Measurement setup*** → ***Quick test setup*** → ***Demo mode setup*** menu:



6.1.4 Tightening

NOTE: "***Tightening***" function is available only on the Delta 7D.

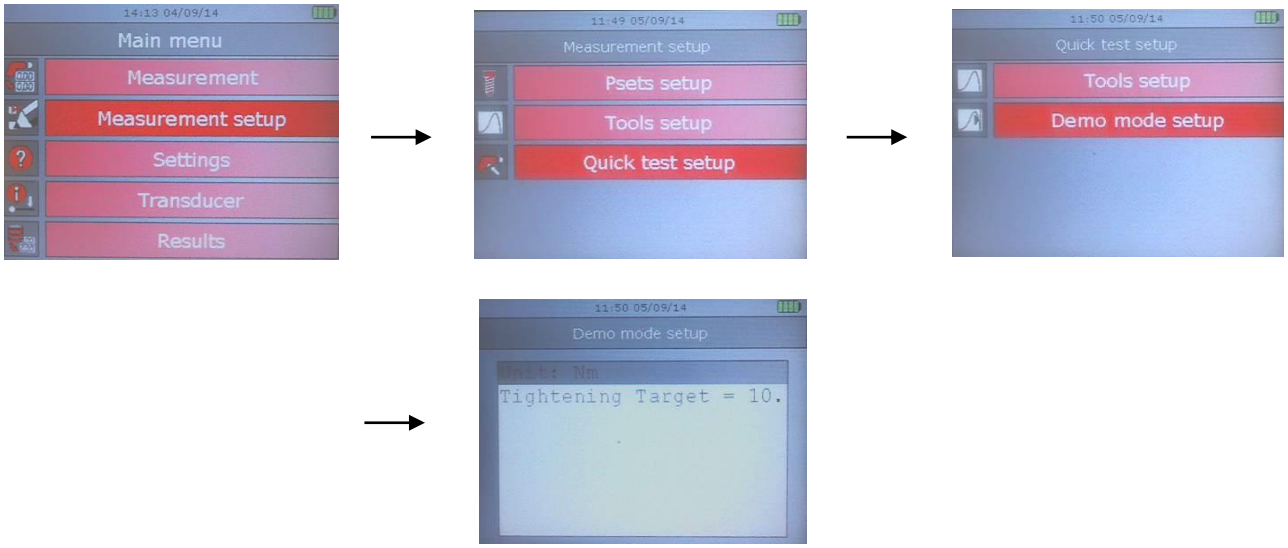
"***Tightening***" mode performs a tightening measuring torque and angle:



The progression bar guides the operator to the target torque.

NOTE: The tool must operate clockwise.

The target torque and the torque measurement unit can be set from the ***Measurement setup*** → ***Quick test setup*** → ***Demo mode setup*** menu:



7 USE OF DELTA 1D

The ***Delta 1D*** gives a Demo Mode and a menu for testing nutrunners, pulse tools and wrenches.

For the ***Delta 1D*** model:

- Test of tools and wrenches are executed directly from the main menu; this version does not support the Pset definition by DeltaQC software.
- Network port is disabled.
- Curves are not created.
- Statistic Control and Cm-Cmk are not available.

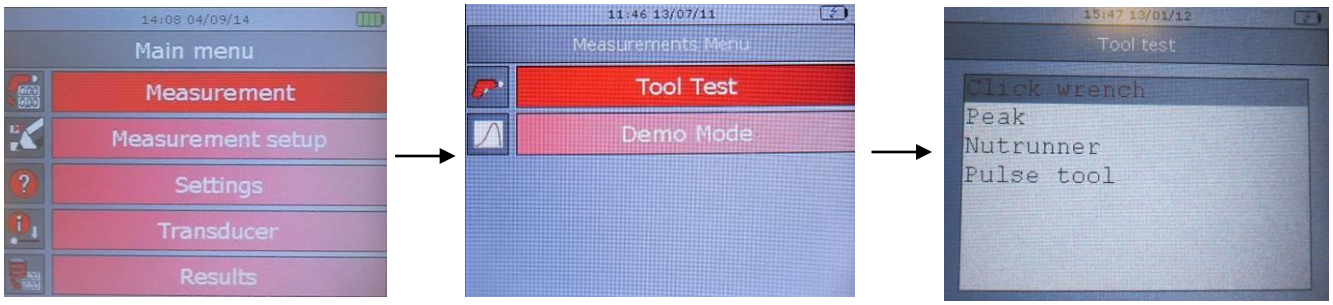
The main menu is as follows:

Measurement	This option conducts a test by means of a wrench or a tool, or a free test.
Measurement Setup	This option defines the setup parameters for the click-wrenches test, nutrunners test, peak test, and pulse tools test. Furthermore it allows to choose the measurement unit for the demo mode.
Settings	This menu allows to customize the Delta settings. Refer to the paragraph "*Delta 1D Settings*" for further details.
Transducer	This function shows the details of the transducer connected to the Delta. Refer to the paragraph "*Transducers*" for further details.
Results	It shows the results coming from the click-wrenches test, nutrunners test, peak test, pulse tools test preload pulse tools tests.

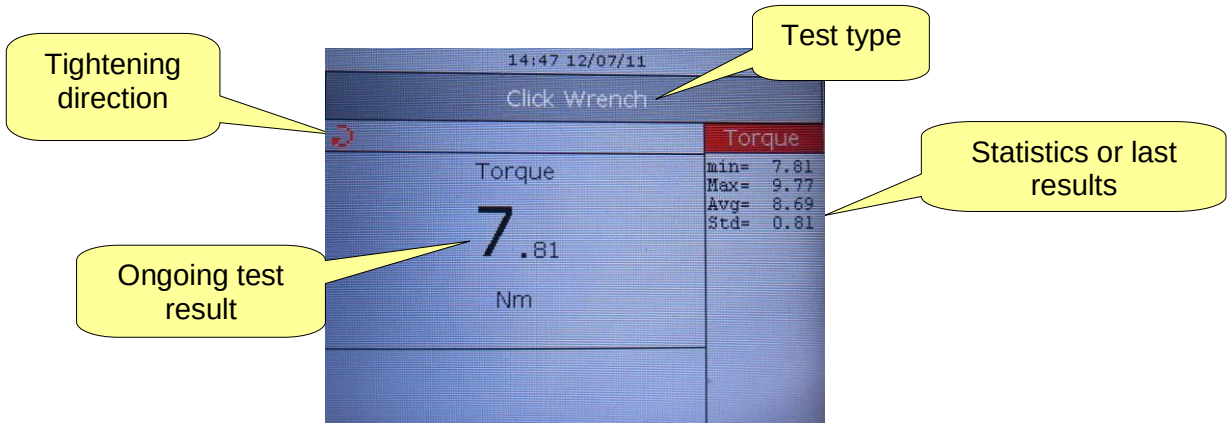
7.1 Testing a Tool

With the ***Delta 1D*** the tests can be executed from the main menu; it is not needed to program them by DeltaQC software.

Select the ***Measurement*** → ***Tool Test*** menu; then select the type of tool that has to be tested:



If the *Results View mode* is set to *Statistics* in the "***Controller*** → ***Configuration***" menu (Delta QC software), the torque result with average, minimum, and maximum values is shown in real time. Starting from the 3rd values also the standard deviation (*Std*) is displayed:



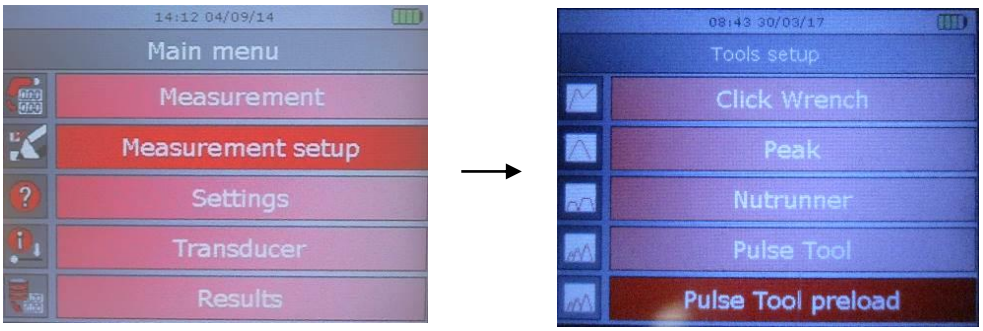
If the *Results View mode* is set to "*Last results"* in the "***Controller*** → ***Configuration***" menu (Delta QC software), the torque result and angle result values are shown instead of the statistics (red color for Not OK result, black color for OK results).

NOTE: For further details about the formulas used by the Delta to calculate the statistics results, refer to the paragraph "*Statistical Computation*".

NOTE: For further details about how the Delta performs the test on the various tools, refer to the following paragraphs: "*Testing Click-wrenches*", "*Peak Test*", "*Testing Nutrunners*" and "*Testing Pulse Tools*".

7.1.1 Test setup

Each kind of test (Click wrench, Nutrunner, Peak and Pulse tool) is configured in the ***Measurement Setup*** menu:

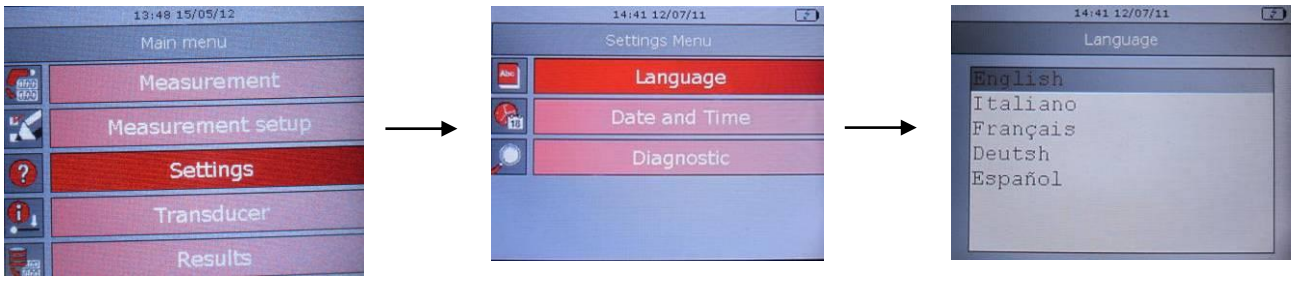


NOTE: For further details about how these parameters are used by the instrument to test a tool, refer to the following paragraphs: "*Testing Click-wrenches*", "*Peak Test*", "*Testing Nutrunners*", *"Testing Pulse Tools", "Testing Pulse Tools with Preload".*

7.2 Delta 1D Settings

7.2.1 Display Language

To set the display language, select ***Settings*** → ***Language*** from the main menu:

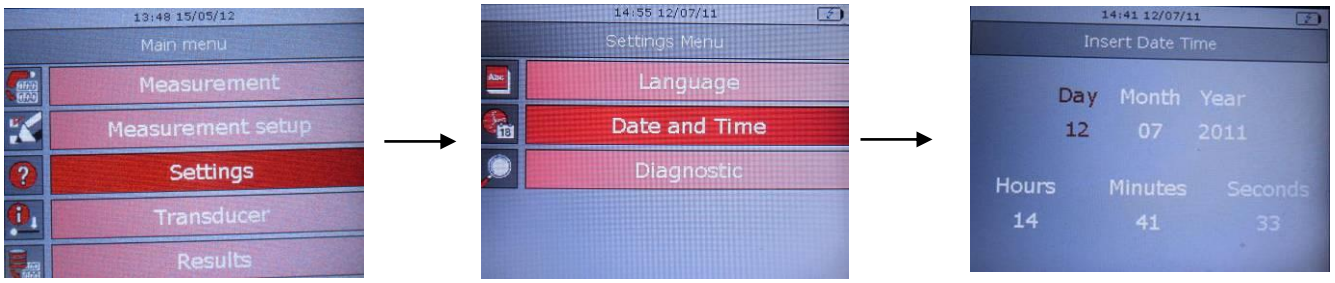


Select the desired language and press "***Valid***" key on the keyboard to confirm.

NOTE: The language can be set also by means of the DeltaQC software. Refer to the paragraph "*Delta Controller Setup*" for further details.

7.2.2 Date and Time

To set the Delta date and time, select ***Settings*** → ***Date and Time*** from the main menu:

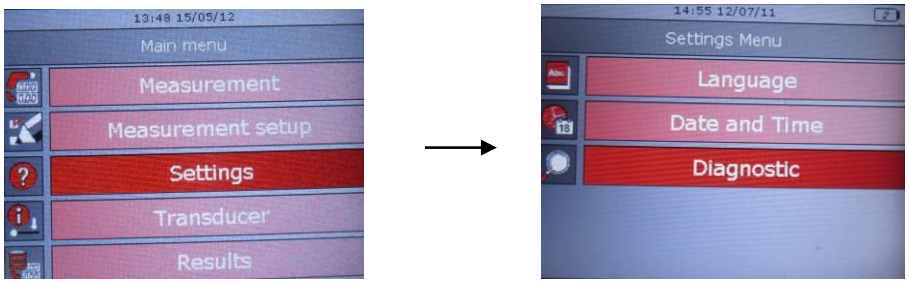


Click on ***Enter*** button on the keyboard to set the date and time.

NOTE: The *Time* is shown on the display, while the *Date* is only associated to the test results.

7.2.3 Diagnostic

The "***Diagnostic***" menu starts the diagnostic procedure. Select ***Settings*** → ***Diagnostic*** from the main menu:



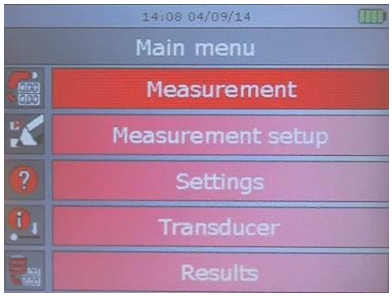
NOTE: For further details about the Diagnostic function, refer to the paragraph "*Delta Diagnostic".*

8 USE OF DELTA 6D/7D

The ***Delta 6D/7D*** are instruments developed to test tools and wrenches; the ***Delta 7D*** also gives a set of test strategies to evaluate the residual torque on joints and to make joint analysis.

The tests must be programmed by the DeltaQC software, which can retrieve the test results and calculate statistics.

The main menu is as follows:

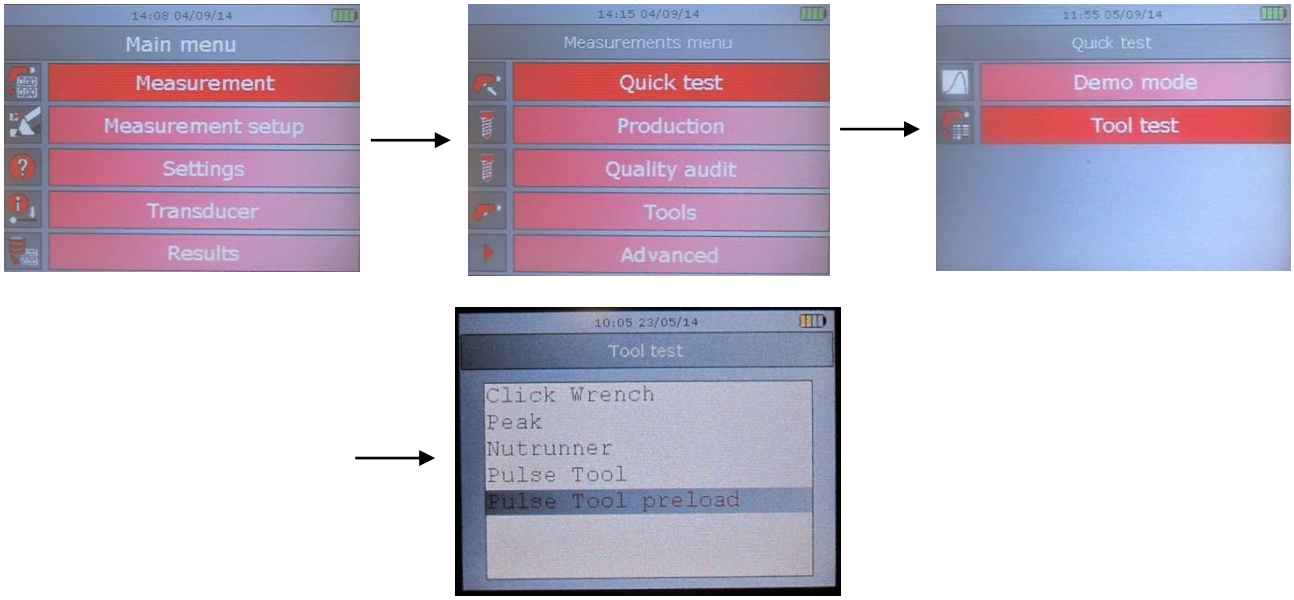


Measurement	This option enters the test submenu: *Quick Test mode*, *Production tests, Quality Audit tests, Tools tests* and *Advance functions (read barcode* and *CVI calibration*). Refer to the next paragraphs for further details.
Measurement Setup	This option defines Psets and Tools directly from the Delta keyboard instead of programming by the DeltaQC software, and defines the general settings for the *Quick Test mode*.
Settings	This menu allows to customize the Delta settings. Refer to the paragraph "*Delta 6D/7D Settings*" for further details.
Transducer	This function shows the details of the transducer connected to the Delta. Refer to the paragraph "*Transducers*" for further details.
Results	It shows the results coming from the Production tests, Quality Audit tests, Tools tests and Quick Test mode.

8.1 Executing a Quick Test

The ***Delta 6D/7D*** has a "*Quick Test*" function, which gives the demo mode menu and the possibility to start quickly a test on wrenches, nutrunners and pulse tools; it is not needed to program them by DeltaQC software as explained in the next paragraphs.

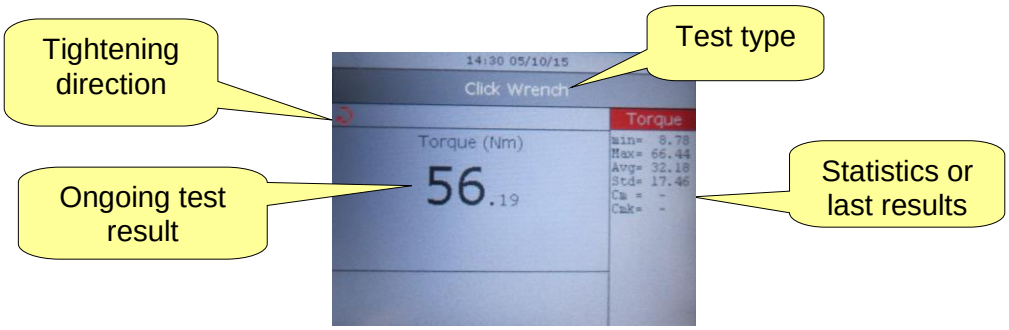
To perform a *Quick Test*, select the ***Measurement*** → ***Quick test*** → ***Tool test*** menu:



NOTE: This menu is the same menu provided by the ***Measurement*** → ***Tool test*** menu of the Delta 1D. Note that the angle reading is not managed in this mode.

Select the tool type to be tested (refer to the screens above).

If the *Results View mode* is set to "*Statistics"* in the "***Controller*** → ***Configuration***" menu (Delta QC software), the torque result with average, minimum, and maximum values are shown in real time. From the 3rd values also the standard deviation (*Std*) is displayed.



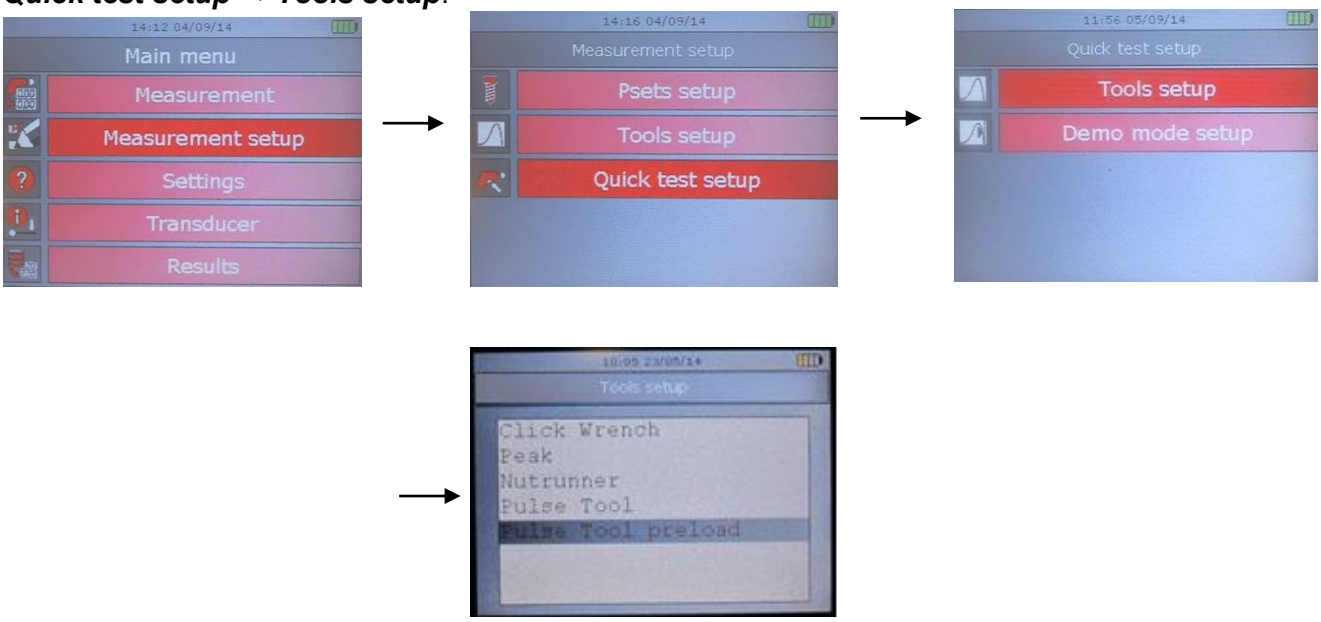
If the *Results View mode* is set to "*Last results"* in the "***Controller*** → ***Configuration***" menu (Delta QC software), the torque result and angle result values are shown in real time (red color for Not OK result, black color for OK results).

NOTE: For further details about the formulas used by the Delta to calculate the statistics results, refer to the paragraph "*Statistical Computation*". The results of the tests executed by the Quick Test function are saved in the Delta memory with the Pset number set to zero.

NOTE: For further details about how the Delta performs the test on the various tools, refer to the following paragraphs: "*Testing Click-wrenches*", "*Peak Test*", "*Testing Nutrunners*", "*Testing Pulse Tools*", "Testing pulse tools with preload".

NOTE: The "Last peak" option in the "Nutrunner" strategy is available only on Delta 6D and 7D for Psets belonging to the **Measurement** → **Tools** menu

To configure the general parameters for the different tool types, select the ***Measurement Setup*** → ***Quick test setup*** → ***Tools setup***:



NOTE: For further details about how these parameters are used to test a tool, refer to the following paragraphs: "*Testing Click-wrenches*", "*Peak Test*", "*Testing Nutrunners*", "*Testing Pulse Tools*" and *Testing pulse tools with preload*

8.2 Execute a Test (Tool Test, Joint Test, Production Tightening)

To test a *Tool* with the ***Delta 6D/7D***, the following sequence is required:

1. Create one (or more) *Pset* containing the test data for the tool to be tested.
2. Create a *Tool*.
3. Associate a maximum of five *Psets* to the tool.
4. Start the *Pset* and test the *Tool*.

To perform a *Quality Test* on a joint with the ***Delta 7D***, the following sequence is required:

1. Create one (or more) *Pset* containing the test data for the joint to be tested.
2. Start the *Pset* and test the joint.

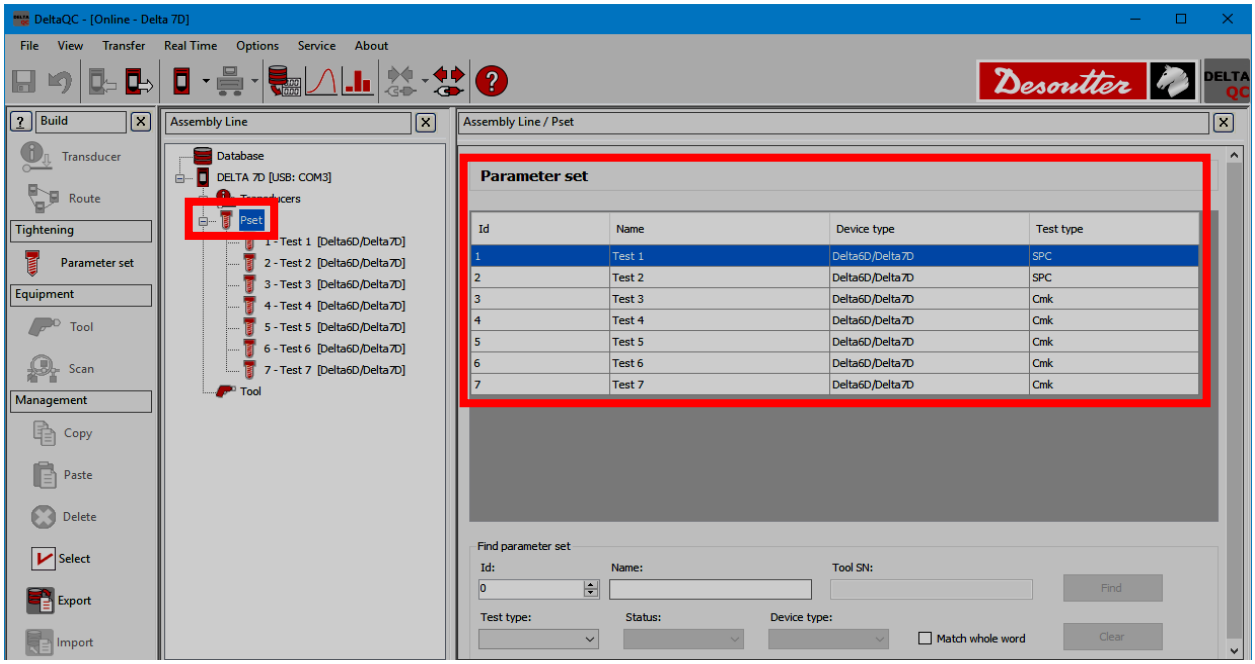
To perform a *Production Tightening* with the ***Delta 7D***, the following sequence is required:

1. Create one (or more) *Pset* containing the test data for tightening operation.
2. Start the *Pset* and execute the tightening.

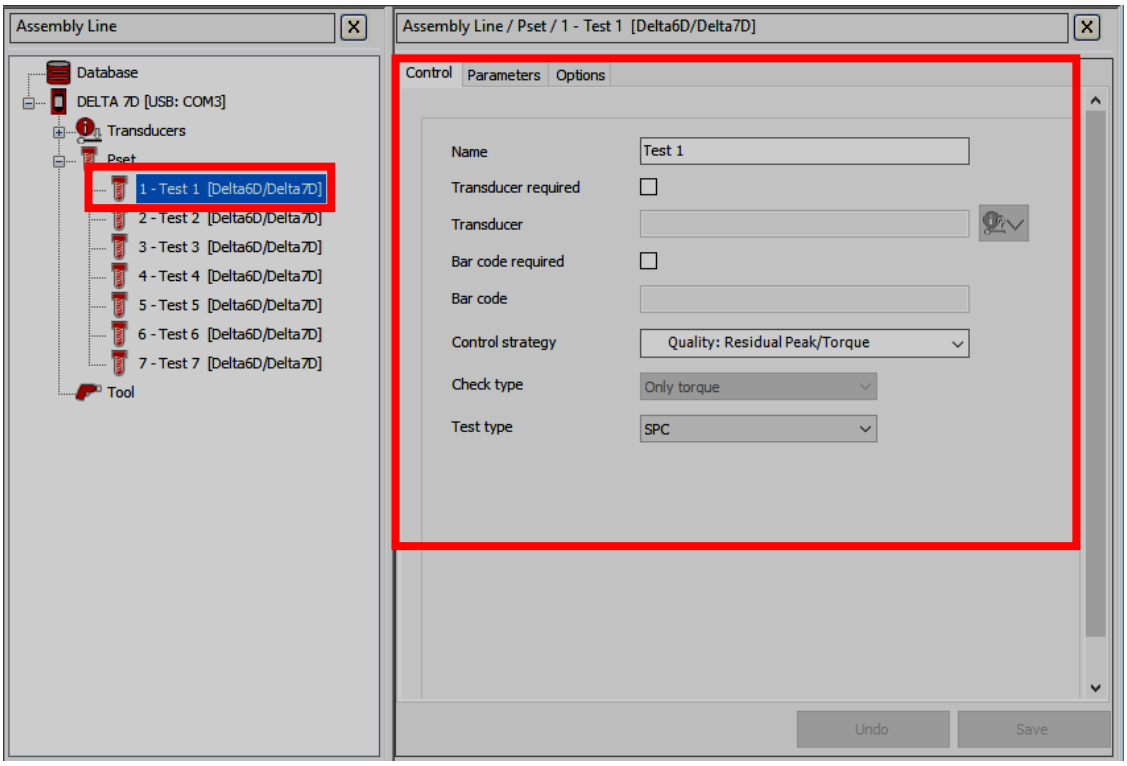
8.2.1 Creating a Pset

Connect the ***Delta*** to the DeltaQC software.

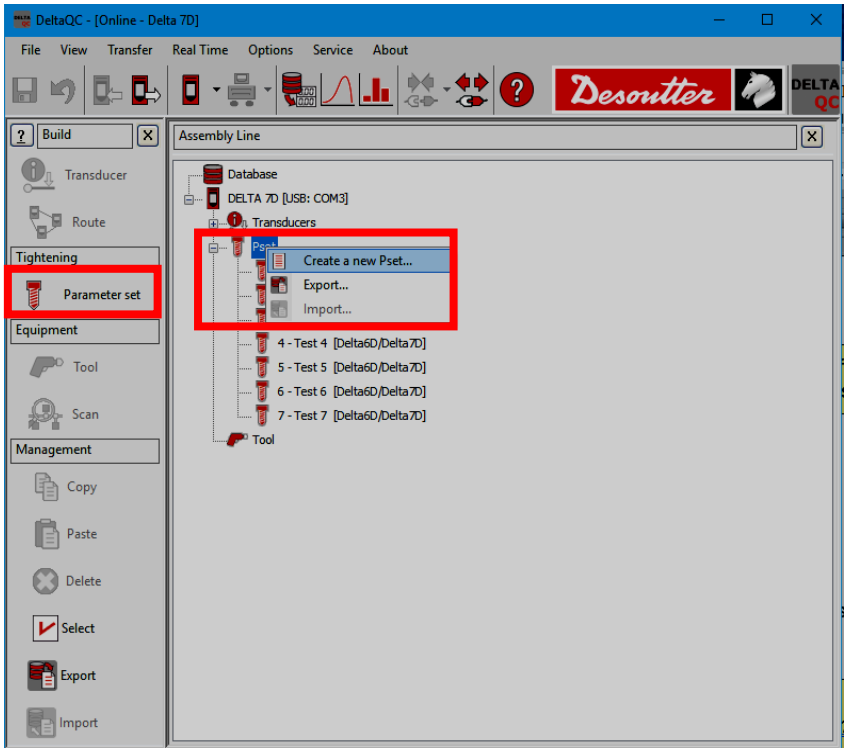
Select the ***Pset*** menu (placed in the *Assembly Line* area) to display the *Psets* list (see figure below):



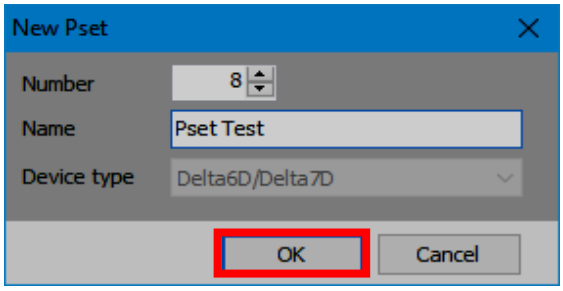
Select a *Pset* from the *Assembly Line* area to display its parameters:



To create a new *Pset*, either click on the ***Parameter set*** icon placed in the *Build area*, or right-click on ***Pset*** in the *Assembly Line area* (and then, click on ***Create a new Pset…***):



From the pop-up that appears (see figure below), select the Pset ***Number*** and type the Pset ***Name***. Then, click on the ***OK*** button to confirm the creation of a new Pset:



NOTE: By default, the Pset ***Number*** assigned is the first number available. It is not possible to use numbers already assigned to other Psets.

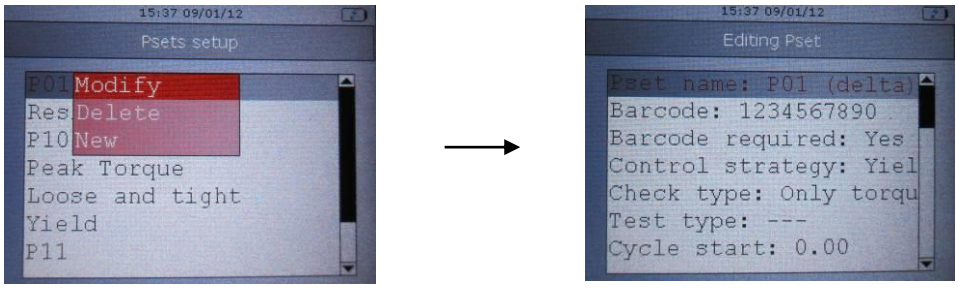
NOTE: For further details about the Pset parameters and how to program them for the various test strategies, refer to the paragraph "*Pset*".

Once the *Pset* is created, it is MANDATORY to create the *Tool* for testing various tools and to link the the *Pset(s)* to the *Tool*.

NOTE: For quality testing joints, the Pset can be run from the Delta by selecting the ***Measurement*** → ***Quality Audit*** menu.

It is also possible to create, modify or delete a *Pset* directly on the Delta. From the main menu, press the ***Enter*** button on the Delta keyboard to select ***Measurement Setup*** → ***Pset setup***:

Press the ***Valid*** button on the Delta keyboard to *Modify/Delete* the selected *Pset*, or to create a new one:



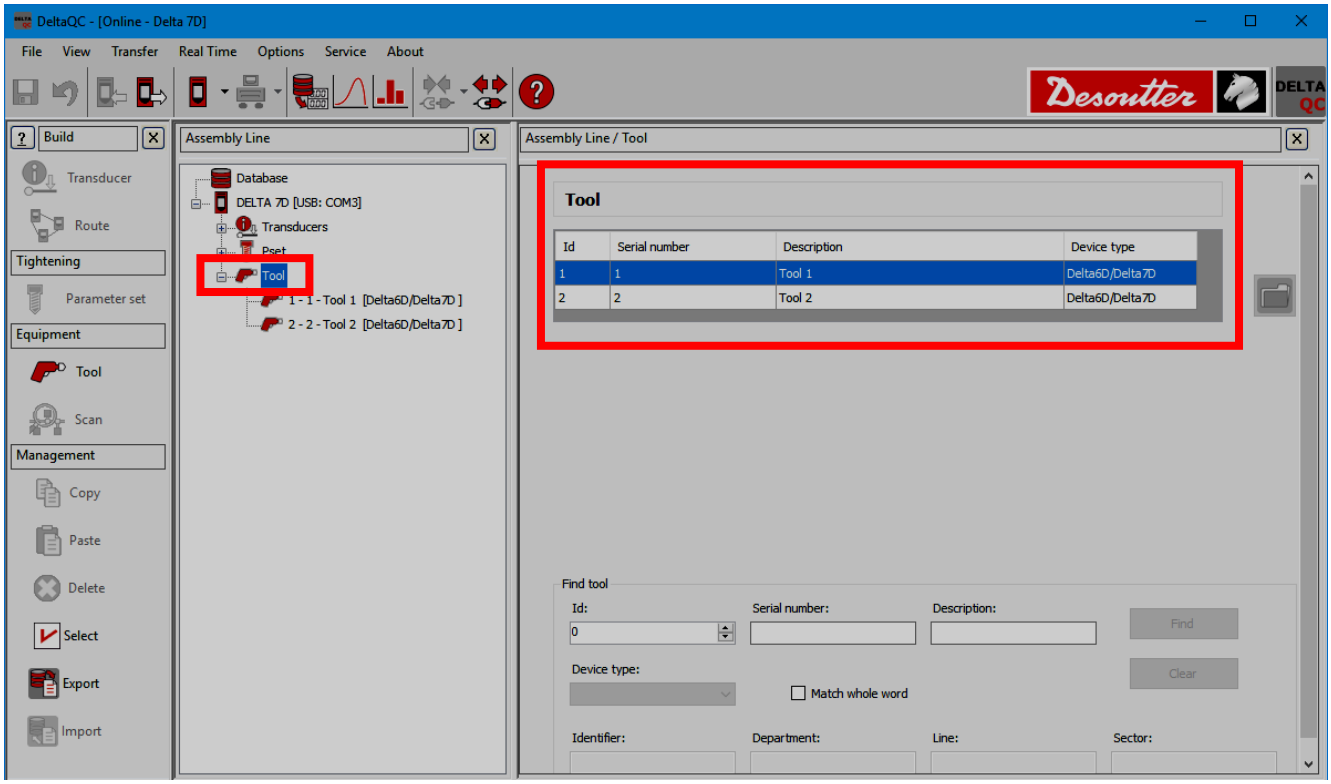
Scroll the parameters using the ***Up***/***Down*** keys and click on ***Enter*** to edit the parameter selected. Use the arrows on the Delta keyboard to set the value by means of the arrow buttons (left/right to select the digit, up/down to increase/decrease the value). Finally, either click on ***Valid*** to save or click on ***Esc*** to quit without saving.

8.2.2 Creating a Tool

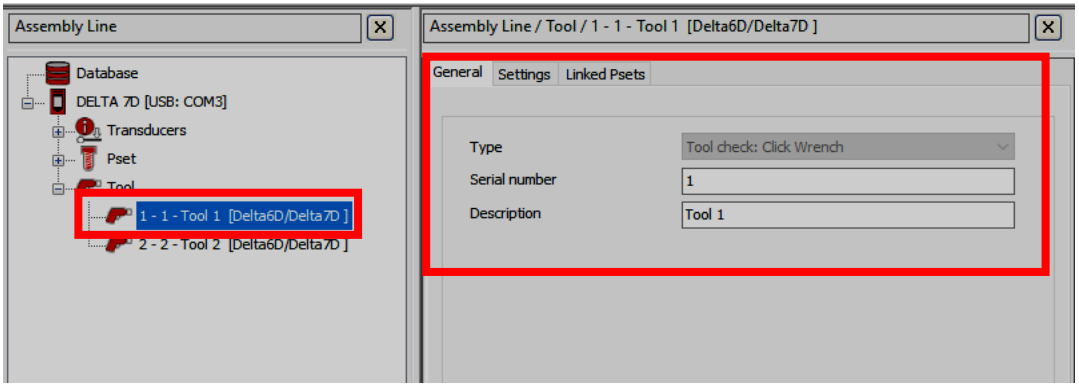
NOTE: Creating a tool is necessary for tool testing; for *Testing Joints* and *Production Tightening operations*, this paragraph is not applicable.

Connect the ***Delta*** to the DeltaQC software.

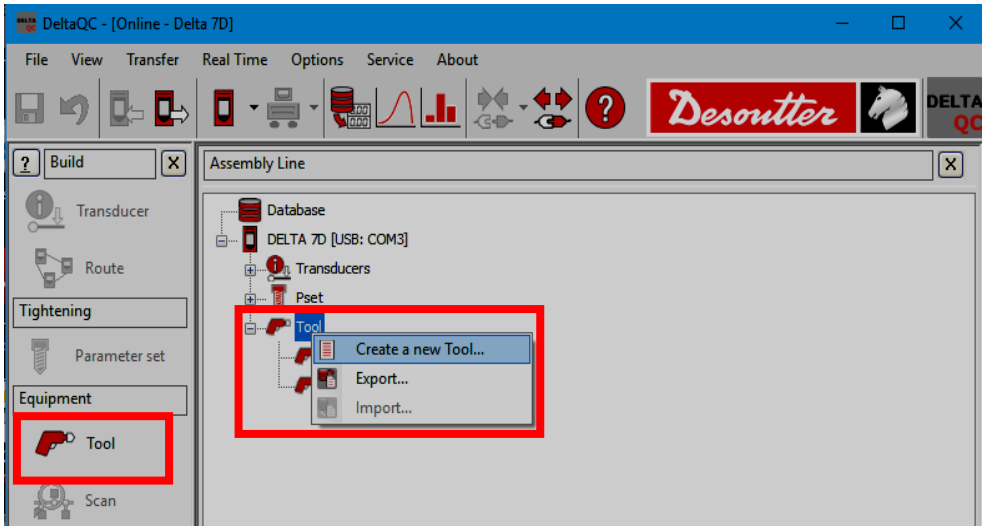
Select the ***Tool*** menu (placed in the *Assembly Line* area) to display the *Tools* list (see figure below):



Select a *Tool* from the *Assembly Line* area to display its parameters:

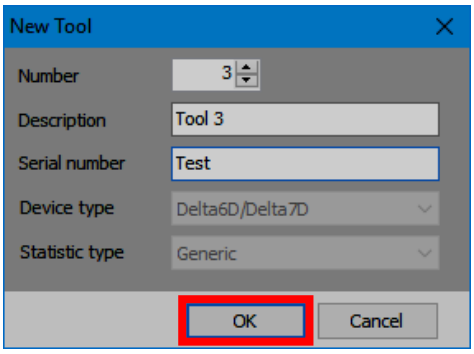


To create a new *Tool*, either click on the ***Tool*** icon placed in the *Build area*, or right-click on the ***Tool*** node in the *Assembly Line area* (and then, click on ***Create a new Tool…***):



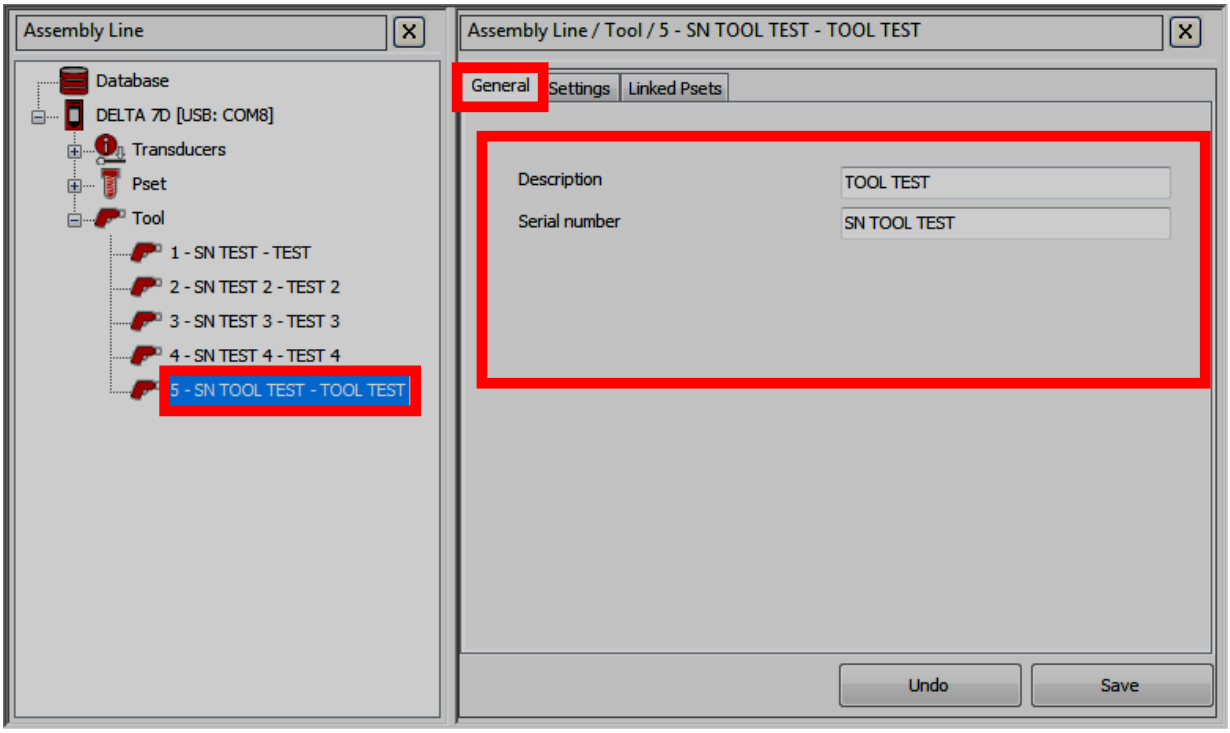
NOTE: It is possible to add up to 1000 tools.

From the pop-up that appears (see figure below), select the Tool ***Number***, type the Tool ***Description*** and the ***Serial Number***. Then, click on the ***OK*** button to confirm the creation of a new Tool:

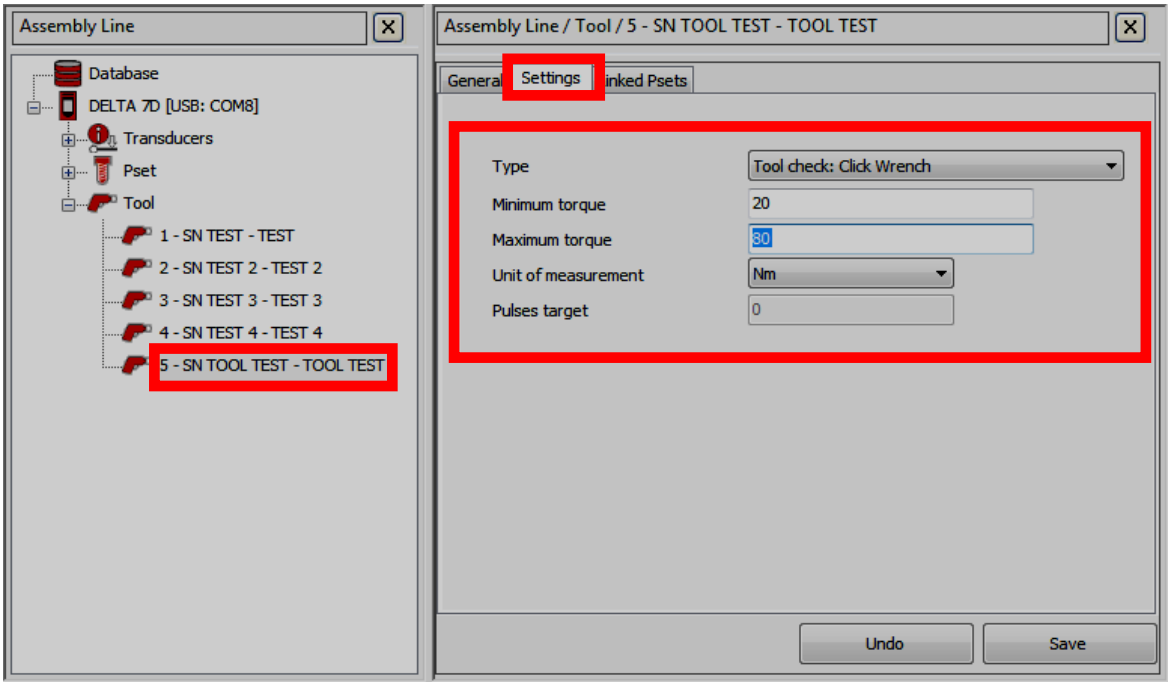


NOTE: By default, the Tool ***Number*** assigned is the first number available. It is not possible to use numbers already assigned to other Tools.

After clicking ***OK***, the information entered while creating the *Tool* are displayed in the ***General*** tab (see figure below):



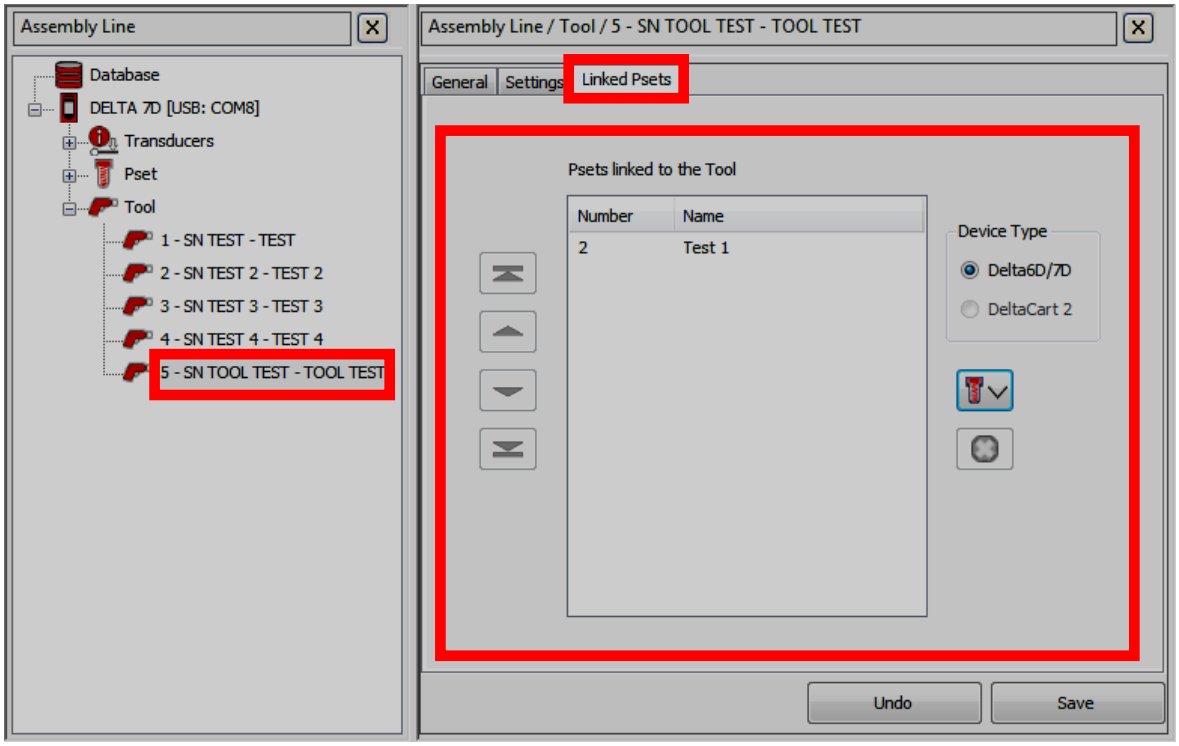
Select the ***Settings*** tab to enter the parameters:



Type	Select the tool type from the list.
Minimum torque and ***Maximum torque***	These two values are information data that characterize the tool; they are not used by the Delta for the test and statistics.

Unit of measurement	Select the measurement unit from the list.
Pulse target	For *Pulse Tools*, it specifies the tool frequency (pulses per seconds). This is an information field, and it is not used for calculating results and statistics.

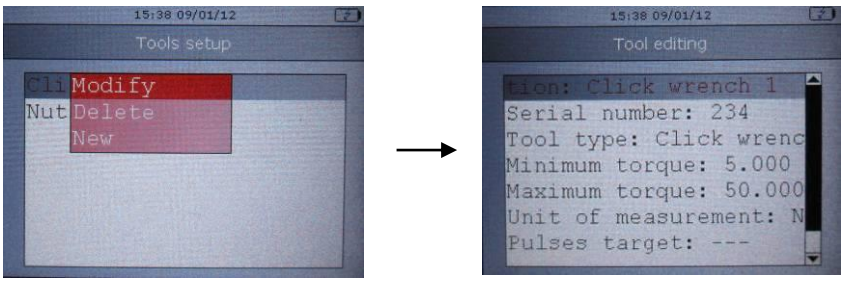
Select the ***Linked Pset*** tab to link *Pset(s)* to the *Tool*:



Pset linked to the Tool	To test a *Tool* on the Delta, it is MANDATORY to associate a *Pset*. If it is not done yet, firstly define a *Pset* (refer to the paragraph "*Creating a Pset*"). Finally, associate in the above folder the *Pset* that is used to test the *Tool*. Click on  to link a *Pset* to the *Tool*. Click on  to remove it. It is possible to associate up to five *Psets* to each *Tool*.

It is also possible to create (or modify) a *Tool* directly on the Delta. Hence, select ***Measurement Setup*** → ***Tools setup*** from the main menu:

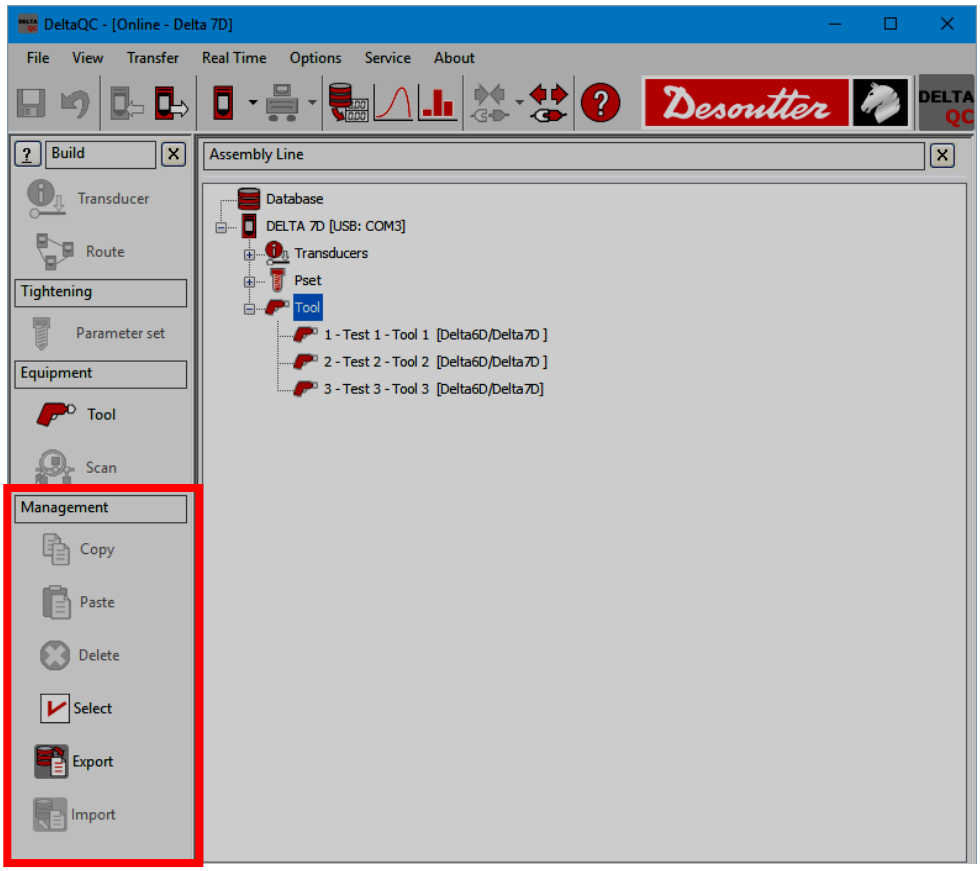
Press the ***Enter*** button on the Delta keyboard to *Modify/Delete* the selected *Tool* (press ***Valid*** to confirm), or to create a new one:



Scroll the parameters using the ***Up***/***Down*** keys and click on ***Enter*** to edit the parameter selected. Then set the value by means of the arrow buttons (left/right to select the digit, up/down to increase/decrease the value). Finally, either click on ***Valid*** to save or click on ***Esc*** to quit without saving.

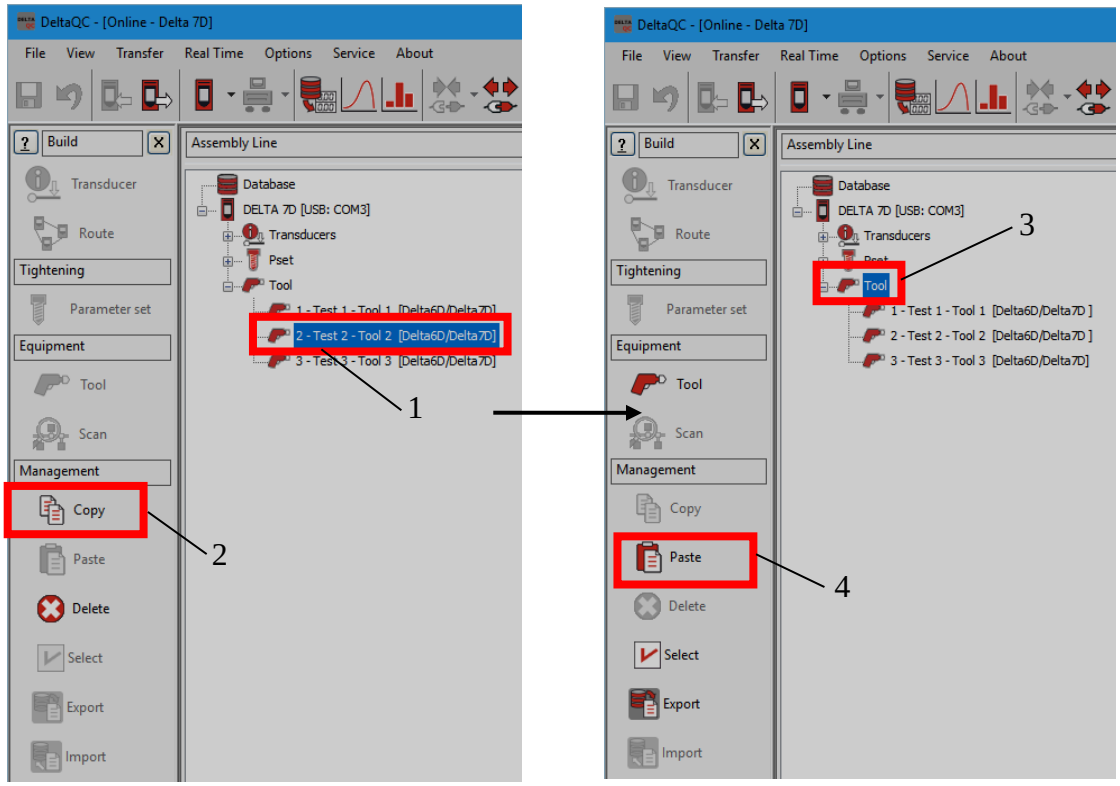
The *Management* area (placed in the *Build* area) provides the commands to:

- *copy* and *paste* a Tool;
- *delete* one or more Tools;
- *export* and *import* one or more Tools.



Copy and *paste* a Tool as described below (refer to the following figures):

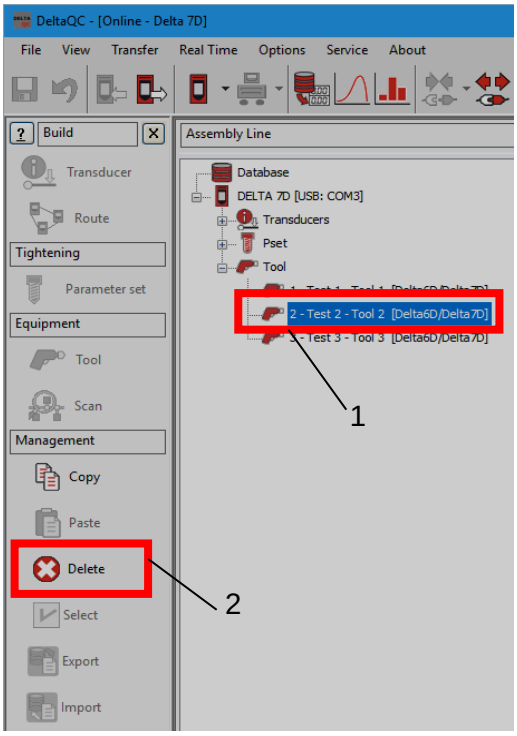
1. In the *Assembly Line* area, select a Tool from the list.
2. In the *Management* area, click on the ***Copy*** icon.
3. In the *Assembly Line* area, click on the ***Tool*** node.
4. In the *Management* area click on the ***Paste*** icon.



Delete a Tool as described below (refer to the figure on the right):

1. In the *Assembly Line* area, select the Tool to delete.
2. In the management area, click on the ***Delete*** icon.

Finally, click on ***Yes*** in the warning message appears to confirm the deletion of the selected Tool.



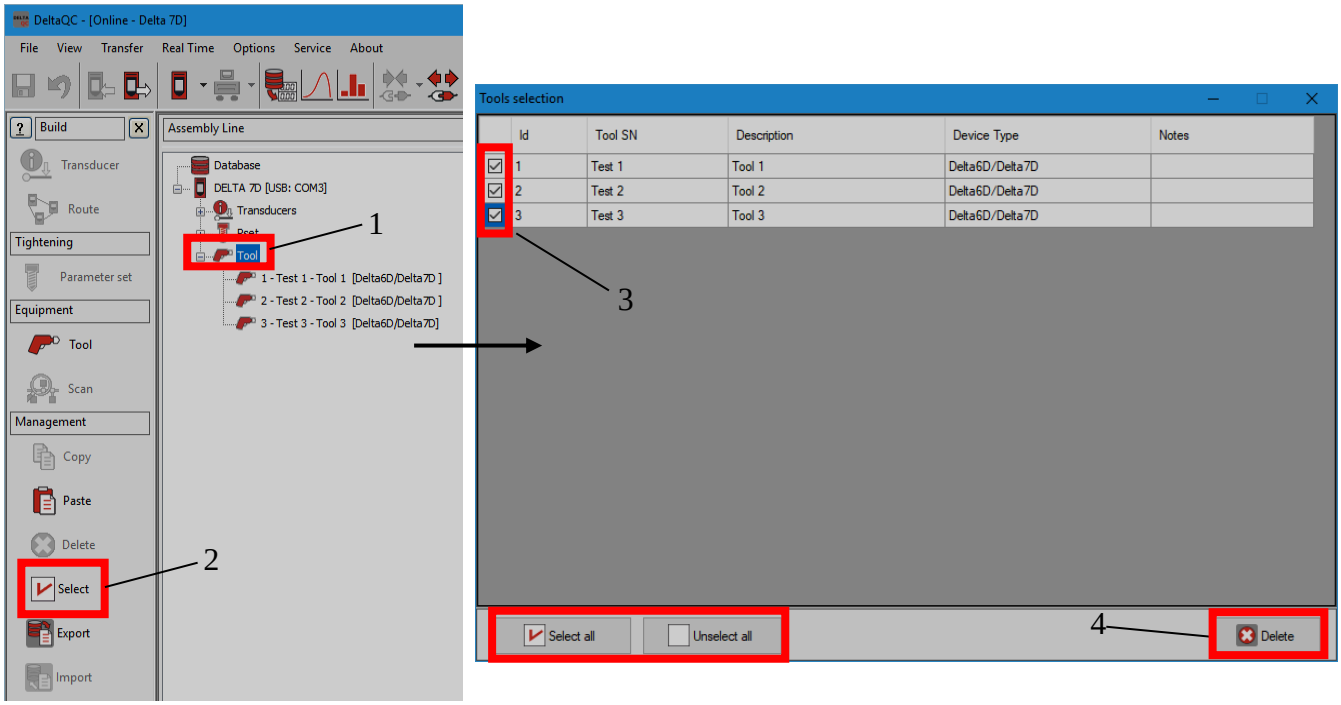
Delete more Tools at the same time as described below (refer to the following figures):

1. In the *Assembly Line* area, click on the ***Tool*** node.
2. In the *Management* area click on the ***Select*** icon.
3. In the *Tool selection* pop-up that opens, select the Tool / Tools to delete.

NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select all the available Tools and to unselect all the Tools.

4. In the *Tools selection* pop-up, click on the ***Delete*** button.

Finally, click on ***Yes*** in the confirmation message that appears to confirm the deletion of the selected Tools.

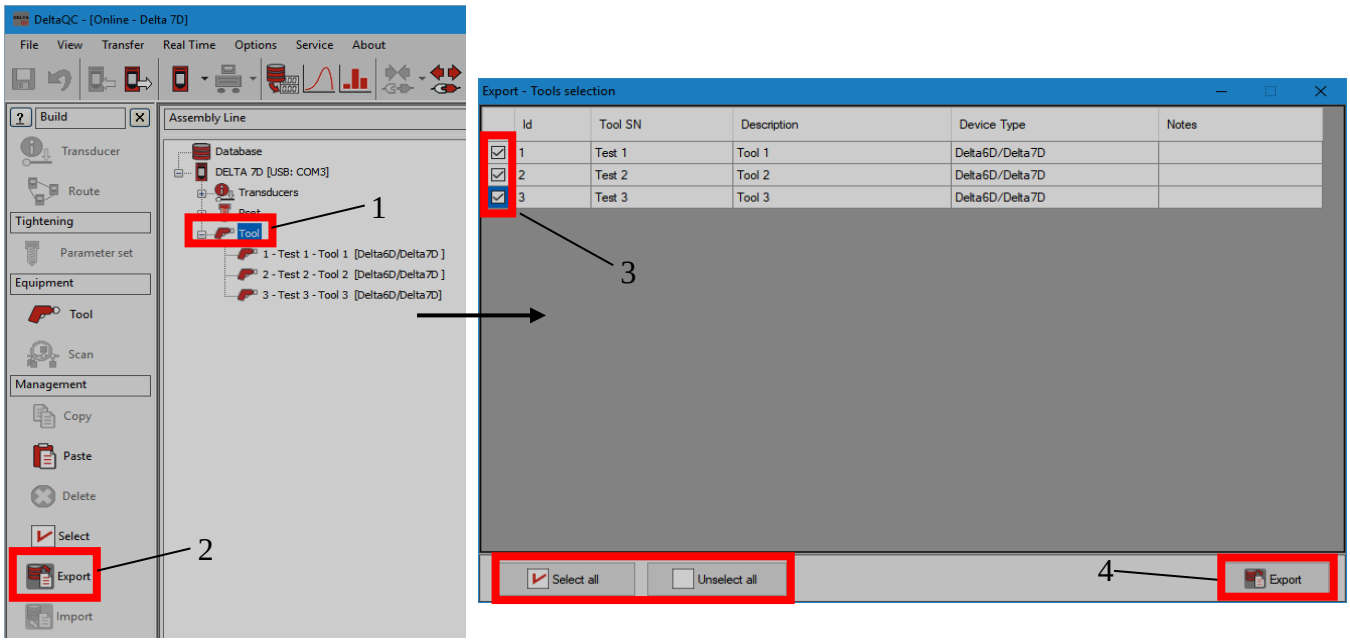


Export one or more Tools from DeltaQC to the PC as described below (refer to the following figures):

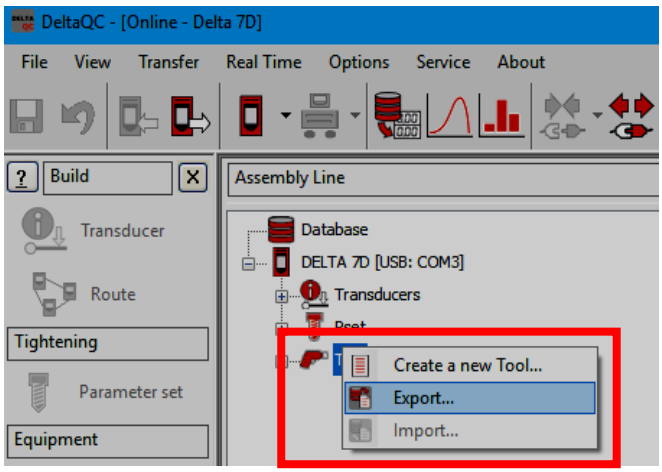
1. In the *Assembly Line* area, click on the ***Tool*** node.
2. In the *Management* area, click on the ***Export*** icon.
3. From the pop-up that opens, select the Tool / Tools to export.

NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select and to unselect all the available Tools.

4. From the *Export – Tool selection* pop-up that appears, click on the ***Export*** button and save the Tools on the PC in an *XML* file.



NOTE: It is also possible to export one or more Tool by right-clicking on the ***Tool*** node in the *Assembly Line* area and then on ***Export…*** (see figure below):



The *import* of one or more Tools can be performed only in the *Offline* mode.

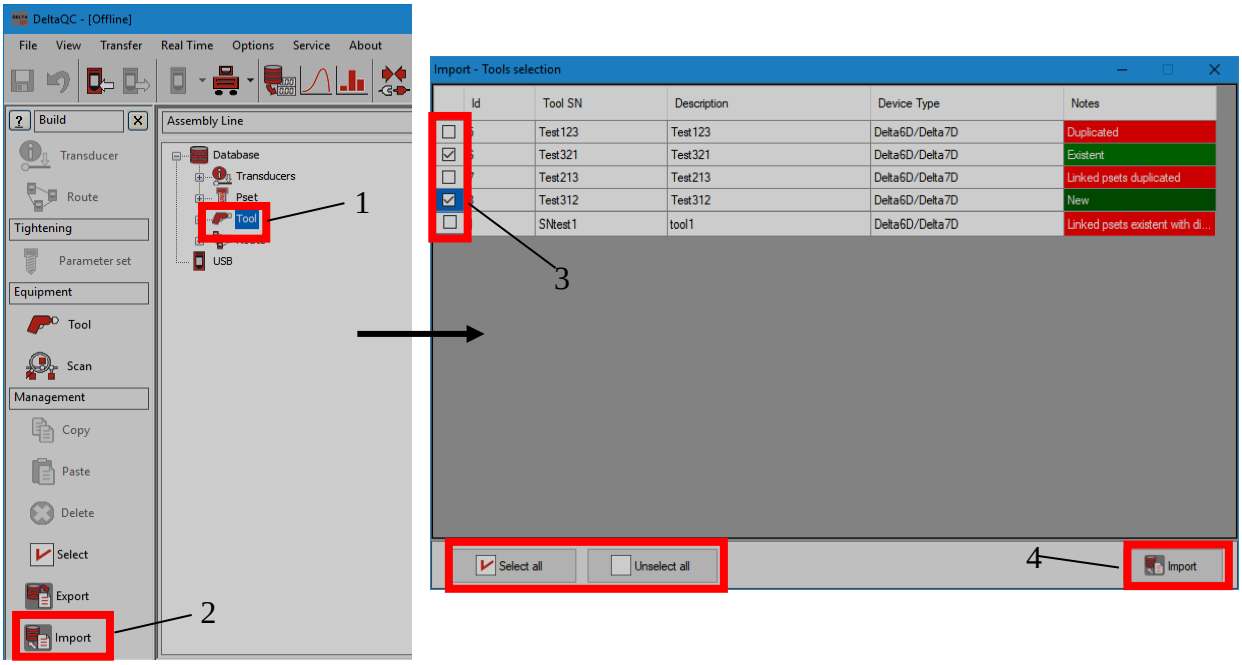
To proceed with the import, click on the ***Disconnect*** icon to disconnect the Delta from the PC.

Then, *import* one or more Tools from the PC as described below (refer to the following figures):

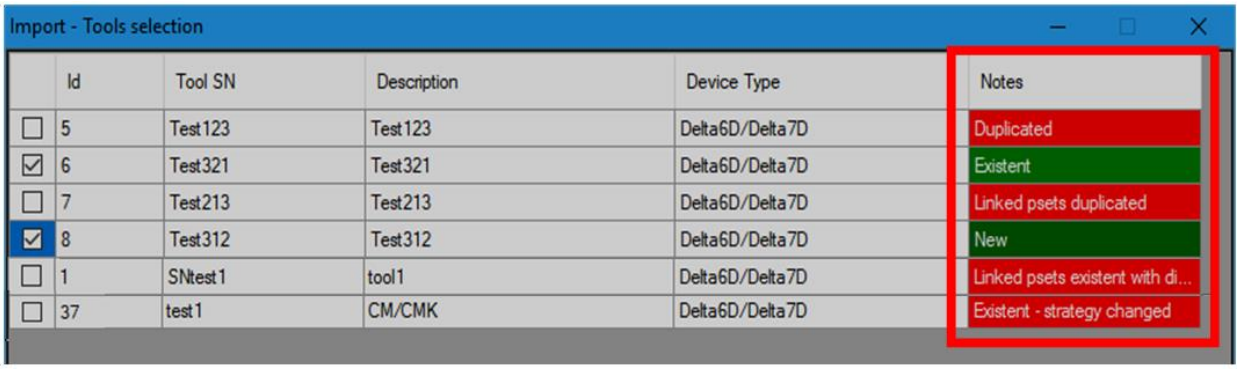
1. In the *Assembly Line* area, click on the ***Tool*** node.
2. In the *Management* area, click on the ***Import*** icon and select the *XML* file from the PC.
3. In the *Import – Tool selection* pop-up that opens, select the Tool / Tools to import.

   NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select all the available Tools and to unselect all the Tools.

4. In the *Import – Tools selection* pop-up, click on the **Import** button.



In the *Import – Pset selection* pop-up, the ***Notes*** column (last column of the table) shows details about the Psets (see figure below):



If a Tool is marked in green as "*New*", there is no existing match in the destination database and it is possible to import the Tool.

If a Tool is marked in light green as "*Existent*", a Tool with the same *Name* and same *Device type* already exists in the destination database, and the Tool imported will overwrite the existing one.

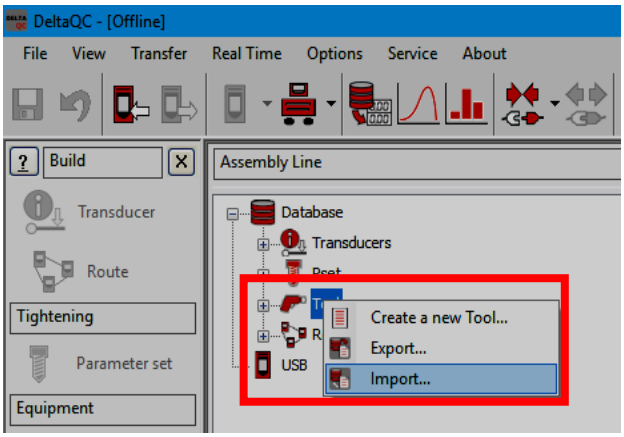
If a Tool is marked in red as "*Duplicated*", a Tool with the same *Name* but different *Device type* already exists in the destination database and it is not possible to import it.

If a Tool is marked in red as "*Linked psets duplicated*", a Pset with the same name but linked to a different *Device type* already exists in the destination database and it is not possible to import it.

If a Tool is marked in red as "*Existent - strategy changed*", a Tool with the same name and same device type but different strategy already exists in the destination database and it is not possible to import it.

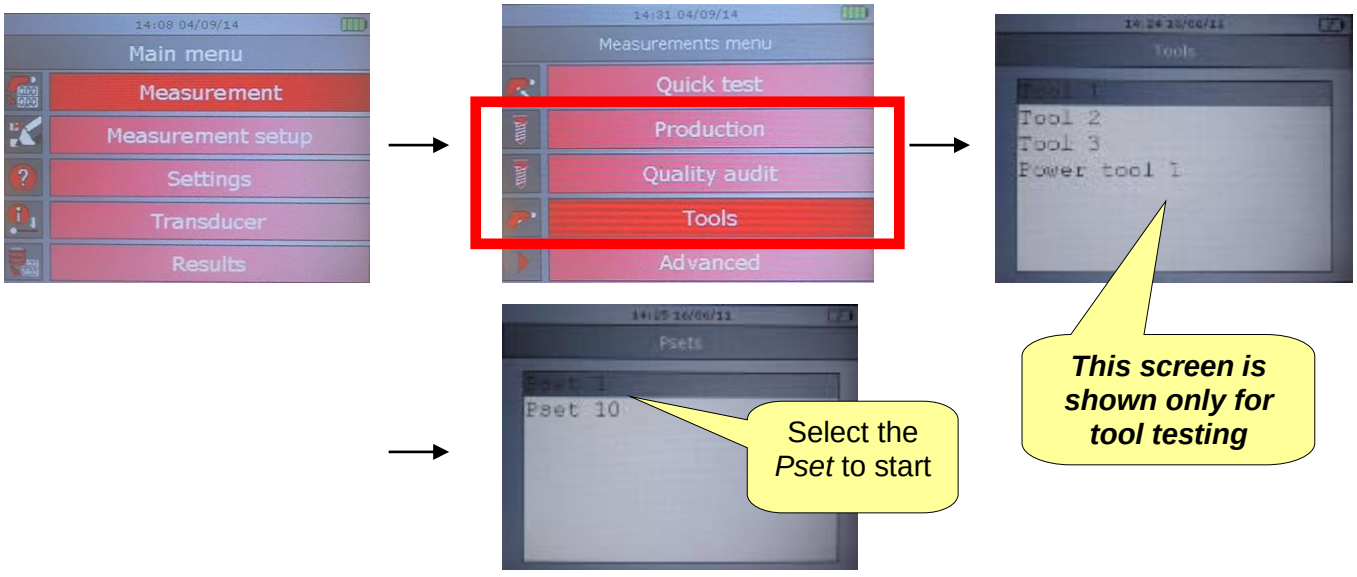
If a Tool is marked in red as "*Linked pset existent with different strategy*", a Pset with the same name but different strategy already exists and it is not possible to import the Tool.

NOTE: It is also possible to import one or more Tool by right-clicking on the ***Tool*** node in the *Assembly Line* area and then on ***Import…*** (see figure below):

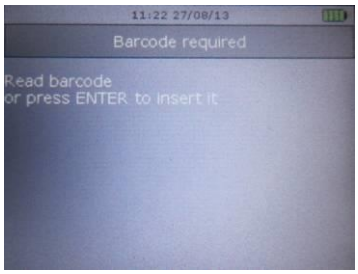


8.2.3 Executing the test

Once the *Pset* (and the *Tool* for *Tool Testing*) is created, it is possible to execute the test.
Firstly, connect a transducer to the ***Delta***.
Then select ***Measurement*** → ***Production*** or ***Quality Audit*** or ***Tools*** menu, according to the test type. Finally select the test to be started, as shown in the next figures:

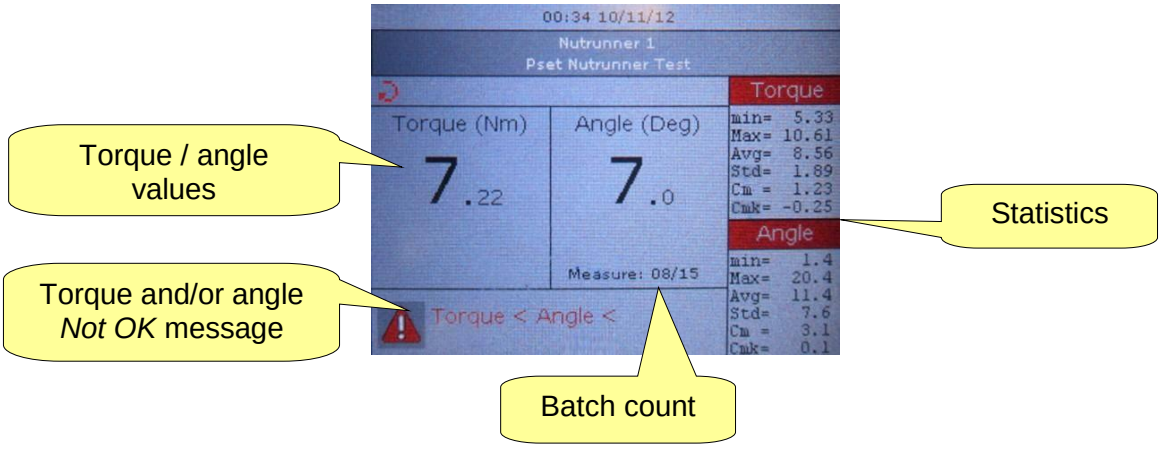


If the "*Bar code required*" flag is activated in the "*Control parameters*" of the *Pset* (Delta QC software), before starting the test the following window requires for a barcode. In this case, it is possible either to scan the barcode string with the barcode reader (internal or external) or to enter it manually by pressing the ***Enter*** button on the Delta keyboard:

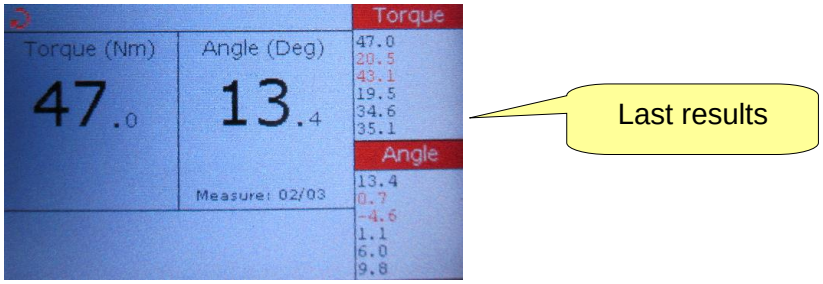


If the *Results View mode* is set to "*Statistics"* in the "***Controller*** → ***Configuration***" menu (Delta QC software), the torque result with average, minimum, and maximum values are shown in real time.

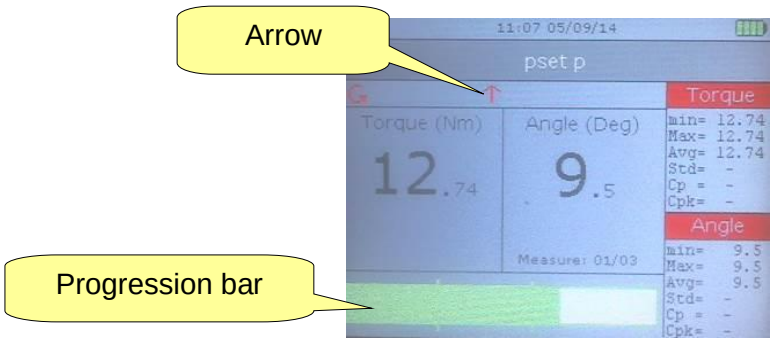
The standard deviation σ (Std) and the Cm-Cmk (Cp-Cpk for joints) are displayed after the 3rd value:



If the *Results View mode* is set to "*Last results"* in the "***Controller*** → ***Configuration***" menu (Delta QC software), the torque result and angle result values are shown in real time (red color for Not OK result, black color for OK results).



For *Production Psets*, a progression bar guides the operator to the target torque (or target angle for *Torque + Angle* and *Prevailing Torque* strategy), and an arrow shows if the torque result is measured at the torque peak (as shown on the figure below) or angle peak:



The progression bar is colored as follow:

- ***Blue***: Test started
- ***Green***: Test is in the OK area
- ***Red***: Test is outside the OK area

If either the test parameters in the *Pset* do not suit the transducer torque range or the transducer type is not suitable for the selected test, an error message is shown and the test execution screen is quit after few seconds automatically.

NOTE: For further details about the formulas used by the Delta to calculate the statistics results, refer to the paragraph "*Statistical Computation*".

The statistics are reset each time a new batch is started.

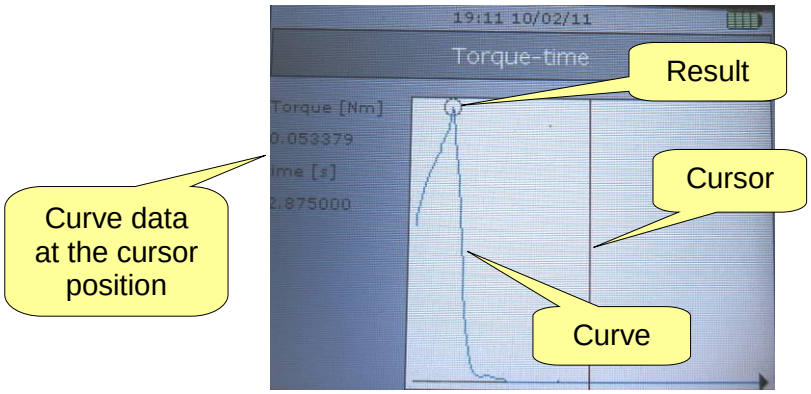
The batch count is shown in the bottom-right corner of the display. It is incremented after each test.
If the click-point (for click-wrenches) or the peak point (for nutrunner) is not detected, the batch count is not incremented (but the result gets stored in the memory).

NOTE: When a batch is quit, a warning message asking to confirm the exit from the Pset is displayed. Press ***Valid*** to exit, or ***Esc*** to return to the Pset.

NOTE: It is possible to activate a function that asks the user if the result must be accepted (and batch count incremented) or not (and batch count not incremented, but result stored in the memory) after each test or only after a *Not OK* test.
Refer to the paragraph "*Delta Controller Setup*" for further details.

After each test, press the ***Enter*** button on the keyboard to display the curve:

Select between ***Torque-Time***, ***Angle-Time*** or ***Torque-Angle*** option.
The following screen is shown:



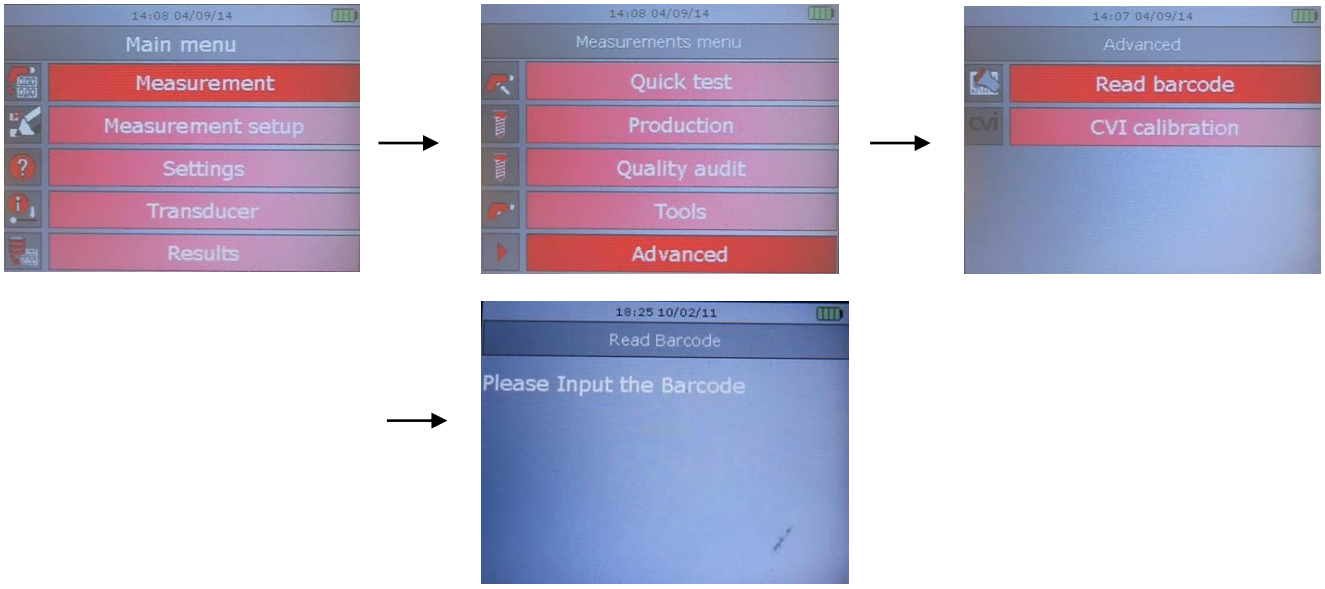
Press the ***Right*** and ***Left*** buttons on the keyboard to move the cursor.
Press ***Esc*** to exit this window.

NOTE: For further details about how Delta performs the tests on the various tools, refer to the following paragraphs: "*Testing Click-wrenches*", "*Peak Test*", "*Testing Nutrunners*" and "*Testing Pulse Tools*".

8.2.3.1 Starting a test by the Barcode reader

To start a test by the barcode string, the Delta must be equipped with the barcode reader (internal or external).

Associate a barcode string to the *Pset* (refer to the paragraph "*Pset*" for further details), and select the ***Measurement*** → ***Advanced*** → ***Read Barcode*** menu:



Scan the barcode string by means of the barcode reader (*integrated barcode reader or external barcode reader*) and the associated *Pset* starts automatically.

NOTE: It is also possible to associate a string scanned by the barcode reader to the *Pset* and select the *Pset* by the Delta keyboard (refer to the paragraph "*Pset*" for further details).

NOTE: It is possible to enter immediately the *Read Barcode screen*, by pressing the left arrow and the right arrow (placed on the Delta keyboard – for further details about the keyboard refer to the paragraph "*User Interfaces - Keyboard*") at the same time.

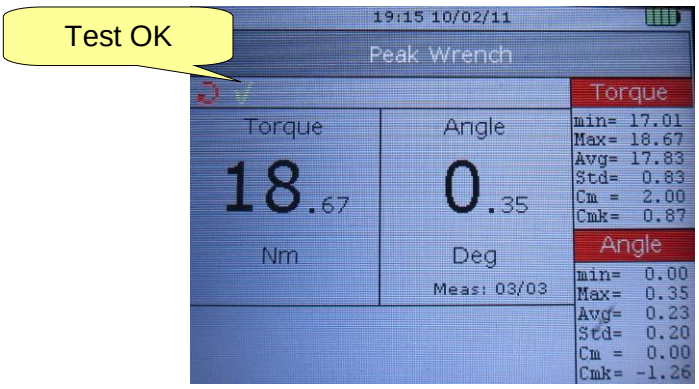
It is not possible to enter immediately the *Read Barcode screen*, if the Delta is set on one of the following screens:

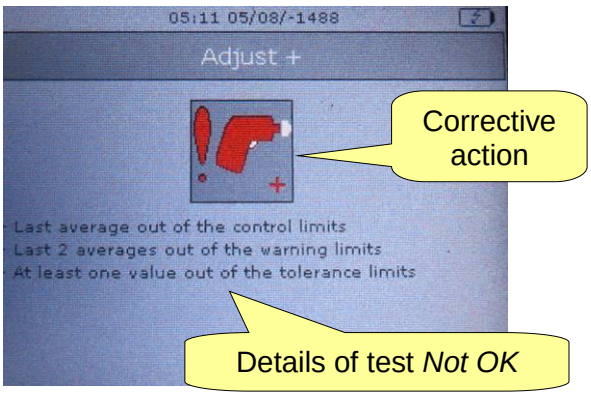
- *Measure screen*
- *Diagnostic screen*
- *Zero adjustment screen (when a transducer is connected with the Delta)*
- *Curves Viewer screen*
- *CVIC calibration screen*
- *Analog Transducer selection screen*
- *Torque / Angle calibration screen*

8.2.4 Statistic Process Control (SPC) test

"*Statistic Process Control*" is a statistical method for preventing errors and for controlling the productive process.
The statistical calculation is based on checking the individual tests on each tool to verify that they are within the set tolerance limits and on the sequence of periodic tests to define the tool's repeatability and its tendency to go "*beyond control*".
The test consists in a periodical execution of a set of tests (typically 3, 5 or 7) on a tool/joint, in order to produce an average value that is compared with successive mean values.
By analyzing these points in sequence, it is possible to determine the tool's tendency to go "*beyond control*" or to repeat values which could be improved.
In this way, defective tendencies in the process can be avoided.

At the end of the test the Delta shows the result of the SPC test:





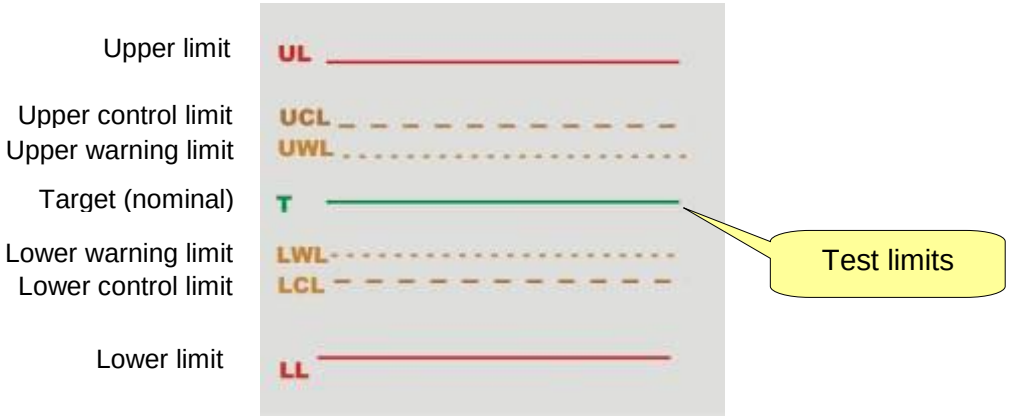
In case of *Not OK* result, the Delta suggests the corrective action to be considered.

NOTE: When testing a joint, the *Cm* and *Cmk* are changed into *Cp* and *Cpk*. Even if during residual torque check strategies the *Pset* force the test type to SPC, it is possible to evaluate the *Cp-Cpk* from the SPC test, by settings the batch number to a value typical of a *Cp-Cpk* test (typically **30** or **50**).

The following table summarizes the possible results for a *Tool* (for a *Process* can be applied the same concept):

ICON	TOOL USABILITY	DIAGNOSIS	FURTHER ACTION
	Can be used	The tool works properly	None
	Can be used	The mean is higher than the upper control limit, but does not exceed the upper tolerance limit	Calibrate, reducing the torque
	Can be used	The mean is lower than the lower control limit, but does not fall below the lower tolerance limit	Calibrate, increasing the torque
	Can be used	Excessive dispersion of the values prevents proper calibration of the tool, but the measured values are still within the tolerance limits	Repair
	CANNOT be used	At least one value is higher than the tolerance limit	Remove the tool from the line and calibrate, reducing the torque
	CANNOT be used	At least one value is lower than the tolerance limit	Remove the tool from the line and calibrate, increasing the torque
	CANNOT be used	Some measured values are outside the tolerance limits. Excessive dispersion of the values PREVENTS proper calibration of the tool	Remove the tool from the line and repair

There are seven rules that are used to determine the *OK* or *Not OK* message for Statistic Control test. The test limits are shown in the following figure:



Upper Limit (UL) and *Lower Limit* (LL) are the test limits specified for the test.
The other limits are calculated as follows:

Upper Control Limit (UCL): $$\mathrm{UCL} = \frac{UL + LL}{2} + A\frac{UL - LL}{6}$$

Lower Control Limit (LCL): $$\mathrm{LCL} = \frac{UL + LL}{2} - A\frac{UL - LL}{6}$$

Upper Warning Limit (UWL): $$\mathrm{UWL} = \frac{UL + LL}{2} + \frac{2}{3} \times \left(UCL - \frac{UL + LL}{2} \right)$$

Lower Warning Limit (LWL): $$\mathrm{LWL} = \frac{UL + LL}{2} - \frac{2}{3} \times \left(\frac{UL + LL}{2} - LCL \right)$$

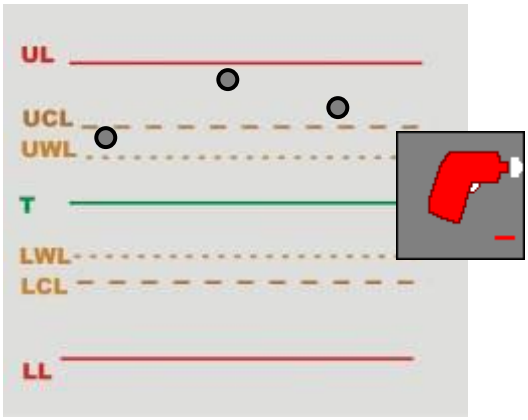
Range: $$Range = D_2 \frac{UL - LL}{6}$$

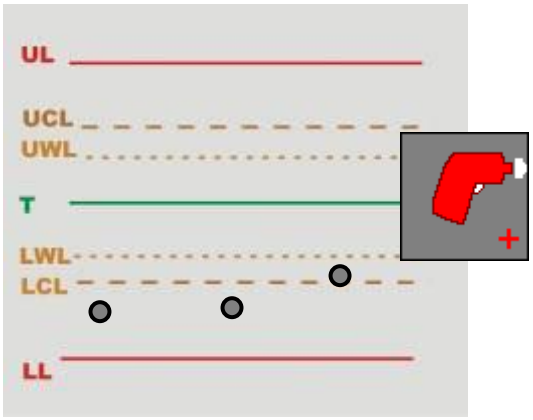
Where A and D_2 are coefficients depending from how many tests are executed in the statistic control test:

Number of tests for Statistic Control	***A***	***D_2***
1	0.000	0.000
2	2.121	3.686
3	1.732	4.358
4	1.500	4.698
5	1.342	4.918
6	1.225	5.078
7	1.134	5.204
8	1.061	5.306
9	1.000	5.393
10	0.949	5.469

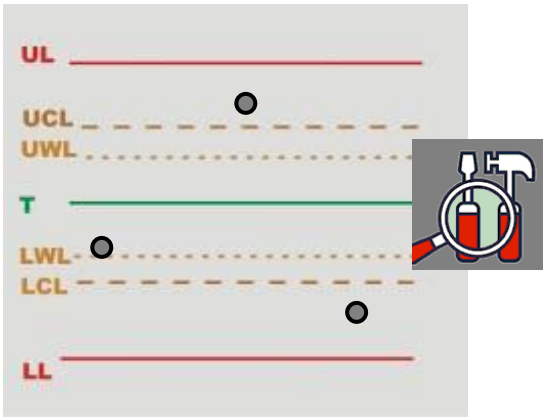
Some of the rules are applied to the set of tests performed in a single statistic control test:

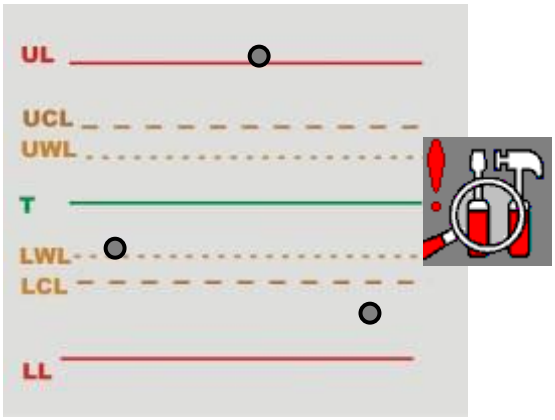
- ***Average out of the control limits***:





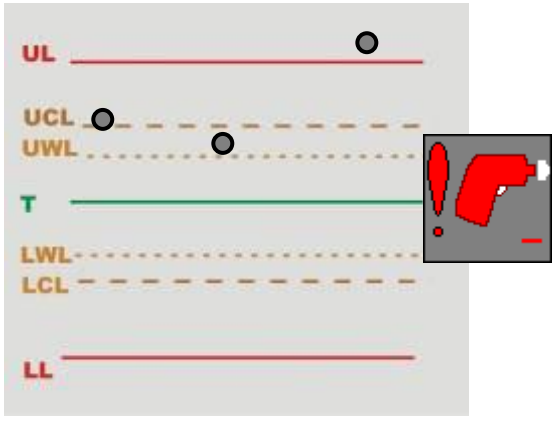
- ***Dispersion is too large***:

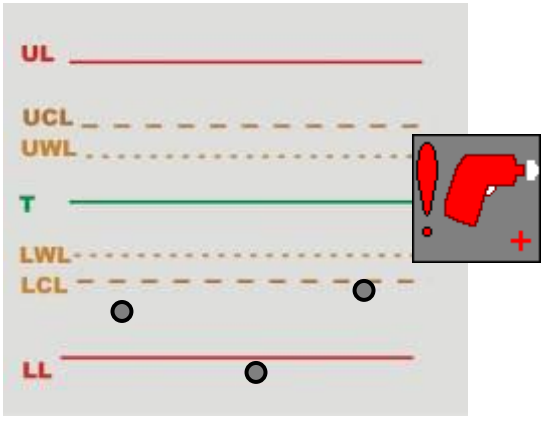




NOTE: Dispersion is considered too big when the difference between the maximum and minimum value is greater that the Range (calculated as shown above).

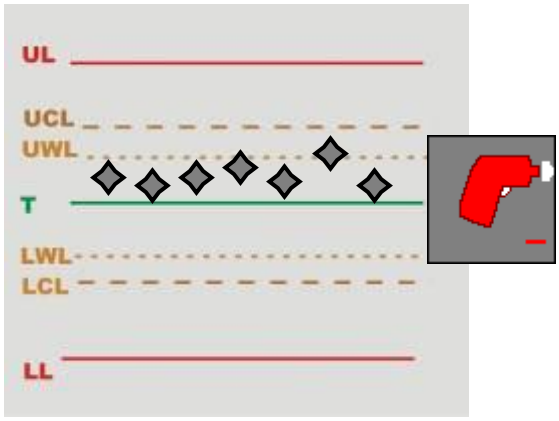
- ***At least one value out of the tolerance limits***:

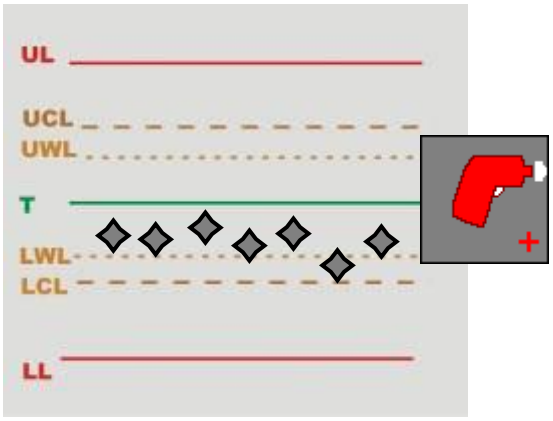




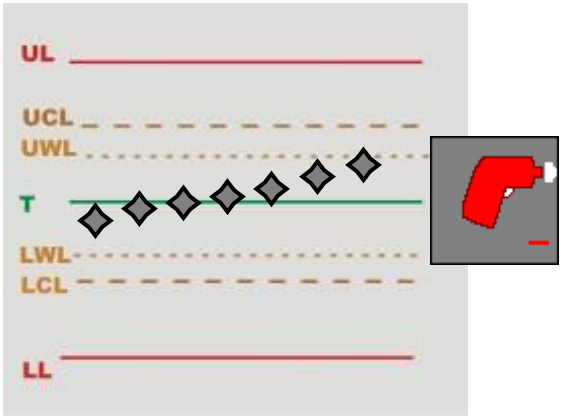
The following rules are applied to the last averages of the set of tests performed in consequential statistic control tests:

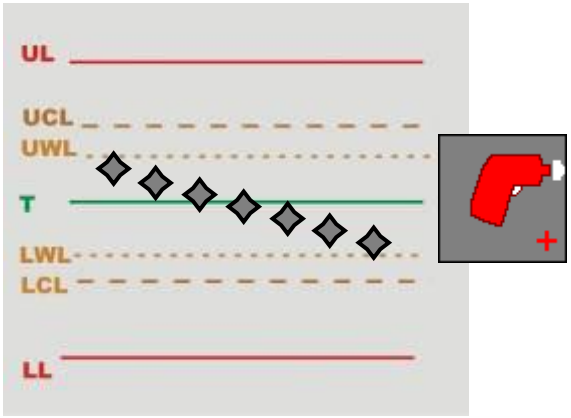
- ***Last 7 averages over or under the nominal value***:



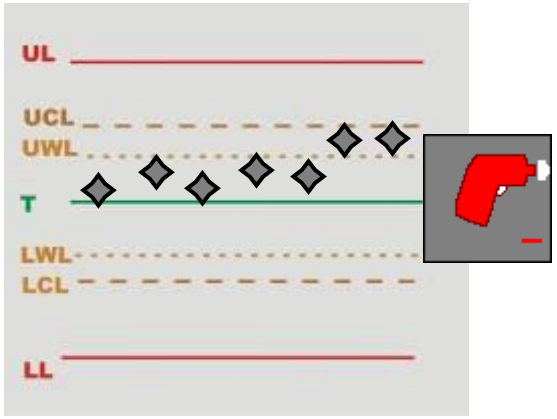


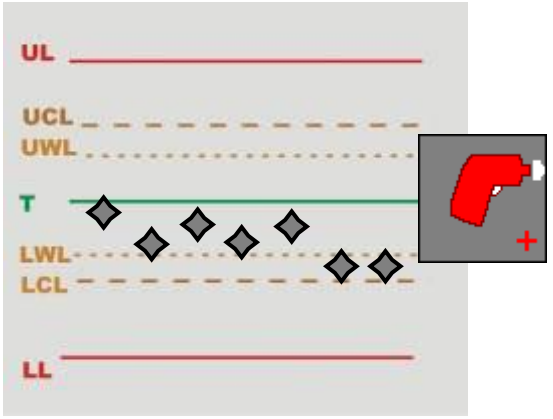
- ***Last 7 averages increasing or decreasing***:



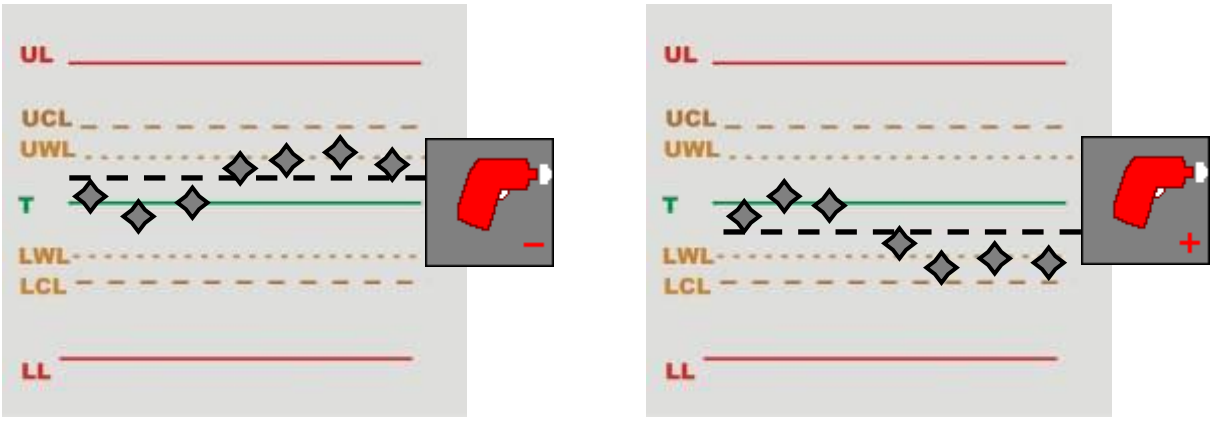


- ***Last 2 averages out of the warning limits***:





- ***Last 4 averages out of 1/3 of the control limits:***



8.2.5 Cm-Cmk test

The Cm-Cmk test is used to test the accuracy and repeatability of tool/process. The result is a value that summarizes the dispersion of a specific number of values measured (Cm or Cp) and the position with respect to the control limits (Cmk or Cpk).

The Cm/Cp measures the repeatability of the tool/process, while the Cmk/Cpk measures also the average of the tool/process respect to the target value. Therefore the Cmk/Cpk value cannot be higher than the Cm/Cp value.

The following figure summarizes the possible scenario of Cm (or Cp) and Cmk (or Cpk) results:

Cm (Cp) low
Cmk (Cpk) low

Cm (Cp) high
Cmk (Cpk) low

Cm (Cp) high
Cmk (Cpk) high

The Cm calculation depends from the tolerance limits: if the tolerance is high, the Cm value increases.

When the Cm is high, the tool is suitable for the assigned operation (if the Cmk is low, that means that the tool needs to be calibrated). On the other side, when the Cm is low the tool is not suitable for the assigned operation; in this case the tool must be repaired or, if it cannot reach a higher value for the Cm, it must be assigned to an operation with a wider tolerance limits.

When the batch of the Cm-Cmk test is completed, the Delta shows the results:

The test result is marked as *OK* (with ✓ icon) if the Cm and Cmk are greater than the minimum Cm and Cmk specified in the Pset; if not, it is marked as *Not OK* (with ✗ icon).

The ***Result distribution*** icon is coloured either in blue (if the distribution is normal) or in red if not; for a batch between 15 and 49 the Shapiro-Wilk test method is used to determine if the distribution is normal. For a batch size equal or over 50 the Chi-squared test method is used.

The right part of the display shows the statistics that correspond to the statistic type selected in the Delta settings (refer to the paragraph "*Delta 6D/7D Settings*" for further details).

NOTE: For further details about the formulas used by the Delta to calculate the statistics results, refer to the paragraph "*Statistical Computation*".

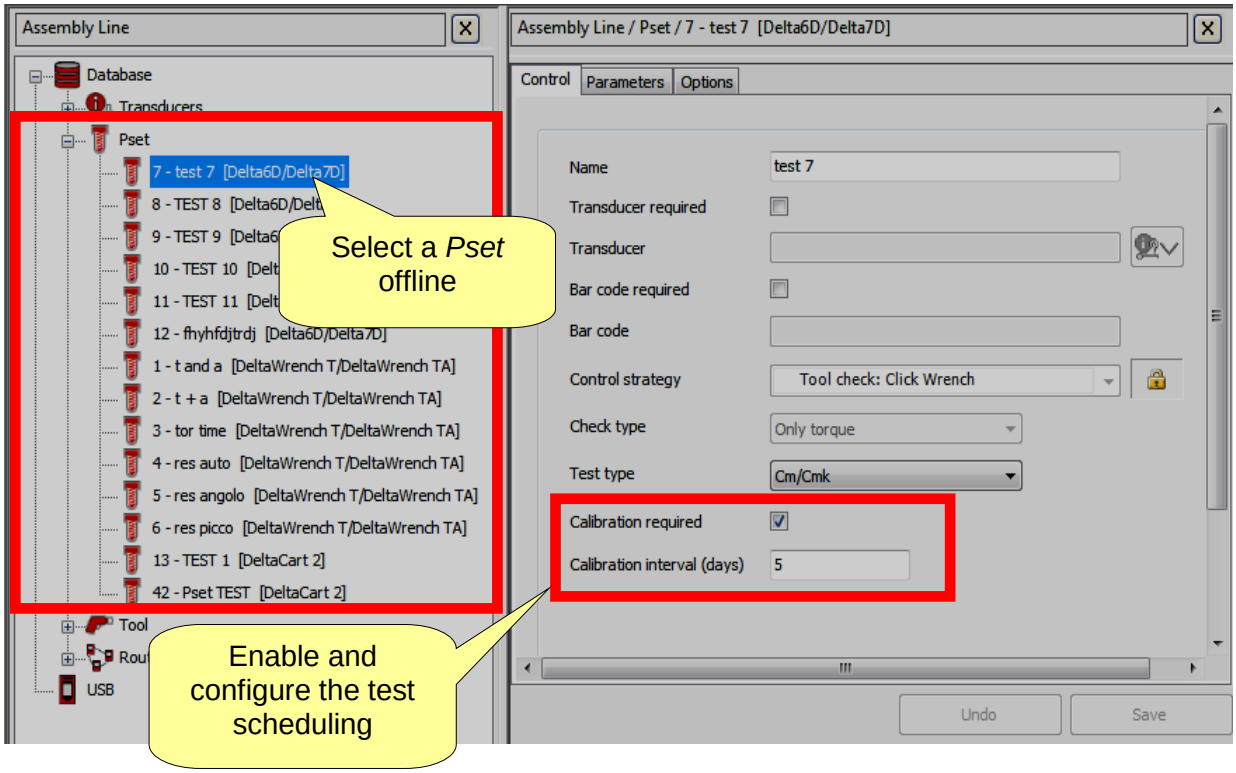
NOTE: The Delta shows the *statistics* or the *last results* according to the controller configuration (refer to the paragraph "*Change results view mode*" for further details).

8.2.6 Scheduling the test

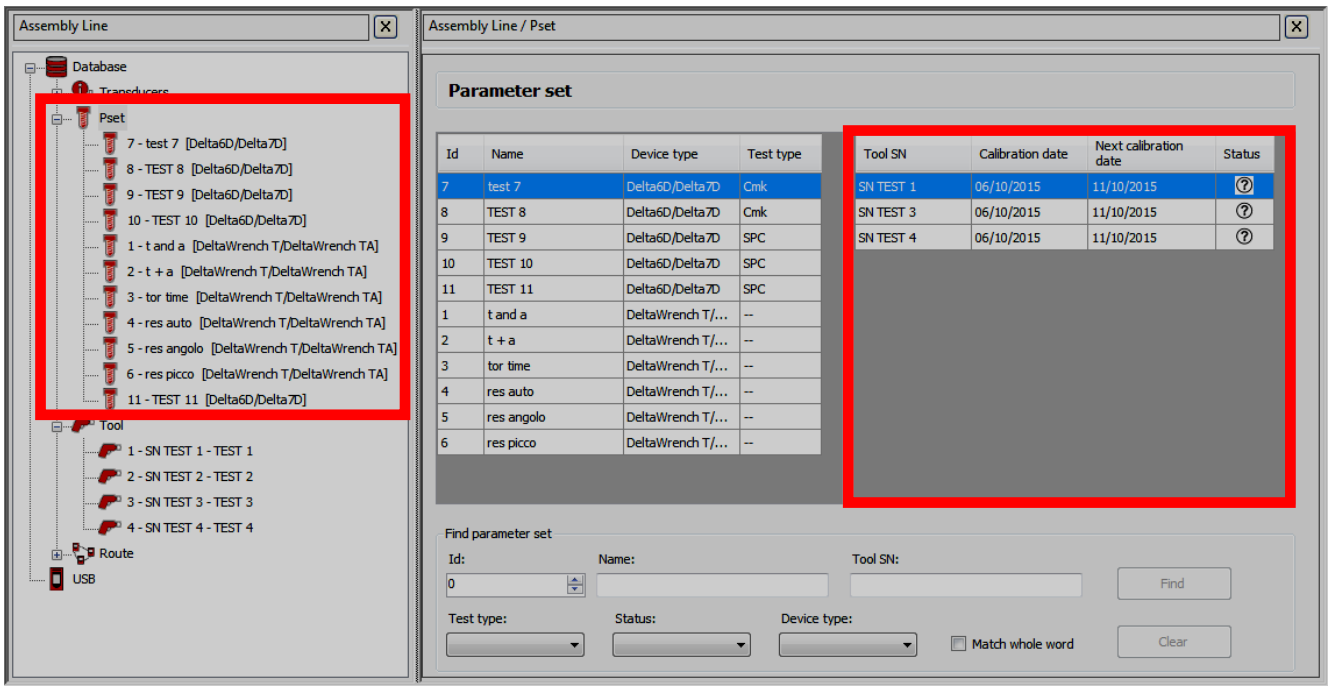
The DeltaQC software is characterized by a function to monitor and schedule the tests. This is available for *Tool Testing Psets*; on the other hand it is not available for *Quality* and *Joint Analysis Psets*.

NOTE: The scheduling is implemented in the *Pset* defined ***Offline***.

In Offline mode, select a *Pset* placed in the *Assembly Line area*; then, in the ***Control*** parameters enable and schedule the test: thus, flag the *Calibration required* option and insert the *Calibration interval (days)* (refer to the following screen):



After linking the *Tool(s)* to the relative *Pset*, select ***Pset*** in the ***Assembly Line*** area:



For each *Pset* the following columns provide information about the *tool status*, the *date of the last test* and the *date of the next test*:

Status	 If the *Pset scheduling* has not been enabled, the *status* is marked in grey.  If the *Pset scheduling* has been enabled but no-one test has been executed yet, the *status* is marked with a question mark.  If the tool has been tested with OK result, the *status* is marked in green.  If the tool has been tested with Not OK result, the *status* is marked in red.  If the ***Calibration interval (days)*** between two tests has been expired, the *status* is marked in yellow, regardless the fact that the previous test was OK or Not OK.
Calibration date	Date of the last test.
Next calibration date	Date of the last test + calibration interval (calendar days), specified in the *Pset*.

8.3 CVI Calibration

The ***Delta 6D/7D*** is characterized by the *CVI II / CVI3 / CVIC II* calibration function.

8.3.1 CVI II calibration function

To perform the calibration, the system must be connected as follows:

To connect the *Delta* and the *CVI II*, use the same cable to connect the Delta to the barcode reader, and a crossed serial cable to be connected to the serial port of the *CVI II*.

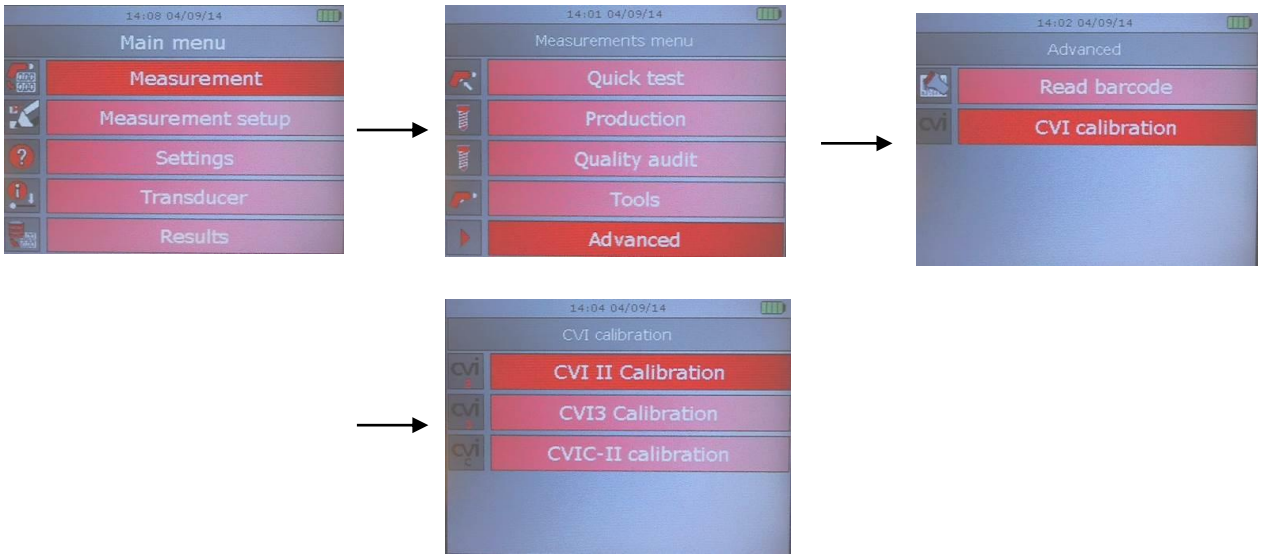
NOTE: For *CVI II* connection and calibration function details, please refer to the specific documentation.

To execute the calibration, perform the following steps:

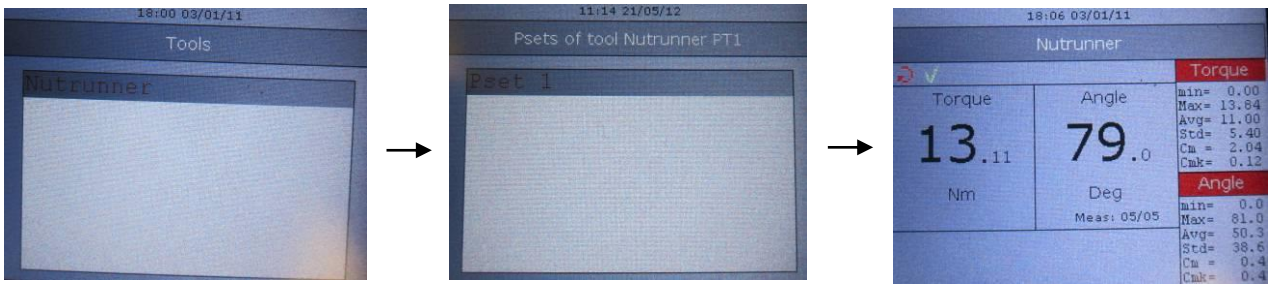
- Connect the system as shown in the figure above.
- Ensure that the SIMAP-Box interface is disabled.

NOTE: Refer to the paragraph "*Enabling the SIMAP-Box*" for further details about how to enable/disable the SIMAP-Box.

- On the Delta, define a *Tool* and a *Pset* associated to it, with the torque (and possibly angle) to test the *CVI II* tool. The batch size must be set to 5, to match the number of tests required by the *CVI II* calibration test. Do not enable the barcode in the *Pset*.
- Start the calibration procedure on the *CVI II*.
- Select the ***Measurement*** → ***Advanced*** → ***CVI Calibration*** → ***CVI II Calibration*** function on the Delta:



- Select the tool defined for the *CVI II* and the *Pset* associated, and execute the 5 tests of the batch:



- Once the 5 tests are performed, confirm (or cancel) manually the new calibration coefficient on the *CVI II* (the new calibration coefficient is not sent automatically to the *CVI II*).

The messages exchanged between the *Delta* and the *CVI II* are in the following format:

ZZZZ GG/MM/YY HH:mm:ss torque angle S\r\n

Where:

-	**ZZZZ**	Counter, starting from 0001 and incremented after each result; it is reset when the test execution window is quit.
-	**GG/MM/YY**	Date (day/month/year)
-	**HH:mm:ss**	Time (hours:minutes:seconds)
-	**torque**	Torque result
-	**angle**	Angle result (only if included in the test)
-	**S**	Status: A if result is OK, R if Not OK
-	**\r**	Carriage return
-	**\n**	Line feed

8.3.2 CVI3 calibration function

To perform the calibration, the system must be connected as follows:

To connect the *Delta* and the *CVI3*, use the same cable to connect the Delta to the external barcode reader, and a crossed serial cable to be connected to the serial port of the *CVI3*.

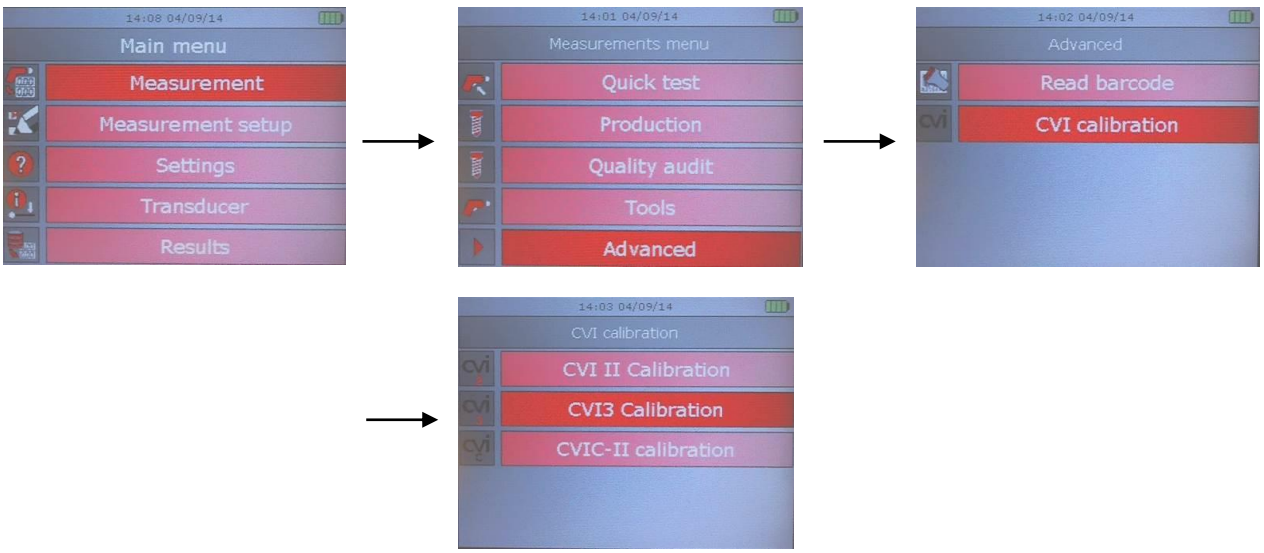
NOTE: For *CVI3* connection, *CVI3* calibration function details and *CVI* Monitor software, please refer to the specific documentation.

To execute the calibration, perform the following steps:

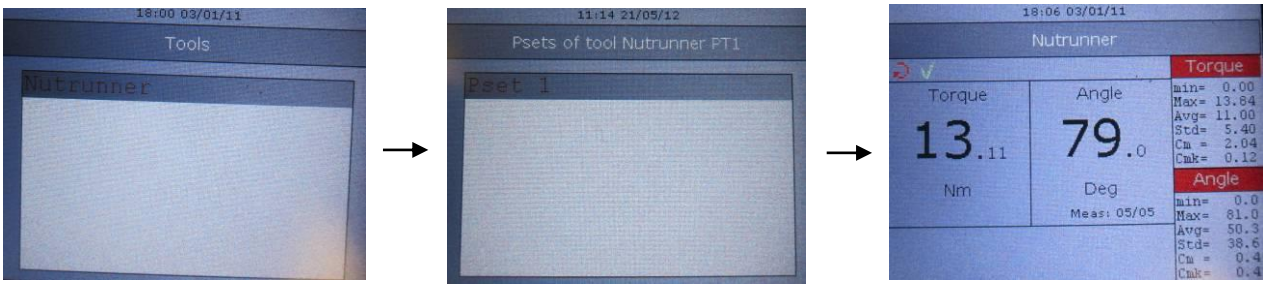
- Connect the system as shown in the figure above (the PC and the *CVI3* must belong to the same network).
- Ensure that the SIMAP-Box interface is disabled.

NOTE: Refer to the paragraph "*Enabling the SIMAP-Box*" for further details about how to enable/disable the SIMAP-Box.

- On the Delta, define a *Tool* and a *Pset* associated to it, with the torque (and possibly angle) to test the CVI3 tool. The batch size defines the number of tests used for the calibration. Do not enable the barcode in the *Pset*.
- Start the *CVI* Monitor software on the PC connected to the *CVI3*.
- On the *CVI* Monitor, start the *Tool Calibration* function; then set the *Mode* to *Manual and Delta*, by selecting *Automatic Pset* (or selecting a *Pset* already defined on the *CVI3*). Finally set the *Number of Tightening* to the same value of the batch size of the *Pset* of the *Delta*.
- On the *CVI* Monitor, start the calibration.
- Select the ***Measurement*** → ***Advanced*** → ***CVI Calibration*** → ***CVI3 Calibration*** function on the *Delta*:



- Select the tool defined for the *CVI3* and the *Pset* associated, and execute the tests of the batch:



- Once the tests are performed, the *CVI* Monitor updates automatically the new calibration coefficient in the *CVI3*.

The messages exchanged between the *Delta* and the *CVI3* are in the following format:

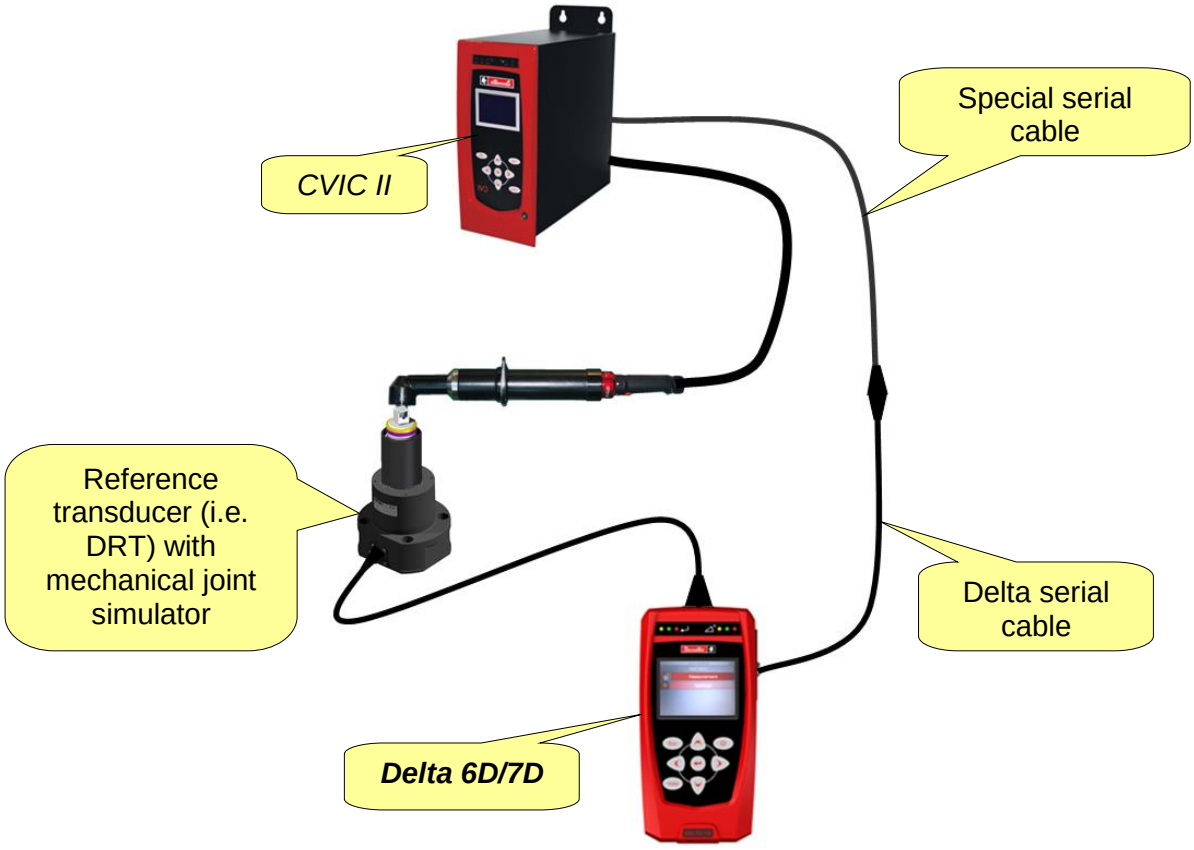
ZZZZ GG/MM/YY HH:mm:ss torque angle S\r\n

Where:

- **ZZZZ** Counter, starting from 0001 and incremented after each result; it is reset when the test execution window is quit.
- **GG/MM/YY** Date (day/month/year)
- **HH:mm:ss** Time (hours:minutes:seconds)
- **torque** Torque result
- **angle** Angle result
- **S** Status: A if result is OK, R if Not OK
- **\r** Carriage return
- **\n** Line feed

8.3.3 CVIC II calibration function

To perform the calibration, the system must be connected as follows:



To connect the *Delta* and the *CVIC II*, use the same cable to connect the Delta to the external barcode reader, and the special serial cable available from the Desoutter Customer Center.

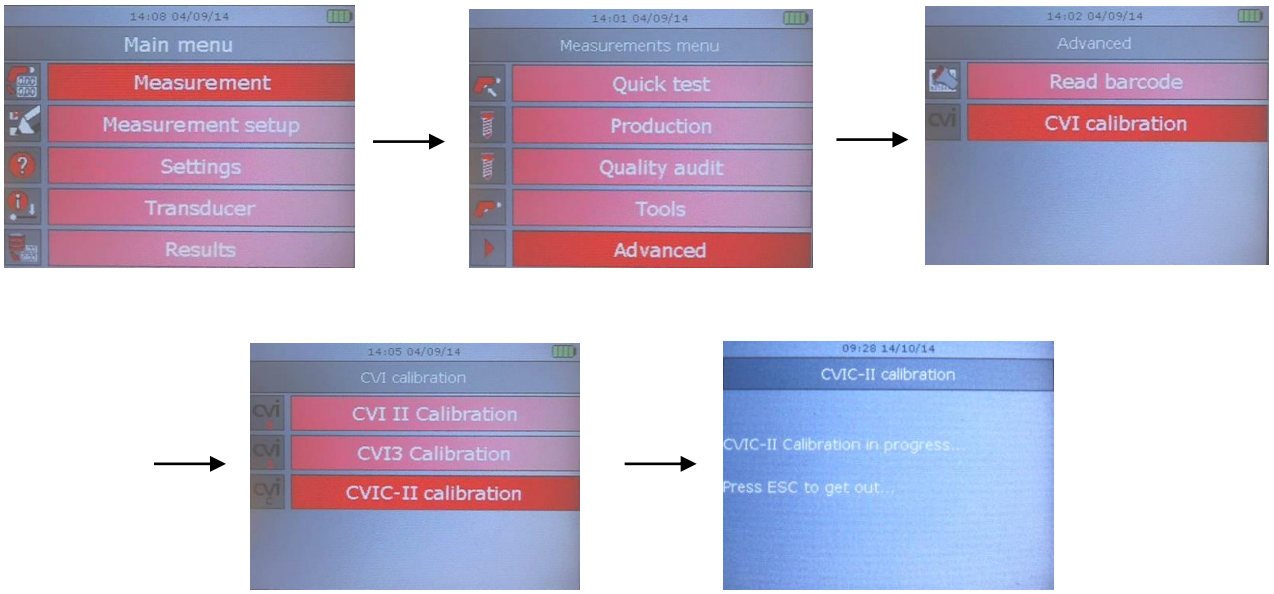
NOTE: For further details about *CVIC II* connection and functions please refer to the specific documentation.

To execute the calibration, perform the following steps:

- Connect the system as shown in the figure above.
- Ensure that the SIMAP-Box interface is disabled.

NOTE: Refer to the paragraph "*Enabling the SIMAP-Box*" for further details about how to enable/disable the SIMAP-Box.

- Select the ***Measurement*** → ***Advanced*** → ***CVI Calibration*** → ***CVIC-II Calibration*** function on the *Delta*:



- On the *CVIC II*, start the calibration (*automatic mode*).
- Execute tests required by the *CVIC II*. The new calibration coefficient is automatically updated on the *CVIC II*. If, during the calibration, a false test is executed, it is possible to quit the procedure (by pressing ***Esc***) and then entering again the calibration menu to restore the process.

8.4 Delta 6D/7D Settings

8.4.1 Display language

To set the display language, select ***Settings*** → ***Language*** from the main menu:

Select the desired language and press "***Valid***" key on the keyboard to confirm.

NOTE: The language can be set also by means of the DeltaQC software. Refer to the paragraph "*Delta Controller Setup*" for further details.

8.4.2 Date and Time

To set the Delta date and time, select ***Settings*** → ***Date and Time*** from the main menu:

Use the ***Left*** and ***Right*** arrows on the keyboard to move in the menu, and the ***Up*** and ***Down*** arrows to increase and decrease the selected field.

Click on ***Valid*** button on the keyboard to save the new date and time.

8.4.3 Statistics

The **Statistics** menu defines the type of statistics calculated by the DeltaQC software; select ***Settings*** → ***Statistics*** from the main menu:

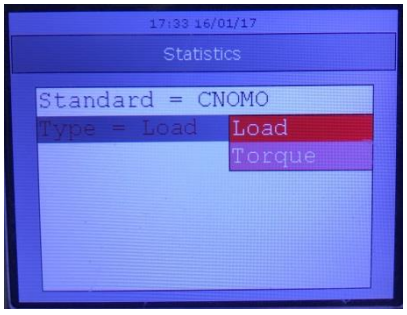
Click on the ***Enter*** button on the keyboard and select one of the following options:

- **ISO**
- **CNOMO**
- **60-181**

Click on ***Valid*** to confirm.

NOTE: Refer to the paragraph "*Statistical Computation*" for further details the three different methods above mentioned to calculate statistical parameters.

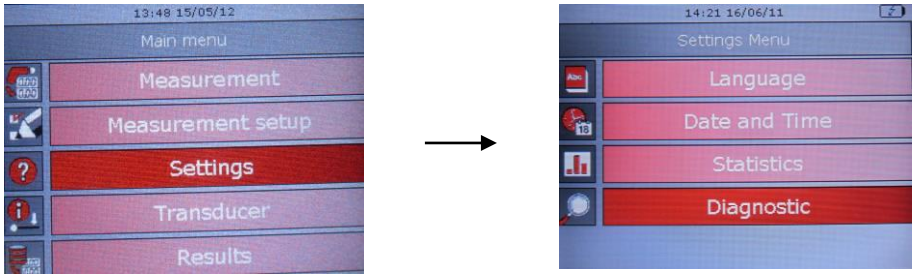
If a FCT transducer is connected to the Delta, the operator can select load or torque values to be shown into statistics:



This affects the values shown in the statistics field on Delta display when a batch is done:

8.4.4 Diagnostic

The "***Diagnostic***" menu starts the diagnostic procedure. Select ***Settings*** → ***Diagnostic*** from the main menu:



NOTE: The diagnostic procedure can be helpful in case of instrument malfunction. For further details about the Diagnostic function, refer to the paragraph "*Delta Diagnostic".*

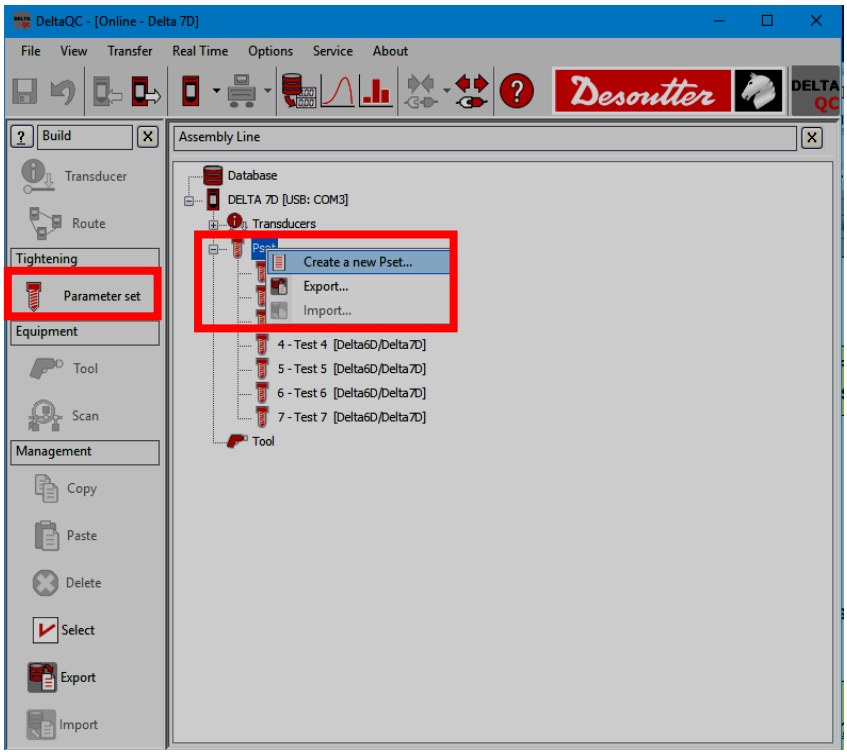
9 PSET

NOTE: This chapter is not applicable for the ***Delta 1D***.

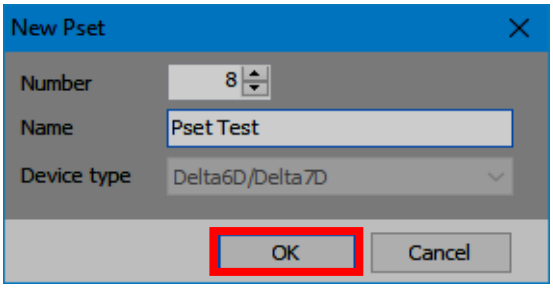
The set of parameters that controls a test process is contained within a so-called **Pset**. This section describes how to setup the Pset parameters necessary to perform a test.

The ***Delta 6D/7D*** can store up to 1000 Psets in its memory. In *Offline mode* it is possible to add up to 32000 Psets (refer to the paragraph "*Offline mode*" for further details).

To create a new *Pset*, either click on the ***Parameter set*** icon placed in the *Build area*, or right-click on ***Pset*** in the *Assembly Line area* (and then, click on ***Create a new Pset…***):



From the pop-up that appears (see figure below), select the Pset ***Number*** and type the Pset ***Name***. Then, click on the ***OK*** button to confirm the creation of a new Pset:



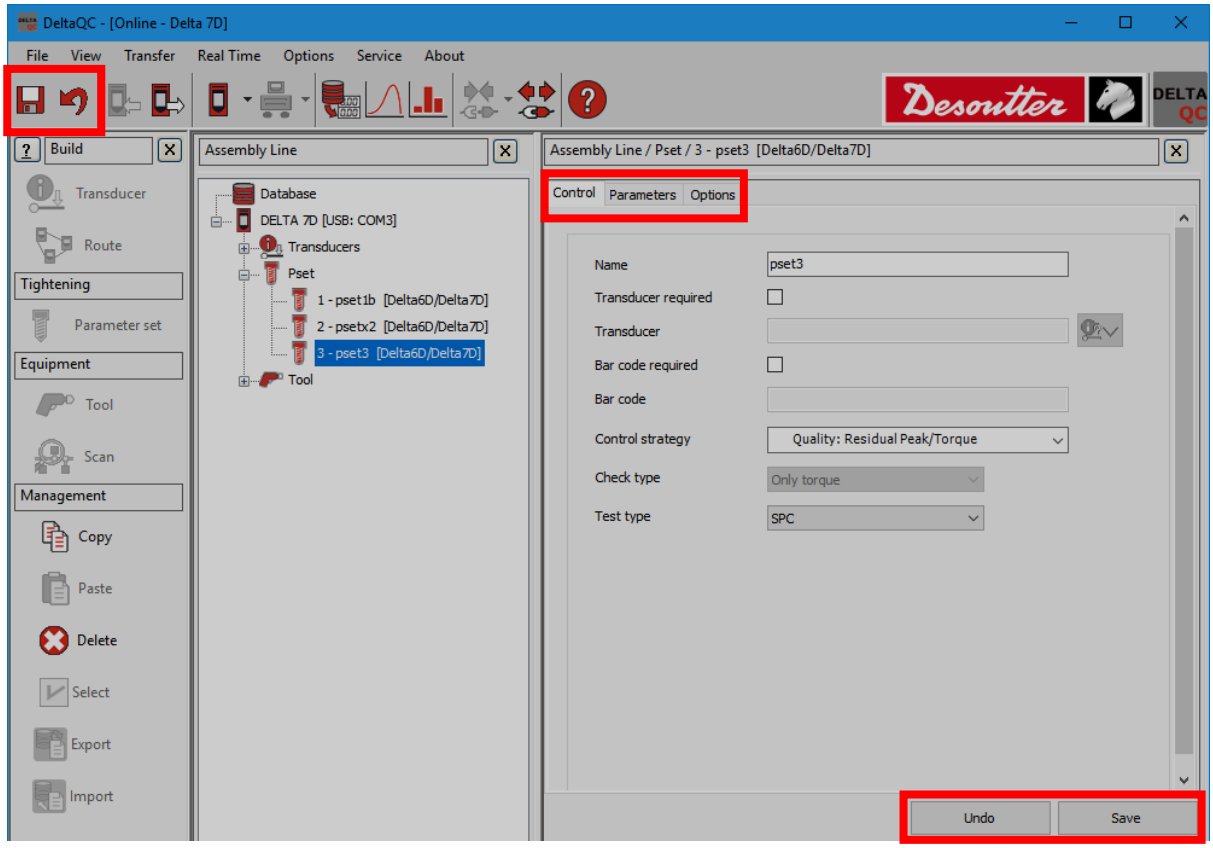
NOTE: By default, the Pset ***Number*** assigned is the first number available. It is not possible to use numbers already assigned to other Psets.

NOTE: For further details about the Pset parameters and how to program them for the various test strategies, refer to the following paragraphs.

Once the *Pset* is created, it is MANDATORY to create the *Tool* for testing various tools; the *Pset(s)* must be linked to the *Tool*.

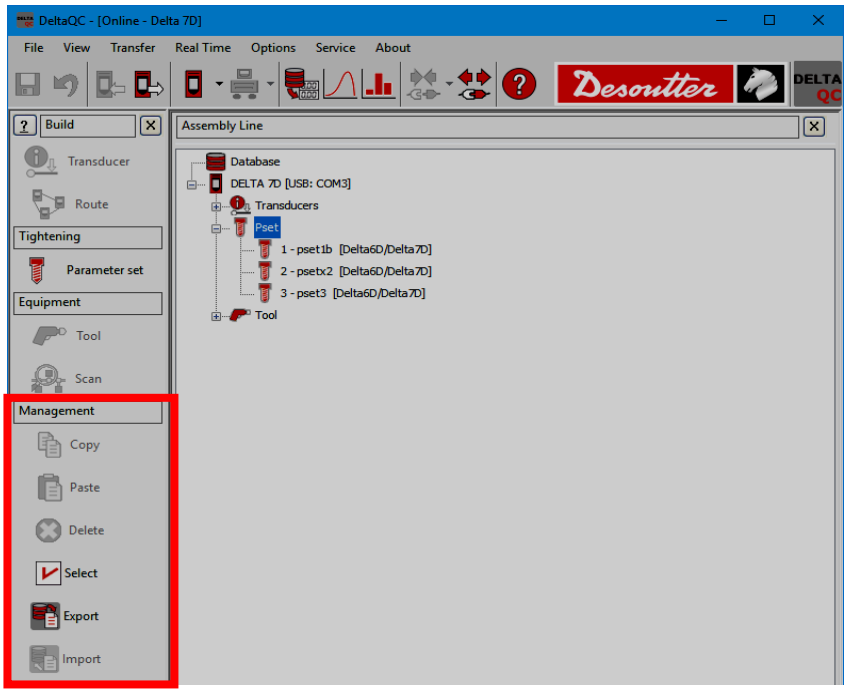
NOTE: It is also possible to create a new *Pset* directly on the *Delta*, by selecting the ***Measurement Setup*** → ***Pset setup*** menu (refer to the paragraph "*Use of the Delta 6D/7D*" for further details).

Configure the parameters contained in the *General, Parameters* and *Options* tab as described in the next paragraphs.
Finally, click on the ***Save*** button to confirm the creation of a new Pset, or on the ***Undo*** button to cancel all the operations (see figure below):



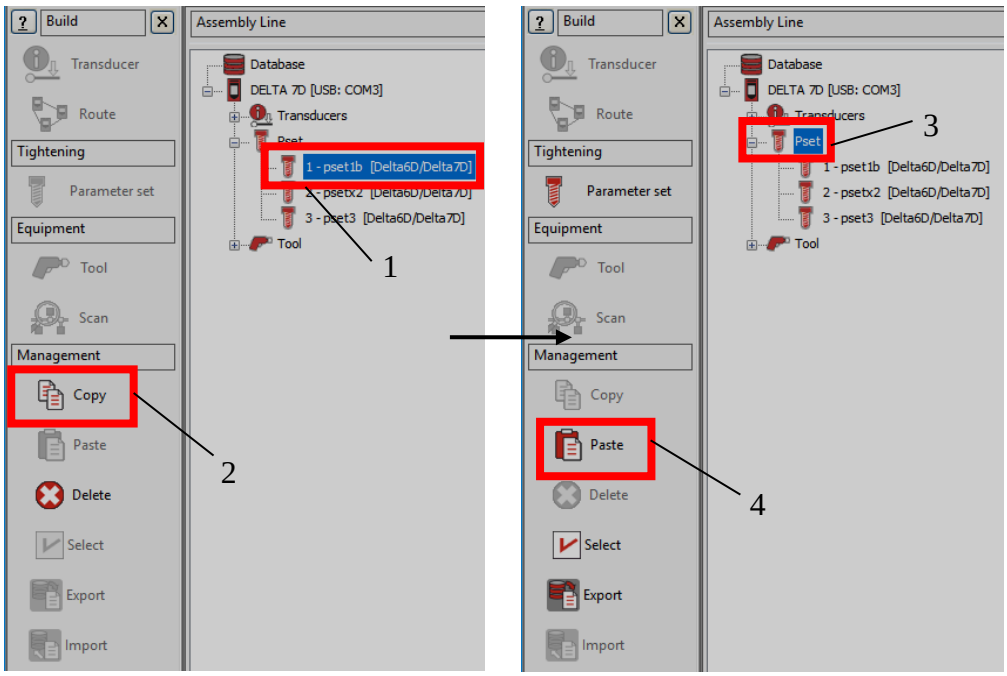
The *Management* area (placed in the *Build* area) provides the commands to:

- *copy* and *paste* a Pset;
- *delete* one or more Psets;
- *export* and *import* one or more Psets.



Copy and *paste* a Pset as described below (refer to the following figures):

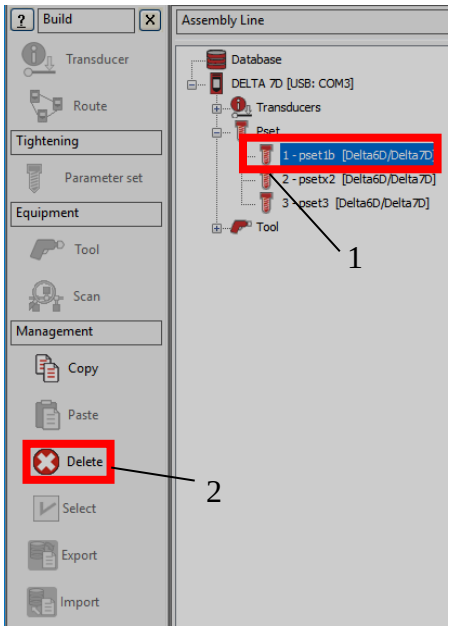
1. In the *Assembly Line* area, select a Pset from the list.
2. In the *Management* area, click on the ***Copy*** icon.
3. In the *Assembly Line* area, click on the ***Pset*** node.
4. In the *Management* area click on the ***Paste*** icon.



Delete a Pset as described below (refer to the figure on the right):

1. In the *Assembly Line* area, select the Pset to delete.
2. In the management area, click on the ***Delete*** icon.

Finally, click on ***Yes*** in the warning message appears to confirm the deletion of the selected Pset.



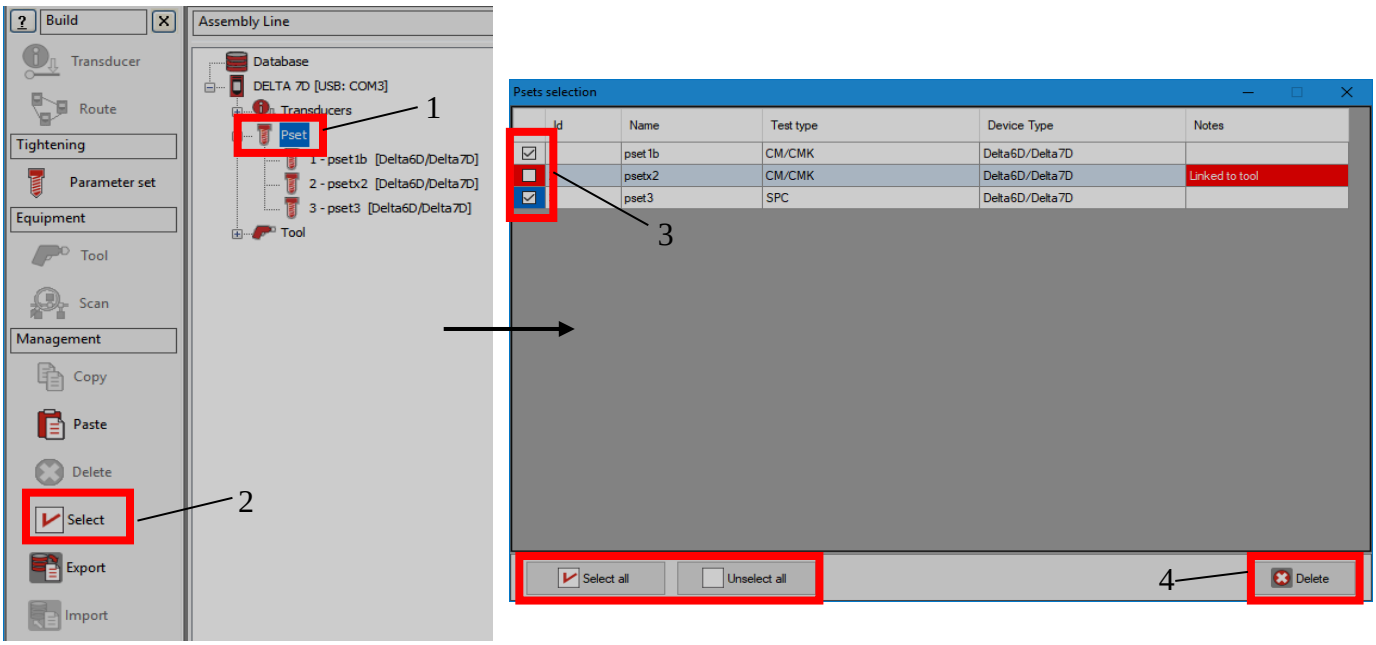
Delete more Psets at the same time as described below (refer to the following figures):

1. In the *Assembly Line* area, click on the ***Pset*** node.
2. In the *Management* area click on the ***Select*** icon.
3. In the *Pset selection* pop-up that opens, select the Pset / Psets to delete.

NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select all the available Psets and to unselect all the Psets.

4. In the *Pset selection* pop-up, click on the ***Delete*** button.

Finally, click on ***Yes*** in the confirmation message that appears to confirm the deletion of the selected Psets.



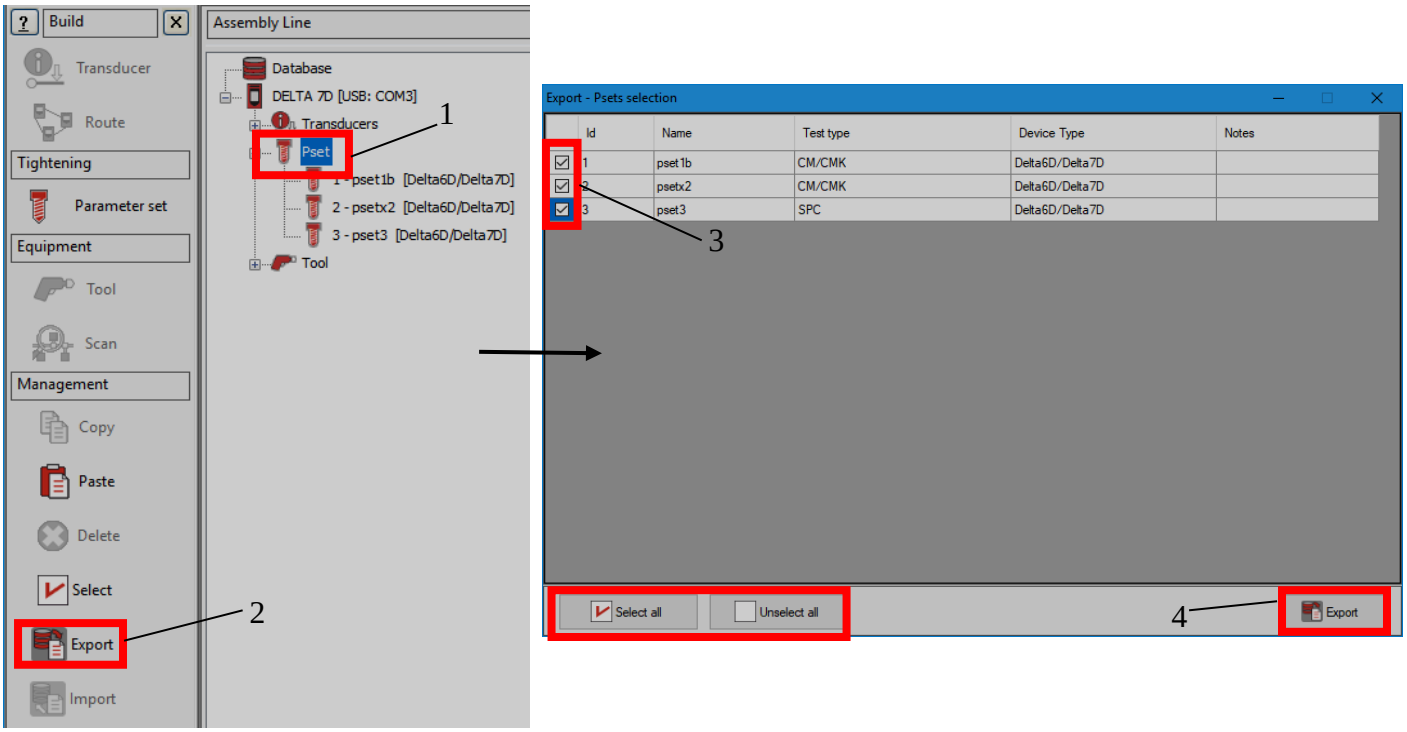
NOTE: The Psets marked in red cannot be deleted since they are ***Linked to Tool*** (see the last column of the above pop-up).
To delete a Pset linked to a Tool, first remove the link between the Pset and the Tool.

Export one or more Psets from DeltaQC to the PC as described below (refer to the following figures):

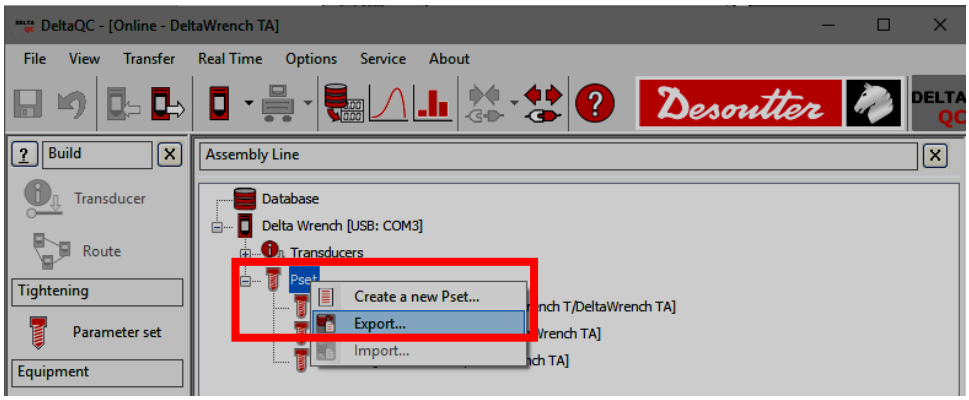
1. In the *Assembly Line* area, click on the ***Pset*** node.
2. In the *Management* area, click on the ***Export*** icon.
3. From the pop-up that opens, select the Pset / Psets to export.

NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select and to unselect all the available Psets.

4. From the *Export – Pset selection* pop-up that appears, click on the ***Export*** button and save the Psets on the PC in an *XML* file.



NOTE: It is also possible to export one or more Psets by right-clicking on the ***Pset*** node in the *Assembly Line* area and then on ***Export…*** (see figure below):



The *import* of one or more Psets can be performed only in the *Offline* mode.

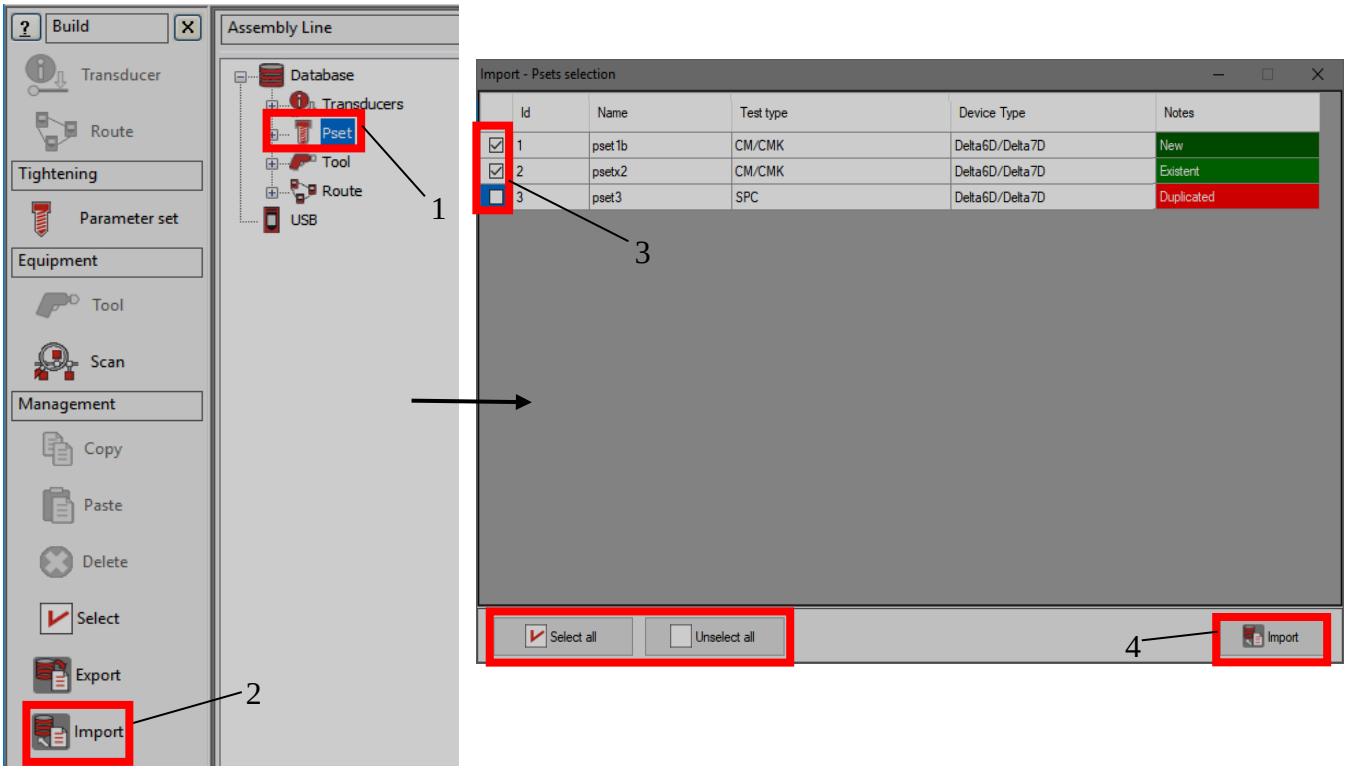
To proceed with the import, click on the ***Disconnect*** icon to disconnect the Delta from the PC.

Then, *import* one or more Psets from the PC files as described below (refer to the following figures):

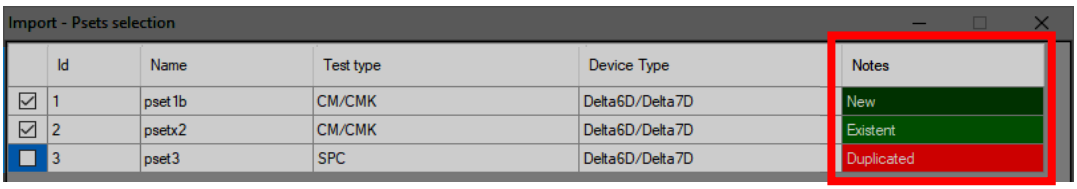
1. In the *Assembly Line* area, click on the ***Pset*** node.
2. In the *Management* area, click on the ***Import*** icon and select the *XML* file from the PC.
3. In the *Import – Pset selection* pop-up that opens, select the Pset / Psets to import.

   NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select all the available Psets and to unselect all the Psets.

4. In the *Import – Pset selection* pop-up, click on the **Import** button.



In the *Import – Pset selection* pop-up, the ***Notes*** column (last column of the table) shows details about the Psets (see figure below):

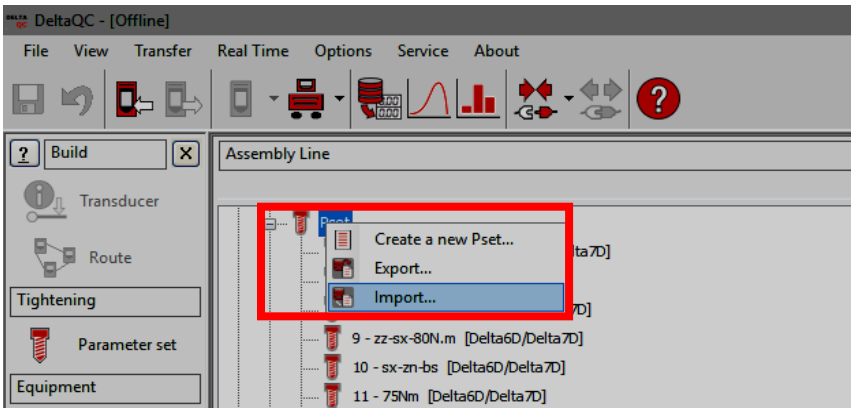


If a Pset is marked in green as "*New*", there is no existing match in the destination database and it is possible to import the Pset.

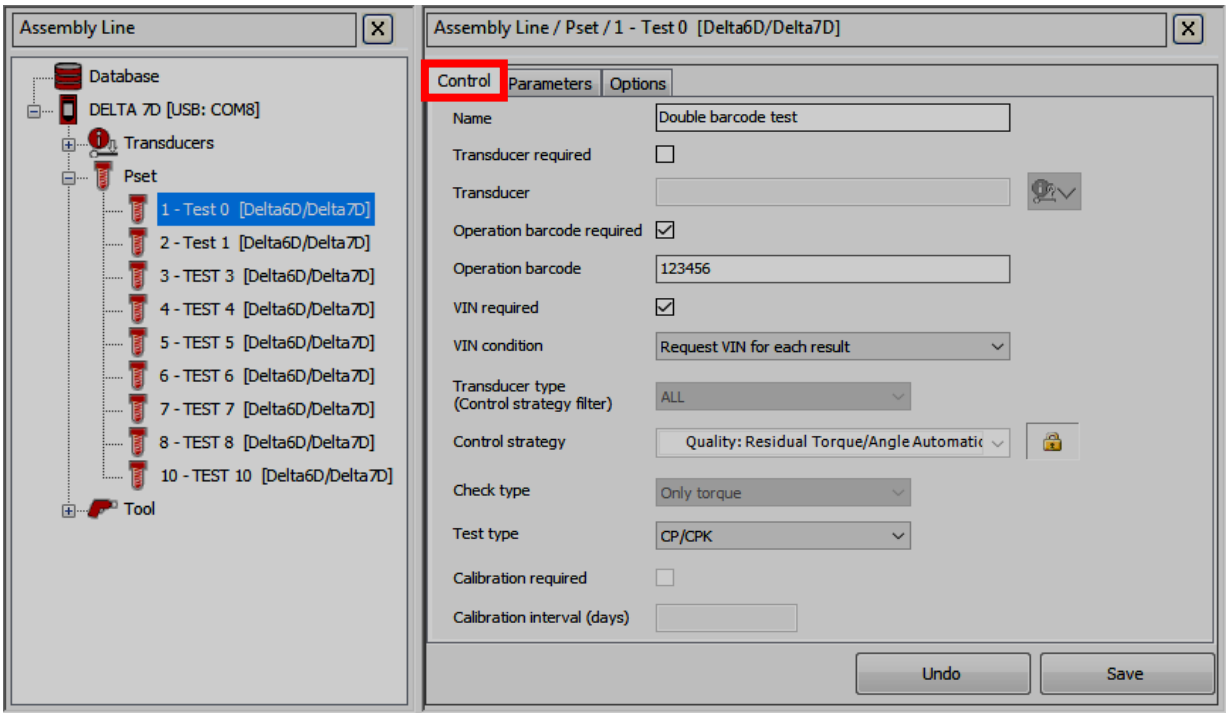
If a Pset is marked in light green as "*Existent*", a Pset with the same name but different configuration already exists in the destination database, and the Pset imported will overwrite the existing one.

If a Pset is marked in red as "*Duplicated*", a Pset with the same name but linked to a different tool already exists in the destination database and it is not possible to import it.

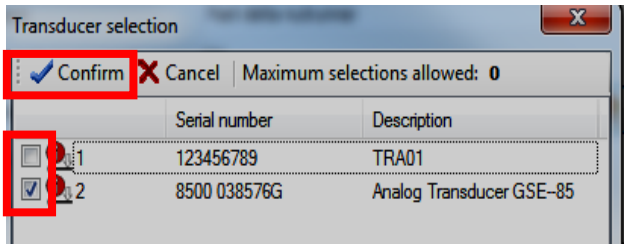
NOTE: It is also possible to import one or more Psets by right-clicking on the ***Pset*** node in the *Assembly Line* area, and then on ***Import…*** (see figure below):

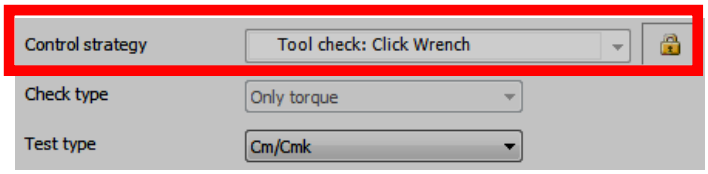


9.1 Main Parameters and Control Strategy



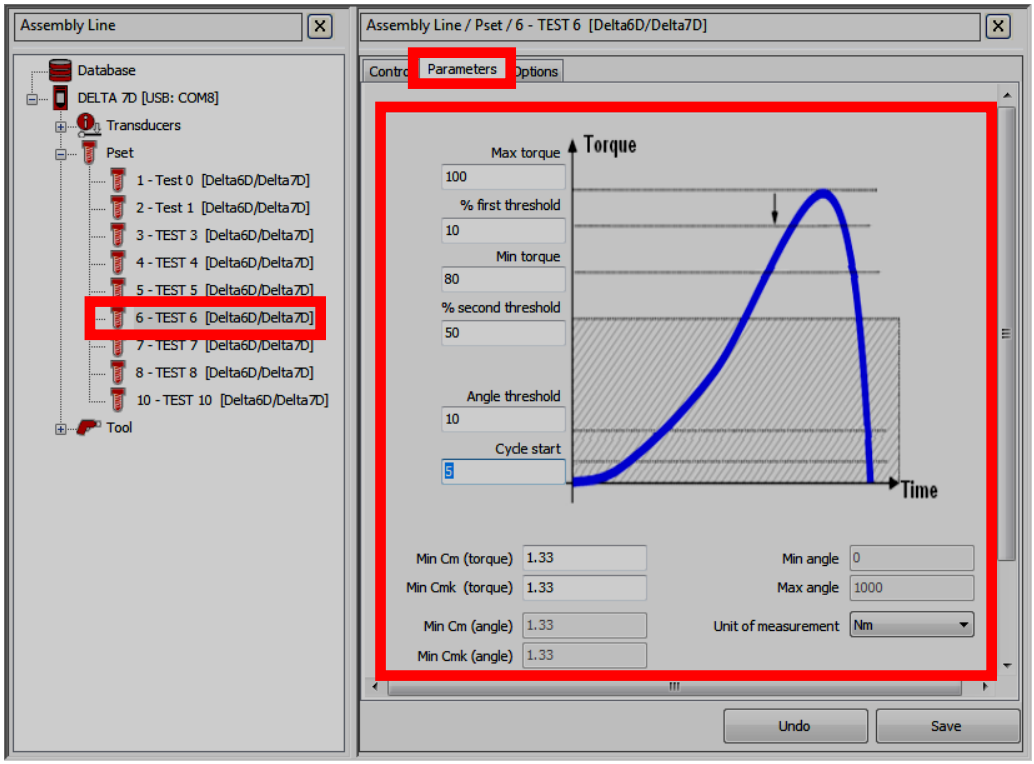
Name	The Pset name must be entered when creating the Pset. However, it is possible to change it in this area.
Transducer required and ***Transducer***	Enable the ***Transducer required*** flag to associate a transducer (*analog* or *digital*) with the Pset. To associate an ***analog transducer*** with a Pset, after flagging the *Transducer required* option, either type the *transducer Serial Number* into the *Transducer box*, or click the "***Connected transducer***" icon on the right (see figure below): 

	The following dialog-box is displayed. Select the analog transducer and click on the ***Confirm*** button:  The transducer selected is associated with the test result. To associate a ***digital transducer*** with a Pset, after flagging the *Transducer required* option, there is only a single option: type the *transducer Serial Number* into the *Transducer box*. **NOTE**: Refer to the paragraph "*Transducers*" for further details about how to define analog transducers.
Operation barcode required and ***Operation barcode***	If the ***Operation barcode required*** option is enabled, the Pset executed requires that a barcode string is scanned (it is also possible to enter it manually with the Delta keyboard). If an ***Operation barcode*** string is specified (and the scan order is set to "Operation barcode first") this string launches automatically the Pset, by entering the ***Measurement → Advanced → Read Barcode*** function on the Delta. If the Pset is selected manually from the Delta keyboard, the barcode string scanned (whichever it is and regardless of the ***Barcode*** possibly specified) is associated with the test result.
VIN required and ***VIN condition***	If the ***VIN required*** option is enabled, the Pset executed requires that a VIN is scanned (it is also possible to enter it manually with the Delta keyboard). If a VIN string is specified (and the scan order is set to "VIN first") this string launches automatically the Pset, by entering the ***Measurement → Advanced → Read Barcode*** function on the Delta. It is possible to select one of the following ***VIN conditions***: - ***Request VIN for each result***: it is required to scan the VIN after each result acquired. - ***One VIN for the batch***: it is required to scan the VIN at the beginning of the batch. The VIN acquired will be linked to result of the batch. - ***Request VIN on NOT OK only***: it is required to scan the VIN after each NOT OK result acquired. The above conditions do not apply if the scan order is set to "VIN first" (for more information, refer to *Barcode reader scan order*)
Transducer Type (control strategy filter)	Select the Control Strategy Filter from the list. To speed up the user operation choice of PSet. One type of Control Strategy Filter can block a strategy not compatible.
Control strategy	Select the *Control Strategy* from the list. For "***Tool check***" *control strategies*, note that if a Pset is already linked to a tool, it is not possible to modify them:

	 Thus, to modify the control strategy all of the association of the Pset with tools must be removed.
Check type	This parameter is active only for control strategies that involve the angle measurement. It is possible to select one of the following options: - ***Only torque***: To have an OK result, the torque must be within the limits (regardless of the angle result). This option is available for the following *Control strategies*: ***Production: Torque Time***, ***Tool check: Peak***, ***Tool check: Nutrunner***, ***Tool check: Pulse Tool***, ***Tool check: Click Wrench***, ***Tool check: Pulse Tool Preloaded***, ***Quality: Residual Peak / Torque***, ***Quality: Yield point***, ***Quality: Residual Torque / Angle Automatic***, ***Quality: Residual Torque / Angle***, ***Quality: Residual Loose and Tightening***. - ***Only angle***: To have an OK result, the angle must be within the limits (regardless of the torque result). This option is available for the following *Control strategies*: ***Tool check: Peak***, ***Tool check: Nutrunner***, ***Tool check: Free Angle***. - ***Torque and angle***: To have an OK result, both the torque and the angle must be within the limits. This option is available for the following *Control strategies*: ***Tool check: Peak***, ***Tool check: Nutrunner***, ***Production: Torque & Angle***, ***Production: Torque + Angle***, ***Production: Prevailing Torque***.
Test type	This parameter specifies if the test is a ***Cm-Cmk*** or a ***SPC*** (Statistic Control) tests. For *Production* strategies and for Tool check: Free Angle strategy, Cm-Cmk is selected automatically. **NOTE**: Refer to the paragraphs "*Statistic Process Control (SPC) test*" and "*Cm-Cmk test*" for further details.
Calibration required and ***Calibration intervals***	These two additional parameters are shown only for Pset (*Tool Testing strategies* only) defined *Offline*. They are used to schedule the tests. **NOTE**: Refer to the paragraph "*Scheduling the test*" for further details.

9.2 Torque / Angle Parameters

NOTE: All the parameters described in the following table are not applicable to all of the *Control Strategies*; the figure above shows only the relevant parameters according to the *Pset Control Strategy*.



Cycle Start	Torque value from which the test starts.
Angle threshold	For control strategies involving the angle measurement, specifies the torque value from which the angle measurement starts.
Minimum torque	Torque limit value (*low*) to get an *OK* result.
Maximum torque	Torque limit value (*high*) to get an *OK* result.
Change screw at	In *Production Control Strategies*, this is the maximum torque applicable before damaging the screw. When exceeding the torque, a warning message is shown on the display.
Unit of measurement	Select the desired unit.
% first threshold and ***% second threshold***	Used only for *Tool Testing Control Strategies*. The use of these two parameters depends on the tool type. **NOTE**: Refer to the specific paragraphs ("*Testing Click-wrenches*", "*Testing Nutrunners*" and "*Testing Pulse Tools*") for a detailed explanation of these thresholds in the various strategies.
Minimum Cm and ***Minimum Cmk***	Minimum value for the Cm and Cmk. If the test gives a Cm or Cmk value lower than the minimum value, the test is marked as *Not OK*.

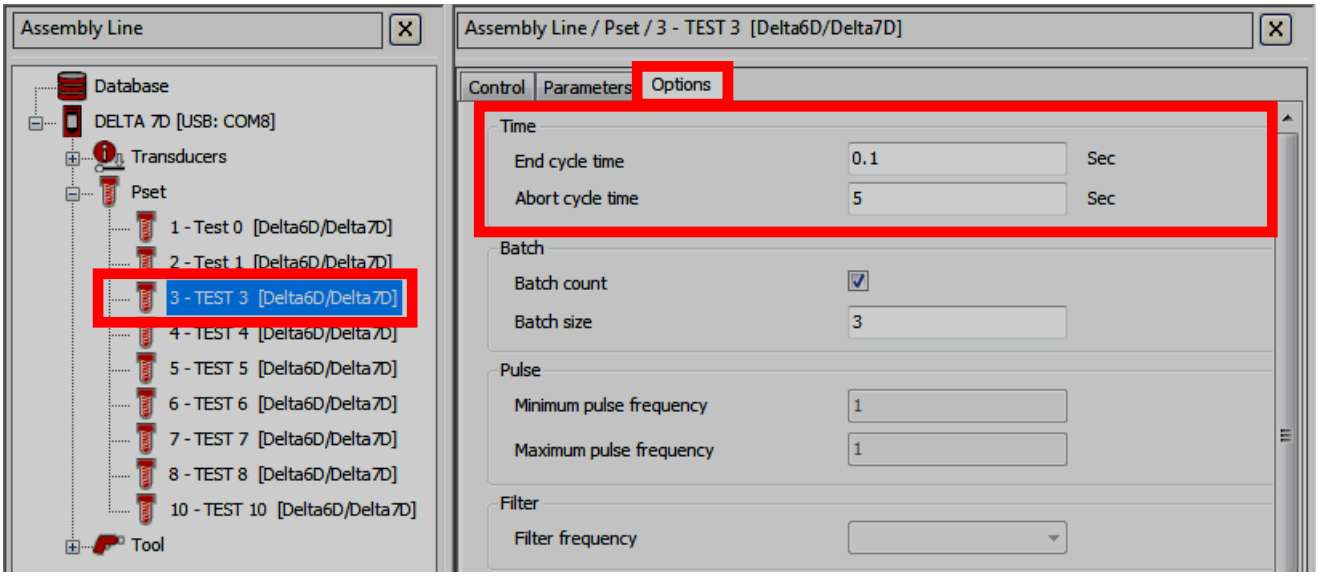
	NOTE: These parameters are not considered either if the torque is not selected as measure to be considered for the result in the main control parameters of the Pset or if the test type is set to *SPC*.
Torque coefficient	Used only for *Pulse Tools Test* only. It is used to correct the torque value read by the *Delta* in order to match the real torque provided by the *Pulse Tool* on the joint (residual torque). The value is in thousandth and must be set between 500 and 1000. **NOTE**: For a detailed explanation of the test of a *Pulse Tool*, and how to calculate this parameter, refer to the paragraph "*Testing Pulse Tools*".
Torque correction coefficient	Used only for *Production* and *Quality strategies*. It provides torque compensation if an extension bar is used on the Q-AUDIT. **NOTE**: Refer to the paragraph "*Calculating Correction Coefficients for Extensions*" for further details.
Angle correction coefficient	Used only for *Production* and *Quality strategies*. It provides angle compensation if an extension bar is used both on the Q-AUDIT and on the DRT5. **NOTE**: Refer to the paragraph "*Calculating Correction Coefficients for Extensions*" for further details.
Minimum angle	Angle limit value (*low*) to get an OK result.
Target angle	Target value for the control strategies in which the operator must get a fixed angle. **NOTE**: Refer to the description of each test strategy for further details.
Maximum angle	Angle limit value (*high*) to get an OK result.
Minimum Cm (angle) and ***Minimum Cmk (angle)***	Minimum value for the Cm and Cmk. If the test gives a Cm or Cmk value lower than the minimum value, the test is marked as Not OK. **NOTE**: These parameters are not considered if the angle is not selected as measure to be considered for the result in the main control parameters of the Pset.
Minimum Cp (torque) and ***Minimum Cpk (torque)***	Used in Quality strategies, Cp/Cpk index measure the ability of a process to produce within specification limits. Minimum value for the Cp and Cpk. If the test gives a Cp or Cpk value lower than the minimum value, the test is marked as Not OK.
Linear slope coefficient	This parameter is active only for the *Yield Point control* strategy. It characterizes the joint stiffness in the linear part of the curve, as torque/angle slope. The minimum value is 0.1; it suits also very soft joints with a ration less than 0.1. The default value is 0.5. **NOTE**: If the unit of measurement used is different from Nm, the *Linear slope Coefficient* is automatically converted according to the unit of measurement selected. **NOTE**: Refer to the paragraph "*Yield Point*" for further details.

Residual angle threshold 1 and ***Residual angle threshold 2***	Angle thresholds that need to reach in the clamping phase to start the strategy algorithm. Refer to the quality strategies: Minimum after breakaway, Residual intersectionResidual intersection and Slope Change.

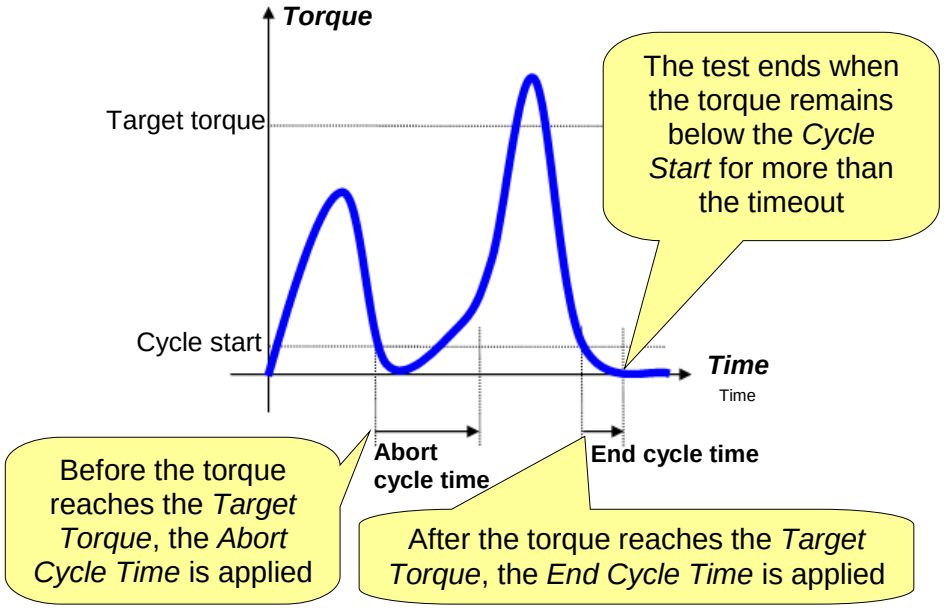
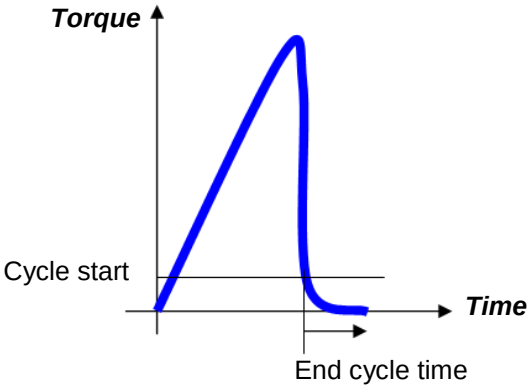
If a transducer is connected, the torque parameters are set by default as follows:

- *Cycle start* = *Angle threshold* = *Minimum torque* = transducer low torque limit
- *Change screw* = *Maximum torque* = Transducer high torque limit

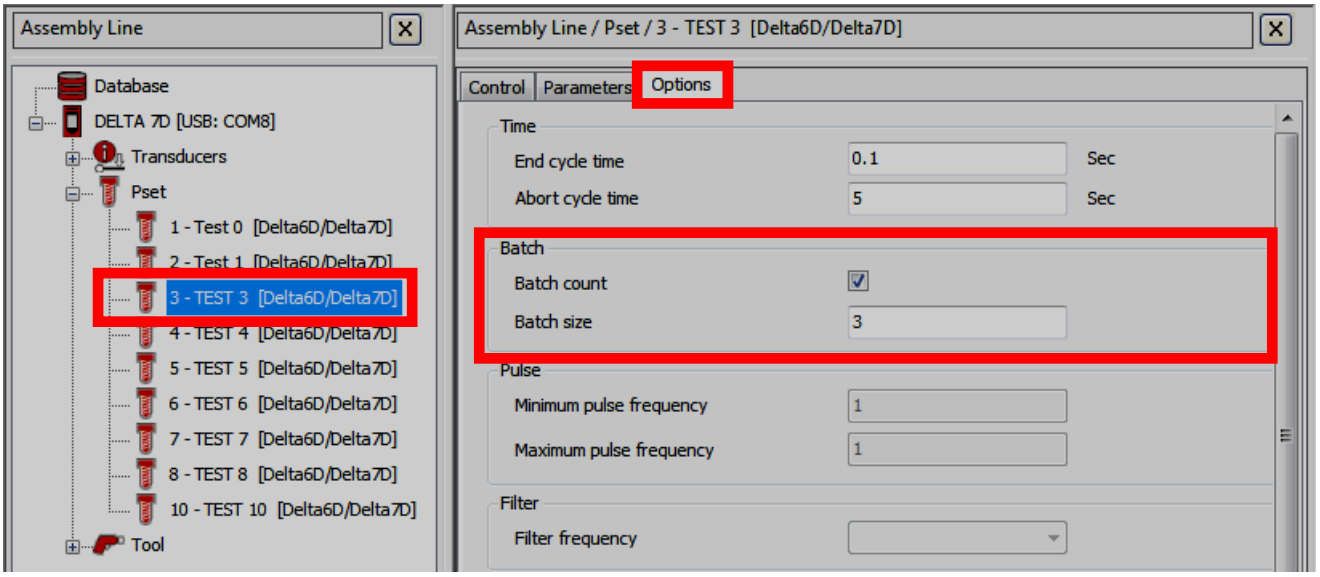
9.3 Timeout Options



Abort cycle time	Used only for the *Production strategies*. It is applied when the torque goes below the cycle start but has not reached the *target torque* value yet. This allows the operator to release the torque for a while and recharge during the tightening operation. The default value is 5 seconds. **Minimum value**: *0.1 sec*

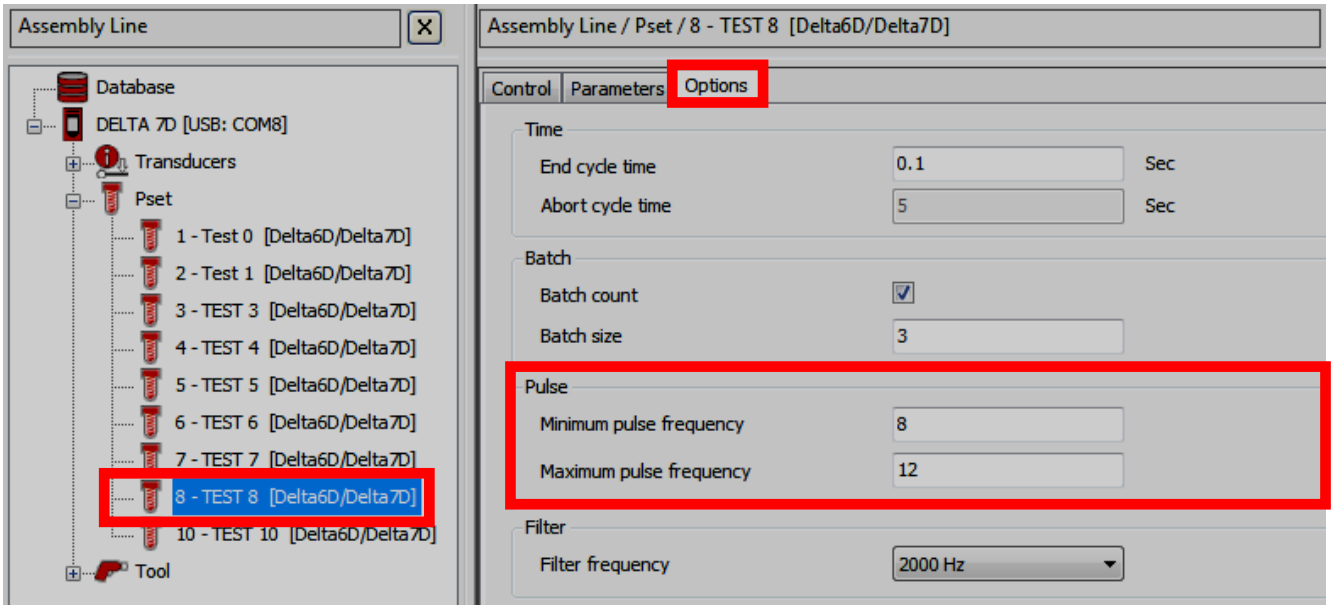
	Maximum value: *30 sec* 
End cycle time	The test ends when the torque drops beneath the *Cycle Start* value for a time longer than the timer. The default value is 0.1 second. **Minimum value**: *0.1 sec* **Maximum value**: *5 sec* For *Production strategies*, it is used only after the torque gets the target torque value; otherwise the *Abort cycle Time* is used.  For *Tool check: Free Angle strategy*, the test ends only after the angle is stable for a time longer than the timer. The default value is 0.1 second.

9.4 Batch Options



Batch count	Select this check box to activate the batch on the Pset. For *Statistic Control tests* and for the *"Tool check: Free Angle" strategy*, it is always selected.
Batch size	If the ***Batch count*** is selected, this parameter specifies how many times the Pset is executed. Typically, the batch function is used to execute a *Cm-Cmk test*. **Maximum value**: *99* For *Quality Control strategies* (since the test type is forced to *SPC*) the batch size must be between 3 and 10. It defines the number of tests for the statistic control. For the *"Tool check: Free Angle" strategy* the batch size must be between 10 and 30.

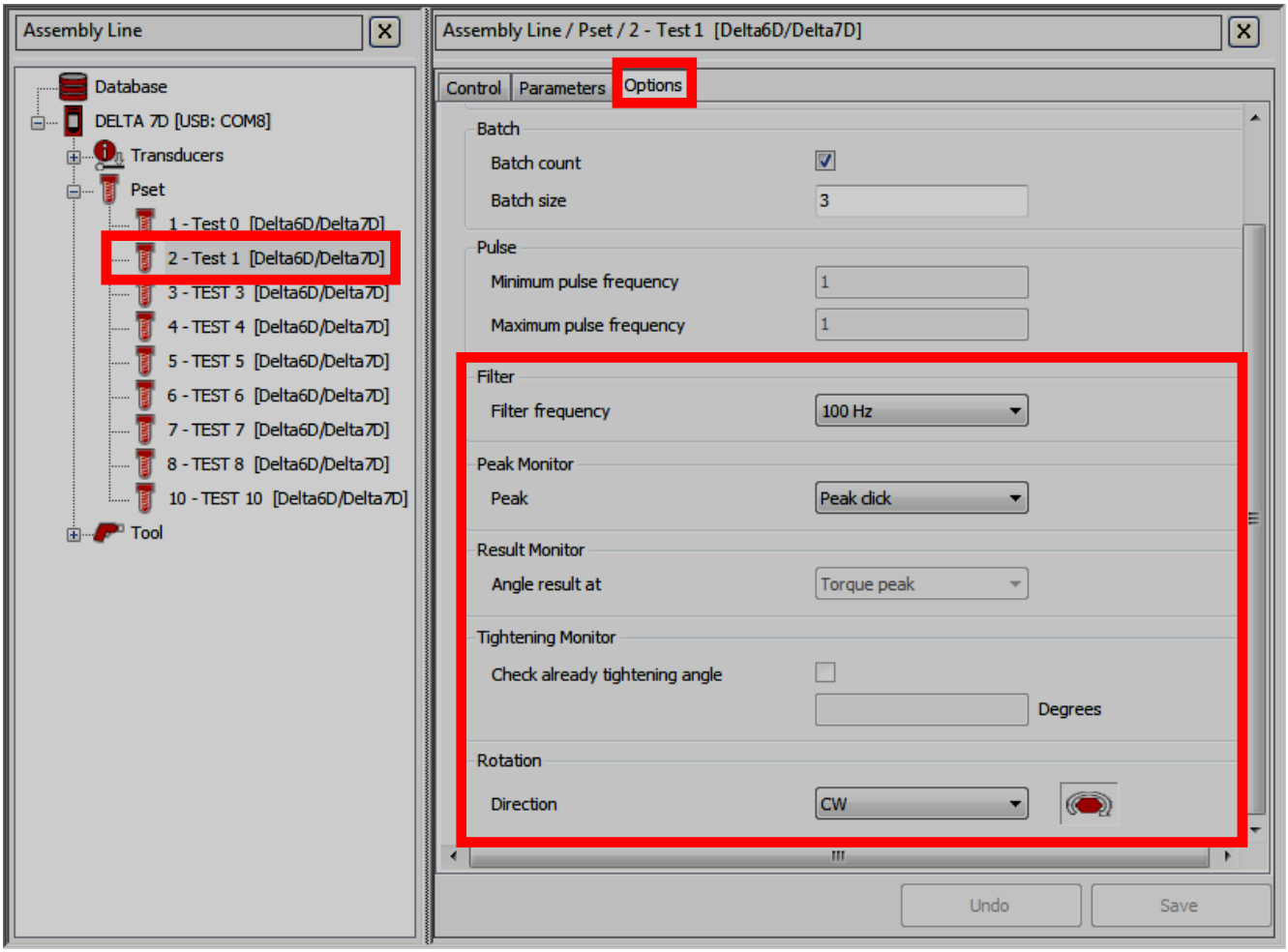
9.5 Pulse Options



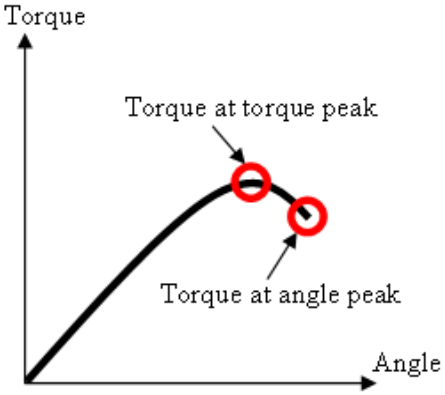
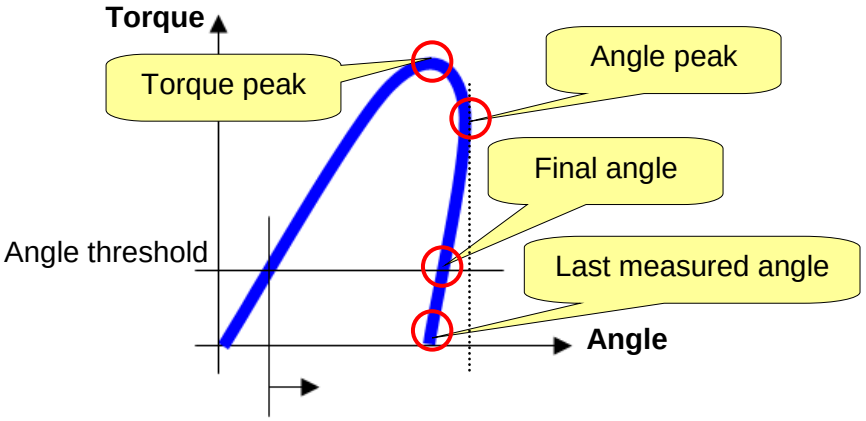
NOTE: The *Pulse options* are active only for the *Pulse Tool* control strategy.

Minimum pulse frequency and ***Maximum pulse frequency***	For *Pulse Tools*, these values are used to calculate the Cm-Cmk related to the number of pulses per second.

9.6 Options



Filter *(Filter frequency)*	Select the filter frequency from the list. This filter is applied to the torque samples measured by the *Delta*.
Peak Monitor *(Peak)*	**The options of this combo box change according to the selected strategy:** • **Click *Wrench:*** Select if the result must be either the torque value measured on the click-point detected by the *Delta* or the absolute peak measured during the test. • **Nutrunner*:*** Select if the result must be either on the highest peak or on the last one, even if lower than the highest one **NOTE**: Refer to the paragraph "*Testing Click-Wrenches*" and "*Testing Nutrunners*" for further details about the *Click Wrench* and Nutrunner tests.

Peak Monitor *(Peak)*	**Used only for *Production strategies.*** Select between ***Torque*** and ***Angle*** option:  **NOTE**: The torque result of a tightening is modified according to the tightening strategy. Refer to the specific tightening strategies at the end of this paragraph for further details.
Result Monitor *(Angle result at)*	**Used only for *Nutrunner and Peak Control strategies.*** ***Result Monitor*** option selects how to calculate the angle result. For *Nutrunner* and *Peak strategies*, further than *Torque peak* option, the following options are available: - *Angle peak (it considers the angle value when the torque reaches the Angle peak)* - *Final angle (it considers the angle value when the torque goes under the Angle threshold)* - *Last measured angle (it considers the angle value at the end of the tightening, even if the torque in under the Angle threshold)* For further details, refer to the figure below:  **NOTE**: The Angle value can be measured ONLY when the torque reaches and goes over the Angle threshold value.

Tightening Monitor *(Check already tightened angle)*	After trying to tighten a screw that is already tightened, the torque increases with a little rotation (or without any rotation) of the screw. This option monitors this event and gives an error message on the display. Enable the flag to activate this option, and specify the ***Check already tightened angle*** value that is typically set to few degrees. If the torque reaches the *Min. Torque* value within this angle, the error message "*screw already tightened*" is shown. The torque red LED is lit and the test ends without generating a torque/angle result. **NOTE**: The *Tightening Monitor* option is not available for the *"Tool check: Free Angle" strategy*.
Rotation *(Direction)*	Select between: ▪ ***CW****:* The test must be executed in clockwise direction. ▪ ***CCW****:* The test must be executed in counterclockwise direction. ▪ ***CW*** and ***CCW****:* The test can be executed in both the directions. When the torque goes over the minimum load, the test is started by considering positive the torque in the direction of the torque applied. Therefore, if different tests of the same batch are executed in opposite directions (some tests clockwise and some tests counterclockwise) all of the test results give a positive torque in the results. **NOTE**: The Pulse tool Preload strategy is available only in CW.

10 OFFLINE MODE

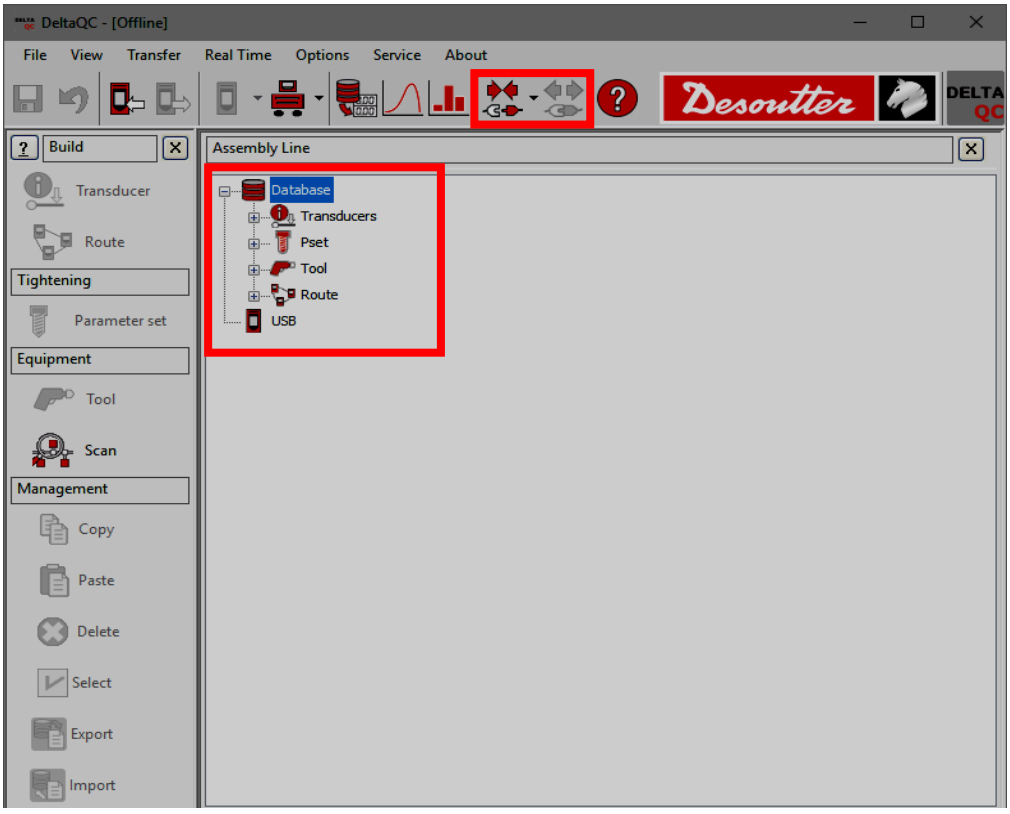
NOTE: This chapter is not applicable for the ***Delta 1D***.

The ***Offline*** mode allows the user to create *Transducers*, *Tools* and *Pset* without a *Delta* connected to the PC. All the data are stored in a local database. The tests program defined Offline can be grouped into "*Routes*" and transferred to the Delta.

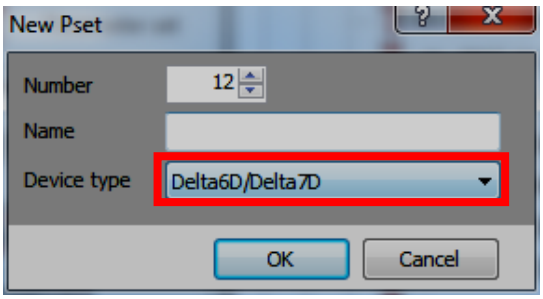
The database stores also up to 300000 *Results* and up to 3000 *Curves* downloaded from the *Delta*. The results downloaded can be analyzed then with the *Statistics* function (refer to the paragraph "*Statistics*" for further details).

NOTE: Refer to the paragraphs "*Results Viewer*" and "*Curves Viewer*" for further details on how to download results and curves from the Delta to the database.

To work in Offline mode, disconnect the *Delta* from DeltaQC software, and select ***Database*** menu.



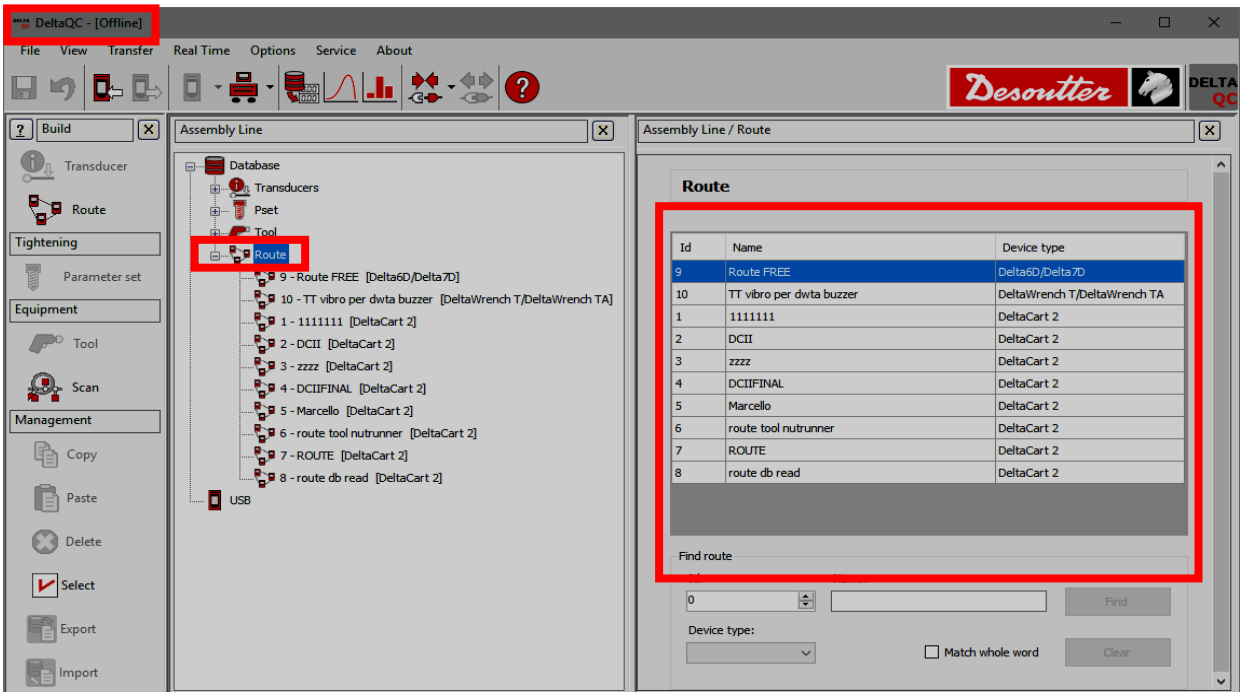
NOTE: When a Pset is created Offline, the additional field ***Device type*** is shown. Select ***Delta6D/Delta7D*** (see figure below):



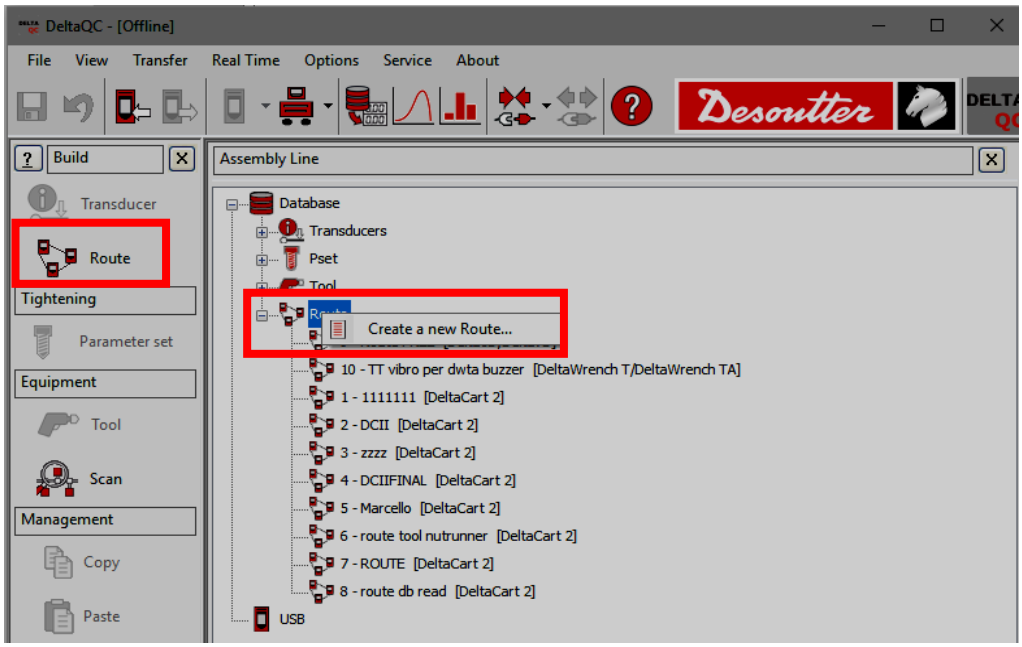
10.1 Create a Route

When working in *Offline mode*, it is possible to create up to 32.000 test programs (*Pset* and/or *Tools*). The ***Delta 6D/Delta7D*** can store up to 1000 *Pset* and 1000 *Tools*. The "*Route*" is used to select the test programs to be transferred to the *Delta*. It is possible to create various Routes (up to 32.000) in order to transfer different set of tests to different *Delta*.

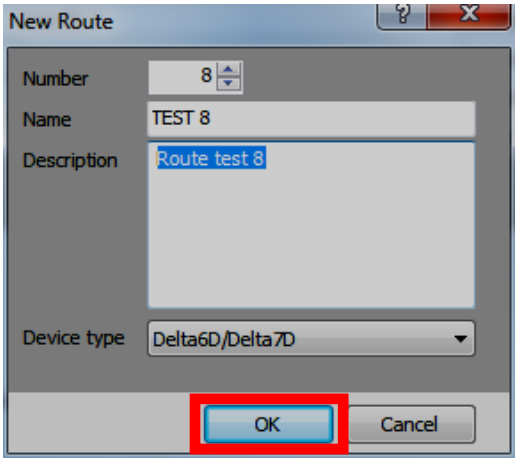
In the *Assembly Line* area of the offline mode, select ***Route***. The *Routes* already created are shown in the right area of the window (see figure below):



To create a new *Route*, either click on the ***Route*** icon placed in the *Build area*, or right-click on the ***Route*** node in the *Assembly Line area* (and then, select on "***Create a new Route…***"):

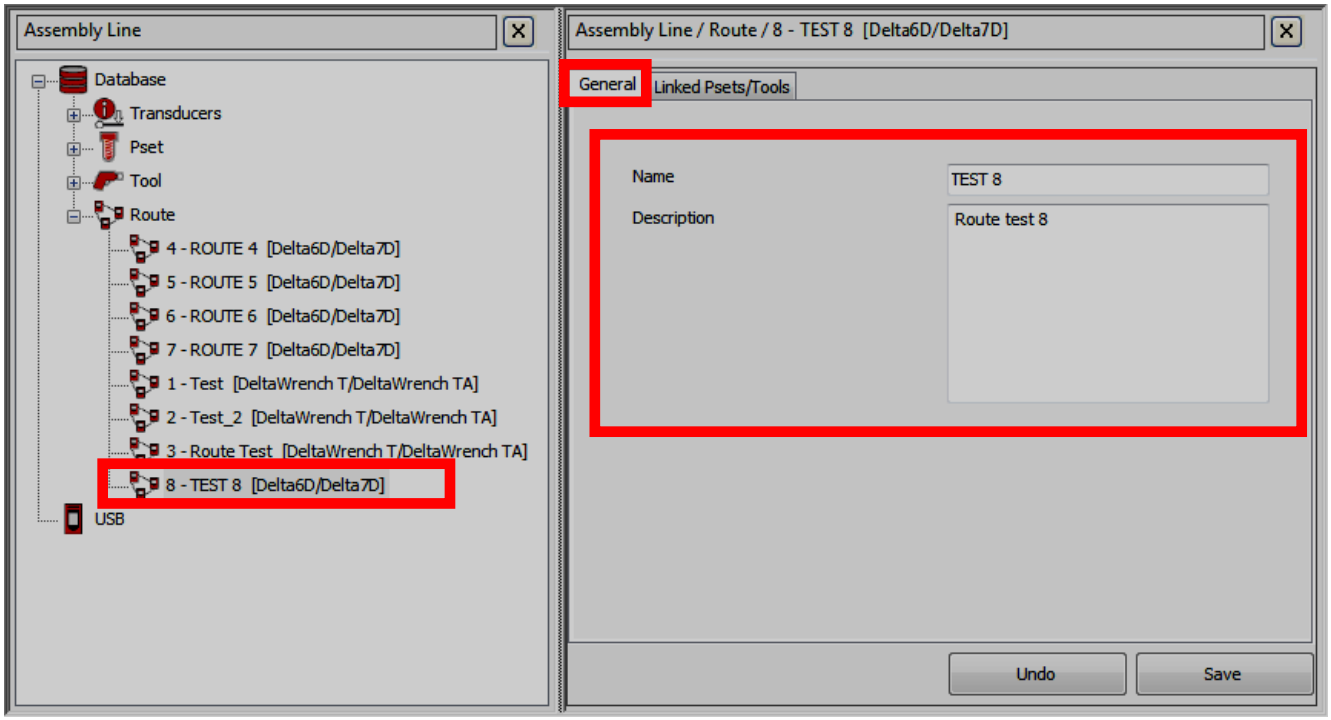


From the pop-up that appears (see figure below), select the Route ***Number***, type the Route ***Name***, enter a ***Description*** and select *Delta6D/Delta7D* from the ***Device type*** drop-down list.
Then, click on the **OK** button to confirm the creation of a new Route:

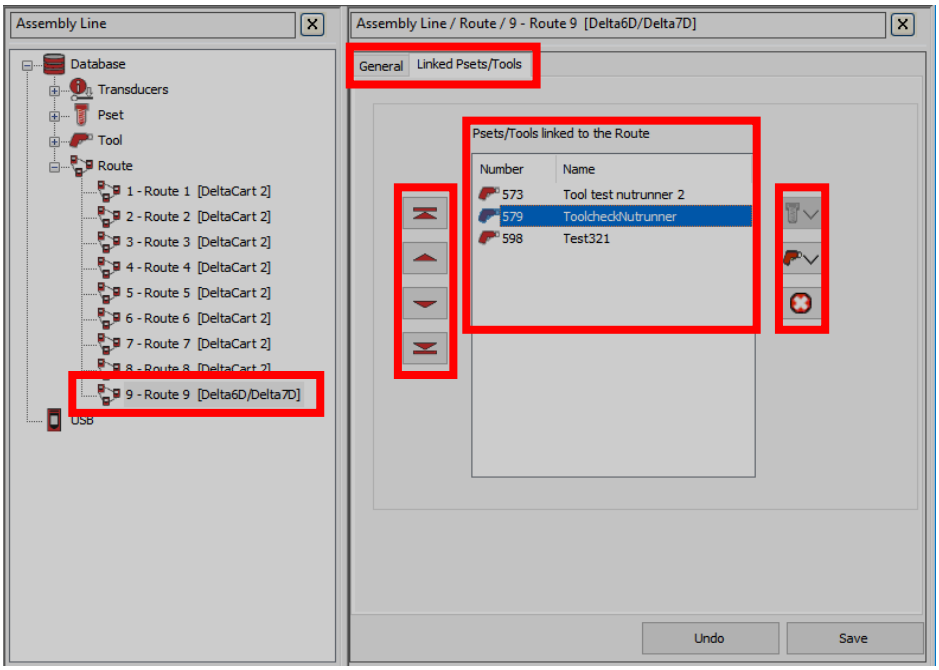


NOTE: By default, the Route **Number** assigned is the first number available. It is not possible to use numbers already assigned to other Routes.

After clicking on ***OK***, the Route data are displayed on the right side of the window in the *General* tab (see figure below):



Select the *Linked Psets/Tools* tab to add *Psets* or *Tools* to the *Route* (up to 1000 items):

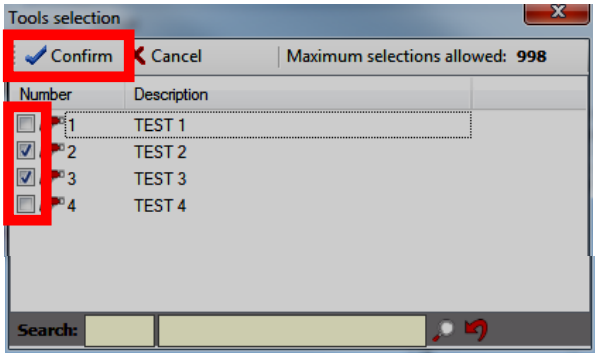


Configure the Route as described below:

- Click on the  icon on the right to add *Pset(s)*, or click on the  icon to add *Tool(s)* to the *Route(s)*.
- Click on  icon on the right to delete an item from the *Route(s)*.
- Click on a Pset/Tool and use the arrows  icons on the left to change the order of the Psets/Tools linked to the Route.
- Click on the ***Save*** button to save the data.

NOTE: The Route can contain either *Tools* or Psets. After adding a *Tool* to an empty *Route*, the *Pset* icon is disabled and vice versa. A *Route* of *Psets* can include only Psets for *Quality tests* (test on joint and joint analysis); it cannot include *Psets* for *Testing Tools*.

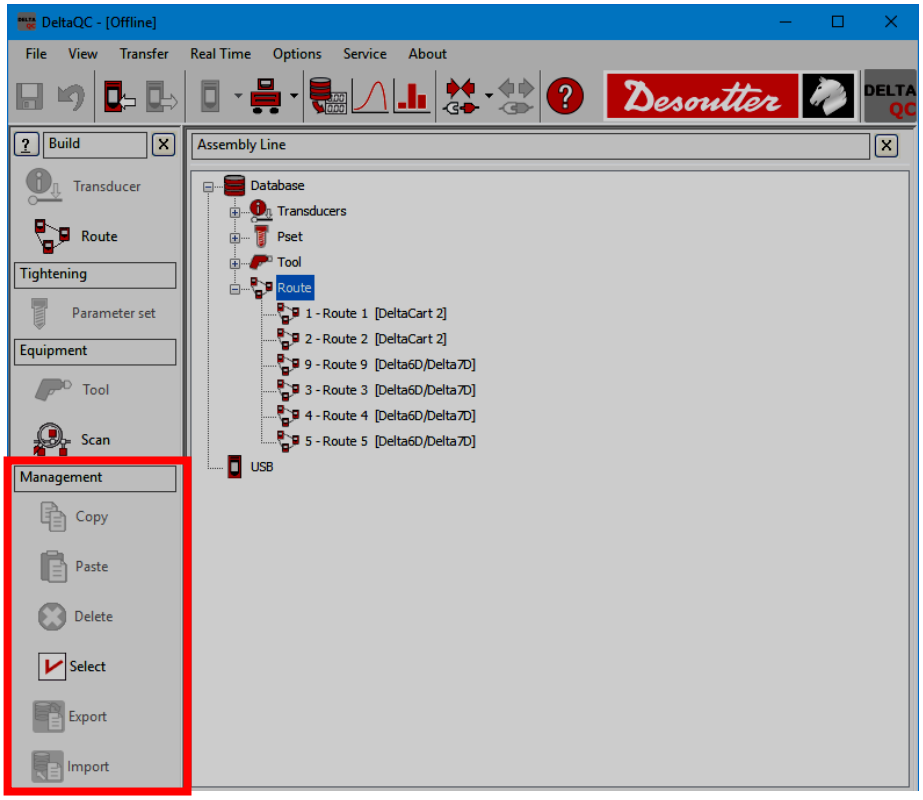
When adding an item to the *Route*, the following screen is shown:



Select the Pset(s)/Tool(s) to add to the *Route* and click on ***Confirm*** to save.

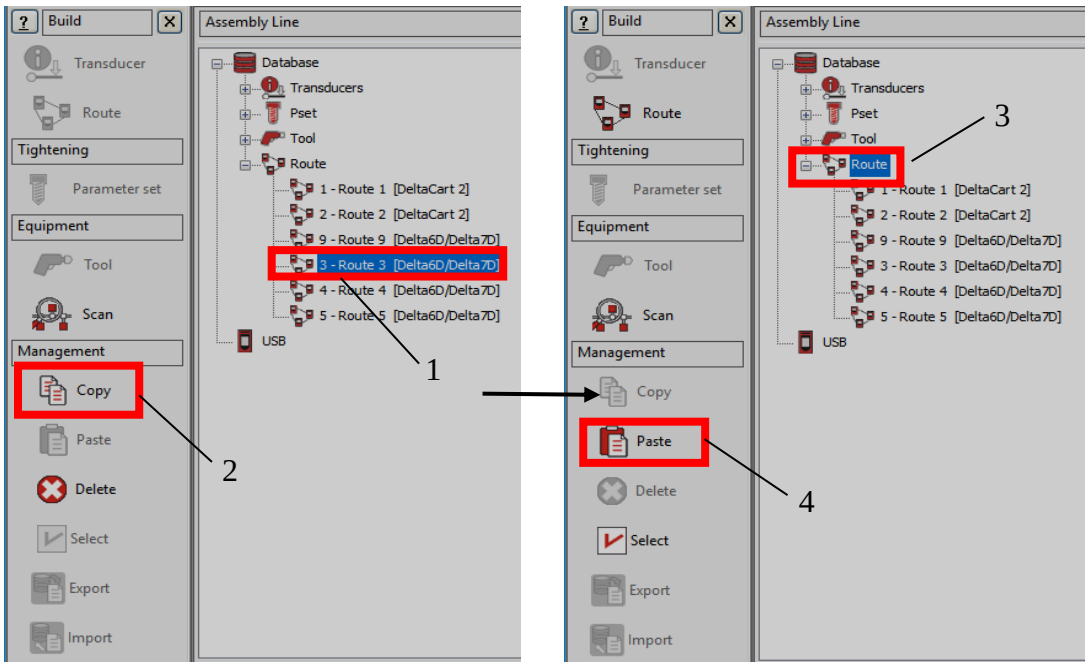
NOTE: If a large number of items is present in the list, use the *Search function* to filter it

The ***Management*** *area* (placed in the *Build area*) provides also the commands to *copy* and *paste* or *delete* one or more routes.



Copy and *paste* a Route as described below (refer to the following figures):

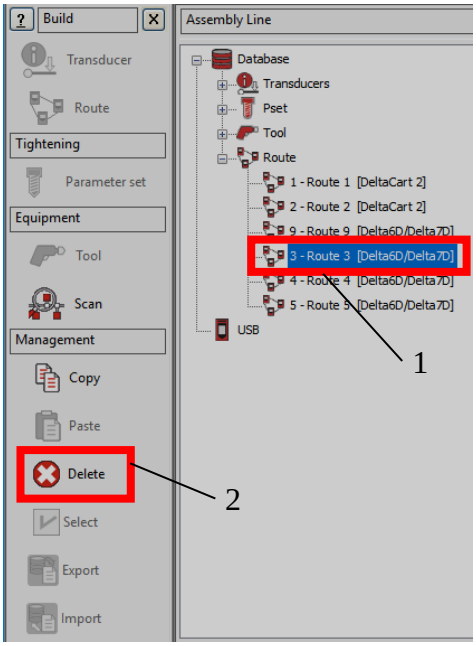
1. In the *Assembly Line* area, select a Route from the list.
2. In the *Management* area, click on the ***Copy*** icon.
3. In the *Assembly Line* area, click on the ***Route*** node.
4. In the *Management* area click on the ***Paste*** icon.



Delete one Route as described below (refer to the figure on the right):

1. In the *Assembly Line* area, select the Route to delete.
2. In the management area, click on the ***Delete*** icon.

Finally, click on ***Yes*** in the warning message appears to confirm the deletion of the selected Route.



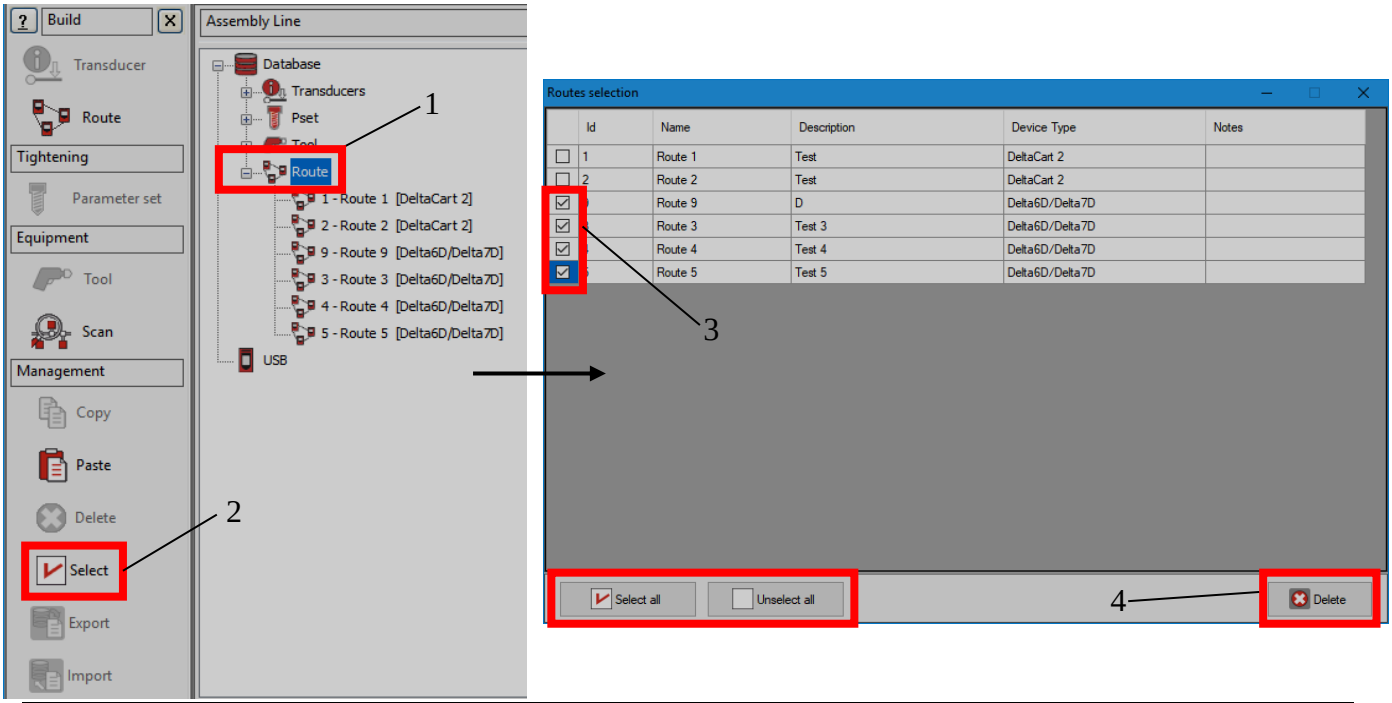
Delete more Routes at the same time as described below (refer to the following figures):

1. In the *Assembly Line* area, click on the ***Route*** node.
2. In the *Management* area click on the ***Select*** icon.
3. In the *Routes selection* pop-up that opens, select the Routes to delete.

NOTE: In the lower section of the pop-up, the ***Select all*** and the ***Unselect all*** buttons allow respectively to select all the available Routes and to unselect all the Routes.

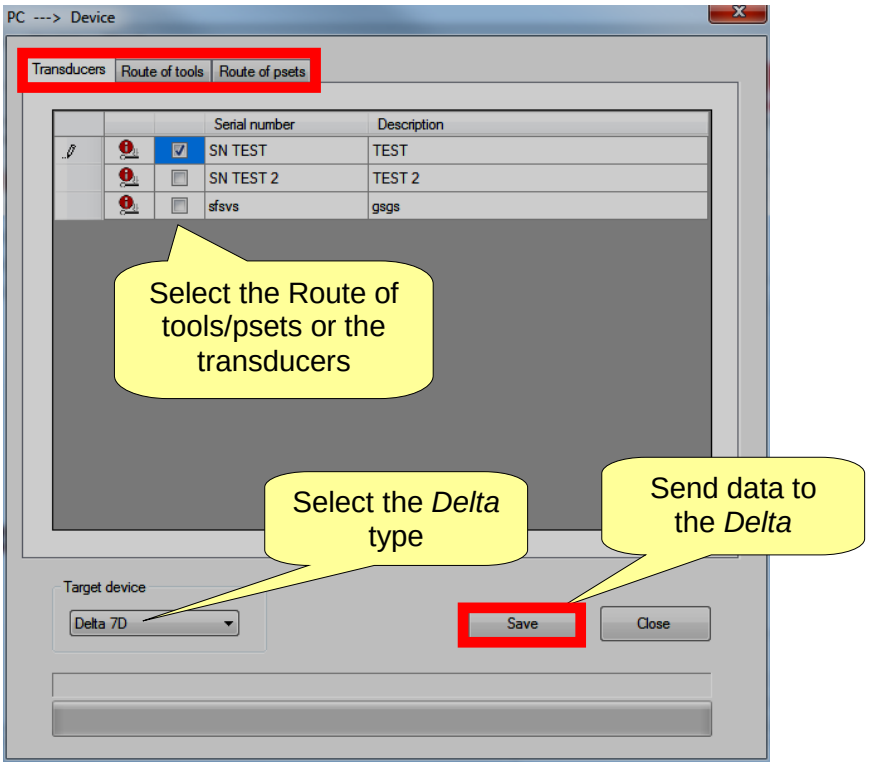
4. In the *Routes selection* pop-up, click on the ***Delete*** button.

Finally, click on ***Yes*** in the confirmation message that appears to confirm the deletion of the selected Routes.



10.2 Transfer the Offline Data to the Delta

Once the *Route* is defined in the *Offline mode* either click on the icon **Transfer PC ---> Device** placed in the main toolbar (refer to the paragraph "*Toolbar*" for further details)  or select the ***Transfer*** → ***PC ---> Device*** from the Menu List (refer to the paragraph "*Menu list*" for further details) to transfer it to the *Delta*:



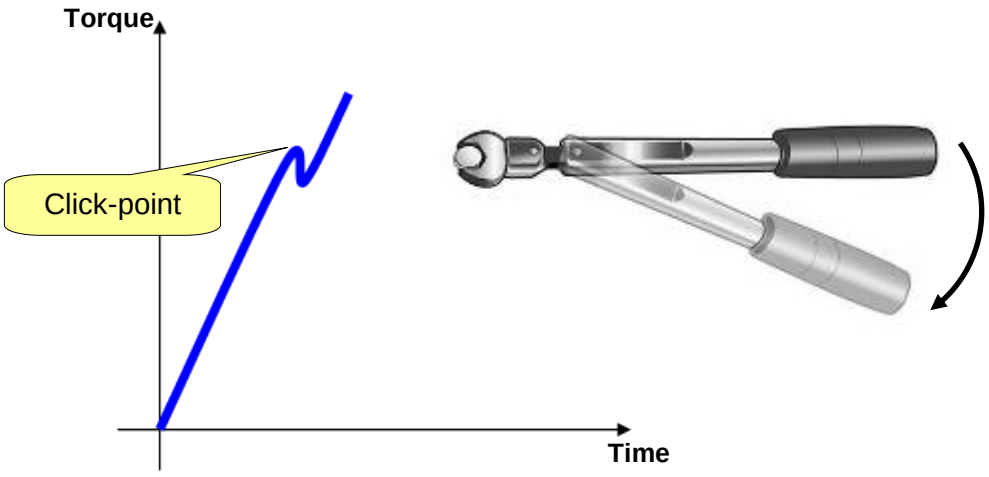
Select either the *Route of tools/psets* or the *transducers* and click on ***Save*** to send data to the *Delta*.
It is possible to send one Route of tools and/or one Route of Psets to each Delta.
It is also possible to transfer to the Delta the analog transducers defined offline.

NOTE: When the *Route* is sent to the *Delta*, all of the Psets / Tools / Transducers previously stored in the Delta memory are deleted. If the user wants to keep a copy of the existing Psets and Tools currently in use on the *Delta*, save them on the database before sending the Route to the Delta.
Refer to the paragraph "*Online mode*" for further details.

11 TESTING CLICK-WRENCHES

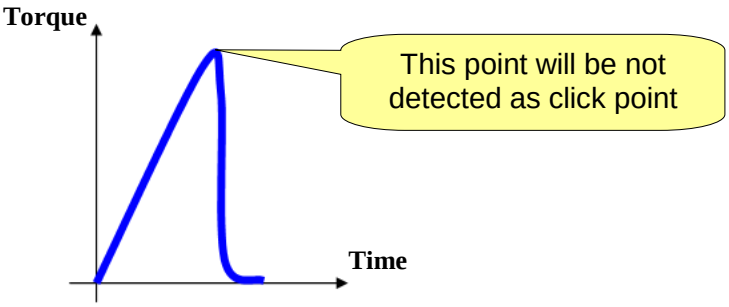
A *Click Wrench* is typically tested on a PST connected to the *Delta*.

The final goal of the *Click Wrench* test is to detect the “click-point” of the wrench:



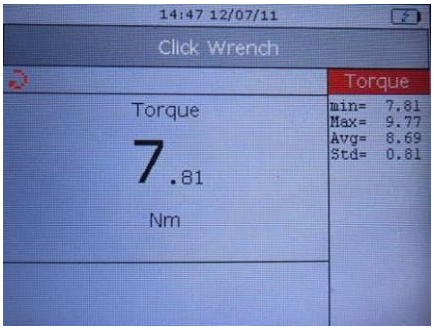
The click-point is detected when the torque drops down and then increases again, producing the typical shape of the "*click*" phenomenon (refer to the following examples):

If the torque only drops down to zero (without increasing again) after a peak-point (as shown in the figure below), the click-point is not detected. For this reason, slip-wrenches cannot be tested with this method (slip-wrenches should be tested with the *Peak Test* (refer to the paragraph "*Peak Test*" for further details)):



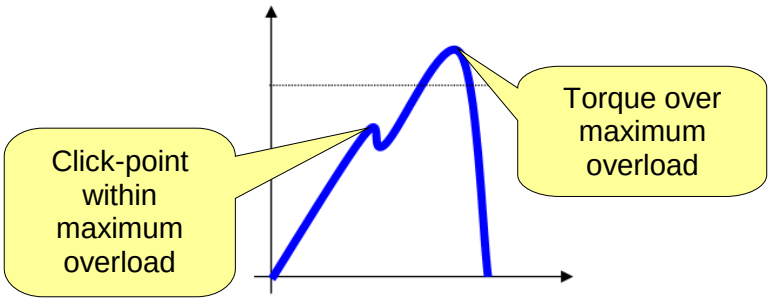
If the test ends and the click-point is not detected, the message "***not detected***" is shown on the display. In this case, the result is the "*torque absolute peak*".

During the test, the torque result is displayed:



The LEDs are activated as follows:

OK (green) LED	**Delta 1D**: Click-point not exceeding the maximum transducer overload. Torque status is marked as *OK*. **Delta 6D/7D**: Click-point within the torque limits. Torque status is marked as *OK*. Torque status is marked as *OK*.
Low (yellow) LED	Click-point detected under the minimum torque. Blinking if click-point is not detected.

High (red) LED	The following results give a *Not OK* result: - Torque over the transducer overload - Torque out from the limits (not for ***Delta 1D***) - Torque status is marked as *Not OK* **NOTE**: The torque status is marked as *Not OK* even if torque goes over the transducer overload after that the click-point was detected within the limit: 

The buzzer is activated as follows:

Buzzer	High tone when click-point detected within torque limits; otherwise, lower tone.

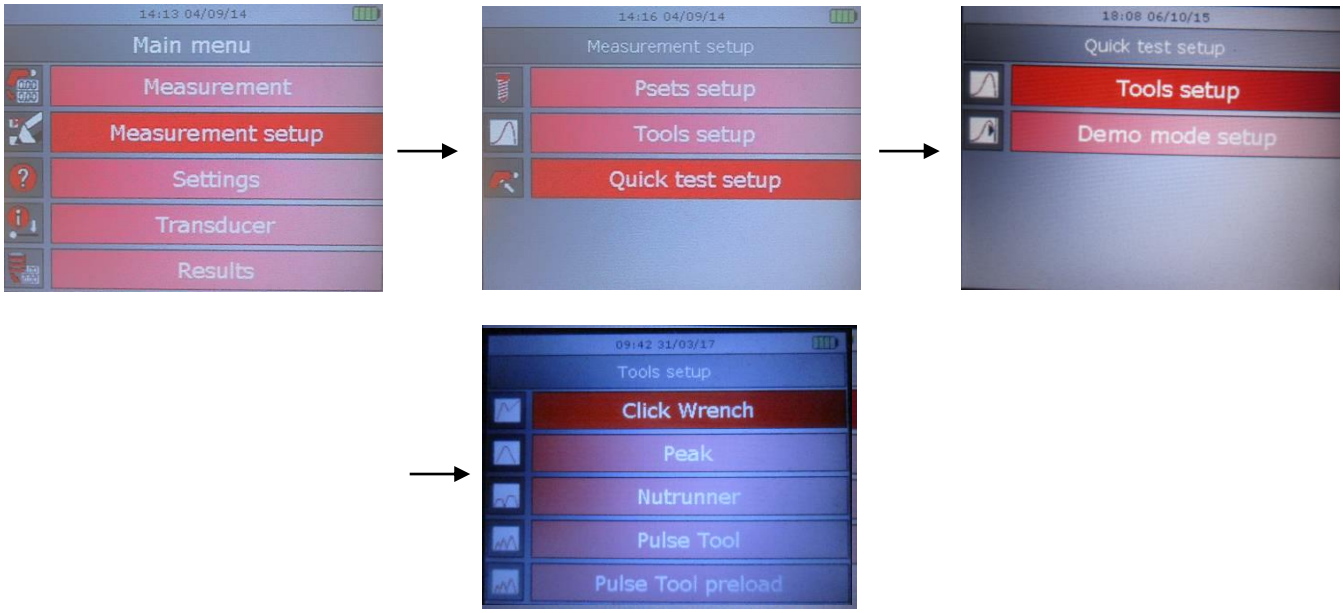
11.1 Test Setup for Click-wrench Test

- **For Delta 6D/7D**, all of the parameters described in this paragraph are stored inside the *Pset*. See below for more information about the specific parameters of the click-wrench and refer to the paragraph "*Pset*" for further details about the Pset.

  For the *Quick Test* mode, the function is the same of the ***Delta 1D*** described below.

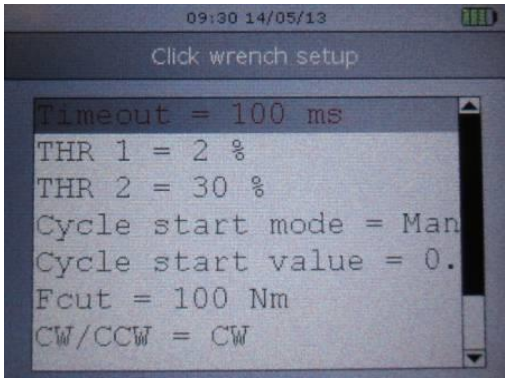
- **For Delta 1D** (and **Delta 6D/7D**) **Quick Test**, all of the parameters described in this paragraph are entered directly on the Delta menu, by selecting ***Measurement Setup*** → ***Tools setup*** → ***Click Wrench*** menu:

Delta 1D – Quick Test Setup



Delta 6D/7D - Quick Test Setup

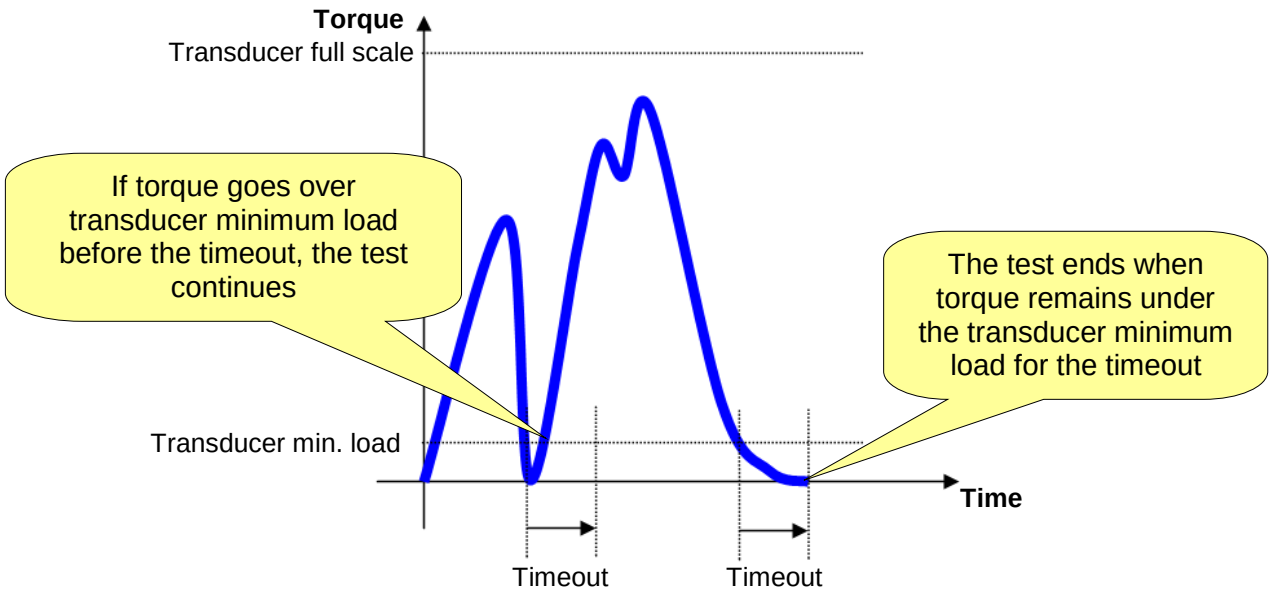
In both the above cases, the following screen is displayed:



Scroll the parameters by means of the ***UP***/***DOWN*** keys; then click on ***Enter*** to edit.

11.1.1 Timeout

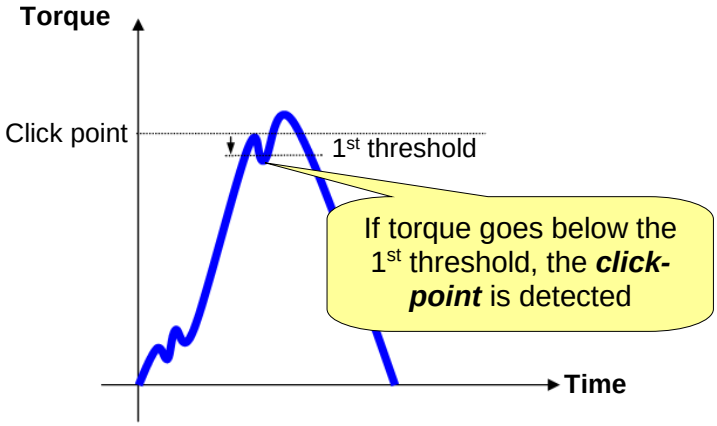
The "***Timeout***" defines the end of the test. When the torque goes and remains below the transducer minimum load (that is normally the 10% of the transducer full scale) for the given timeout, the test ends.



NOTE: The "***Timeout***" can be set from *100 ms* up to *5000 ms*. The default value is *100 ms*.

11.1.2 1st threshold (THR 1)

The "***1st threshold***" is used to detect the click point of the wrench.
The torque must continuously decrease from the measured peak at least for the specified value, in order that it can be considered the ***click point***.
The *1st threshold* default value is 2%, and it is calculated on the relative torque peak value reached during the test:

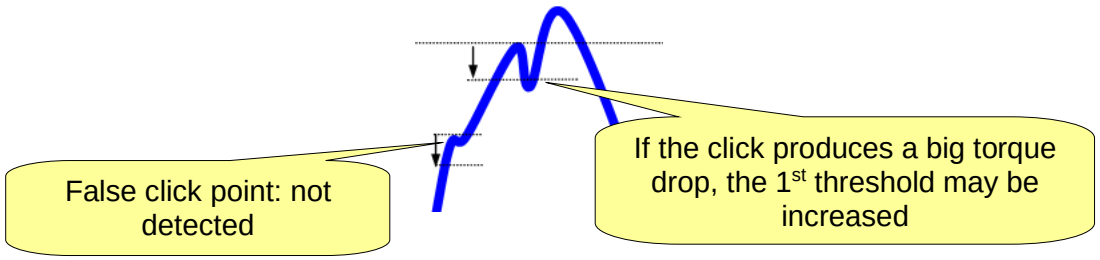


For instance, if the peak is 100Nm and the *1st threshold* is set to 10%, the torque must go under 90 Nm, in order that it can be considered the ***click point***.

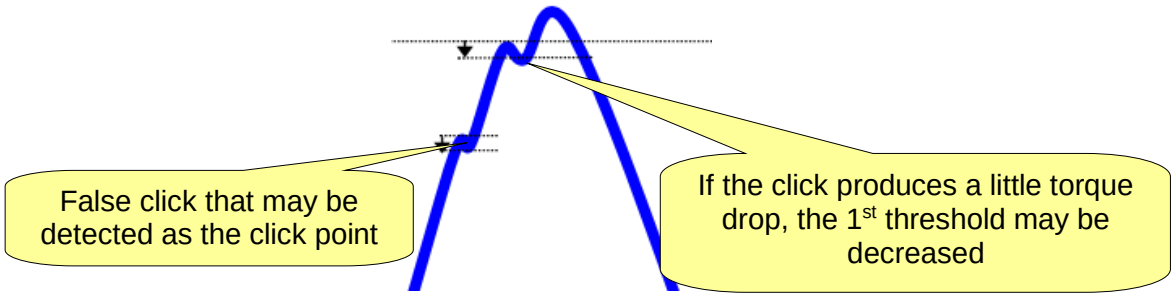
The default value suits many of the click-wrenches.

However, it might be necessary to adjust it according to the specific wrench that is testing.

For example, if the ***click point*** produces a big drop in the torque, this *1st threshold* may be increased, in order to avoid detecting false *click points* at lower toque values (refer to the following figure):



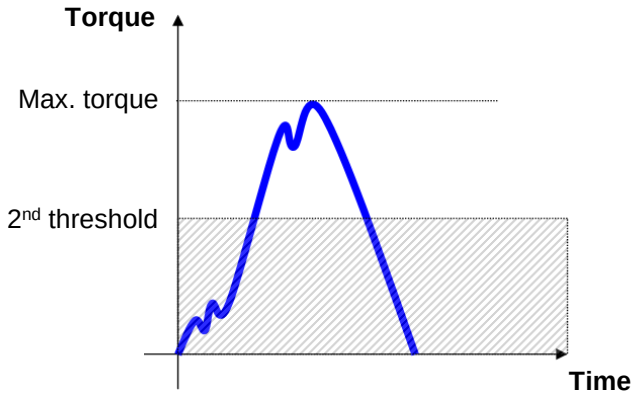
On the other side, if the ***click point*** produces only a little drop in the torque, this *1st threshold* may be decreased in order to detect the *click point*:



NOTE: By decreasing the threshold, the risk to detect false *click points* increases.

To summarize, the *1st threshold* must be set neither too low (in order to avoid the detection of false click) nor too high (in order to detect the real click point).

11.1.3 2nd threshold (THR 2)



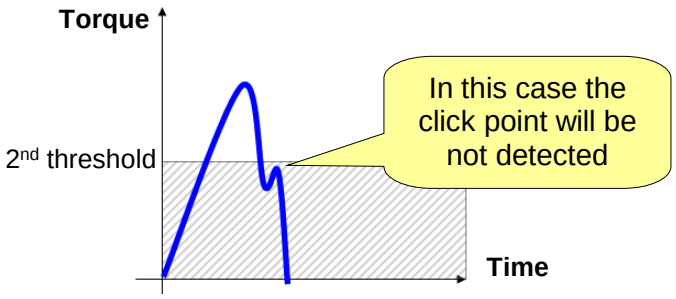
The "***2nd threshold***" is used to exclude all the part of the curve below a certain value from the analysis, where false click may occur if the operator movement is not enough steady.

The *2nd threshold* default value is 30% and it is calculated on the maximum torque value reached during the test.

Under the specified threshold the torque is not considered by the Delta.

NOTE: All of the "click" phenomena, including the point when the torque starts increasing again after the "click", must be over the 2nd threshold.

If not, the ***click point*** is not detected:



11.1.4 Cycle Start Mode and Cycle Start Value

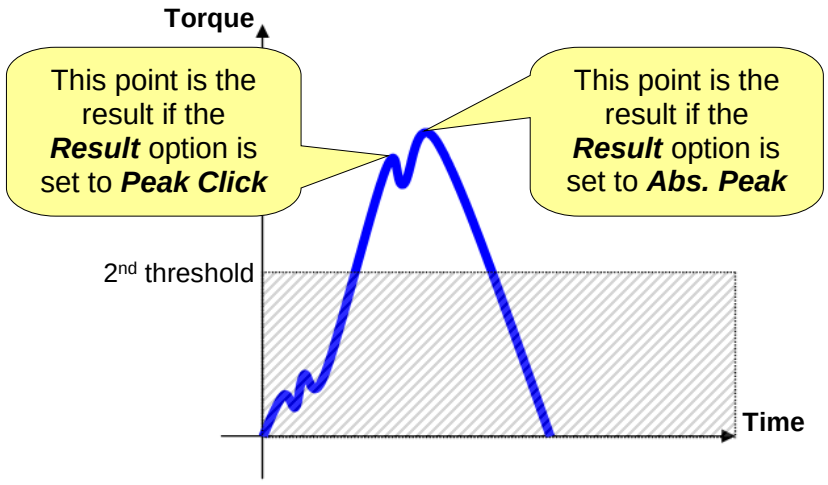
Setting the ***Cycle Start Mode*** to ***Automatic***, the Delta automatically sets the "*Cycle Start"* to the 10% of the capacity of the transducer connected.

Setting the ***Cycle Start Mode*** to ***Manual***, the ***Cycle Start Value*** must be specified.

11.1.5 Filter frequency

The "***Filter frequency***" can be set to 100, 200, 500 or 1000 Hz. This is applied to the samples measured by the torque transducer to filter the noise. The default value 100Hz: it is a convenient value for most of the click-wrenches. However, it may be necessary either to increase the value for wrenches having a click-point very "fast" or decrease in cases where the noise in the measurement is too strong and interferes with the click-point detection.

11.1.6 Result



The "***Result***" defines the peak that must be taken as torque result. If the ***Peak Click*** is selected, the first peak (*click point*) is considered as result of the test; otherwise, if the ***Abs. Peak*** is selected, the maximum torque is considered as result.

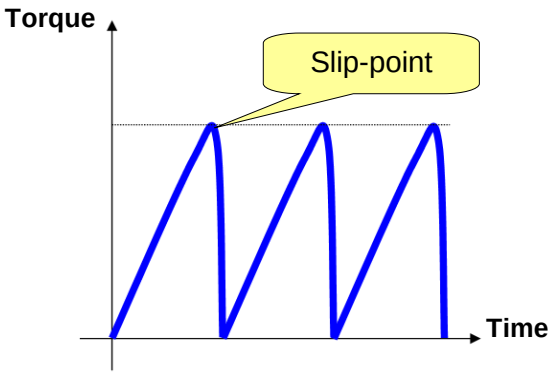
12 PEAK TEST

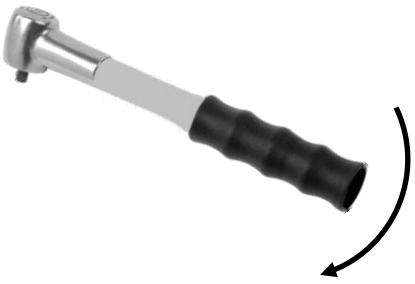
The "***Peak Test***" provides the maximum torque measured during the test.
The "*slip-wrenches"* test is the typical application of this method (for further details, refer to the paragraph "*Testing Slip-wrenches*").

12.1 Testing Slip-wrenches

A *Slip-wrench* is typically tested on a PST connected to the *Delta*.

The "*slip-point*" is the peak value of the curve (refer to the figure below):





The torque result is the peak value measured during the test.

During the test, the torque result is displayed:

NOTE: The filter frequency for peak detection test is *100 Hz*.

The LEDs are activated as follows:

OK (green) LED	**Delta 1D**: Torque peak detected. Torque status is marked as *OK*. **Delta 6D/7D**: The torque green LED is activated if the peak is detected. Torque result within the torque limits. Torque status is marked as *OK*. The angle green LED is activated if the angle is within the angle limits.
Low (yellow) LED	Torque (angle) below the minimum torque (angle).
High (red) LED	The following results give a *Not OK* result: - Torque over the transducer overload - Torque (angle) out from the limits (not for ***Delta 1D***) - Torque (angle) status is marked as *Not OK*

The buzzer is activated as follows:

Buzzer	High tone when green led is activated; otherwise, lower tone.

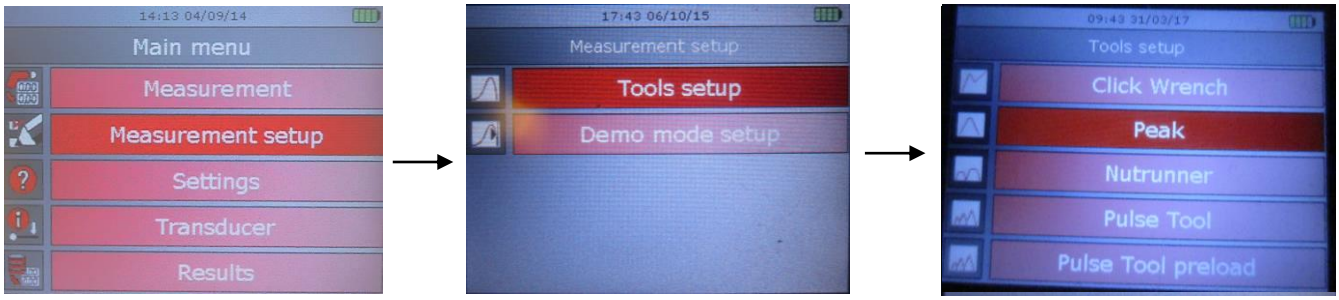
NOTE: The torque LEDs and/or angle LEDs are activated respectively if "*Only Torque*" and/or "*Only Angle*" are selected in correspondence of the *Check Type* in the *Main Pset parameters* (refer to the paragraph "*Main Parameter and Control Strategy*").

12.2 Test Setup for Peak Test

- **For Delta 6D/7D**, all of the parameters described in this paragraph are stored inside the *Pset*. See below for more information about the specific parameters of the peak test and refer to the paragraph "*Pset*" for further details about the Pset.

  For the *Quick Test* mode, the function is the same of the ***Delta 1D*** described below.

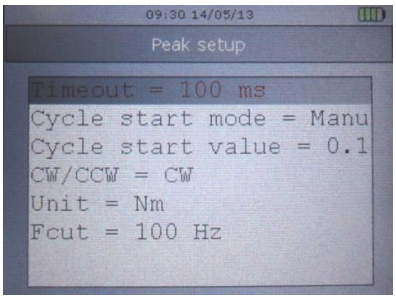
- **For Delta 1D** (and **Delta 6D/7D**) **Quick Test**, all of the parameters described in this paragraph are entered directly on the Delta menu, by selecting ***Measurement Setup*** → ***Tools setup*** → ***Peak*** menu:



Delta 1D – Quick Test Setup

Delta 6D/7D - Quick Test Setup

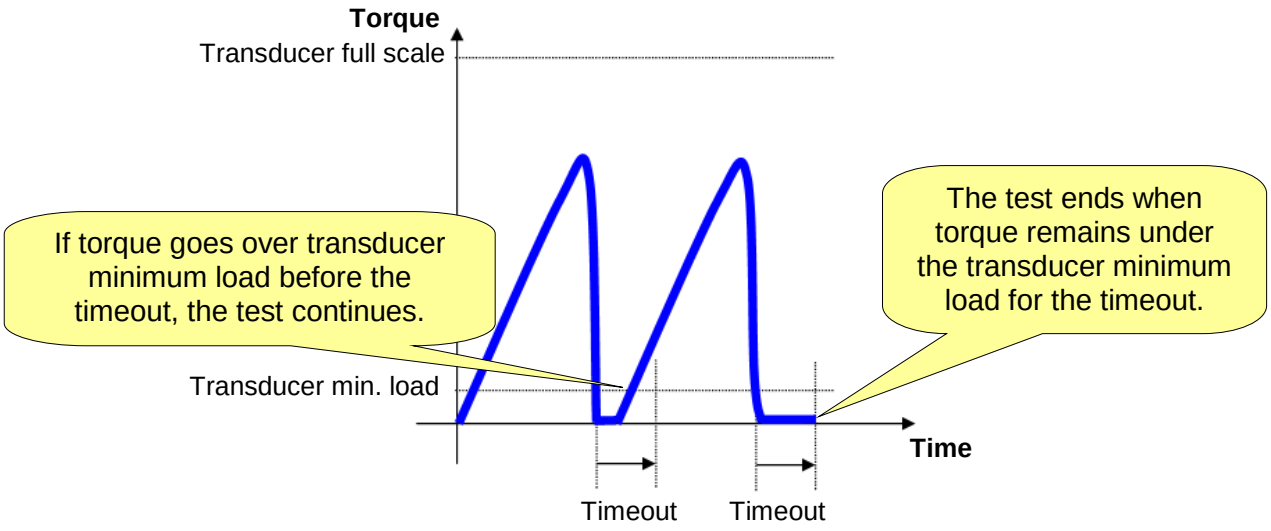
In both the above cases, the following screen is displayed:



Scroll the parameters by means of the ***UP***/***DOWN*** keys; then click on ***Enter*** to edit.

12.2.1 Timeout

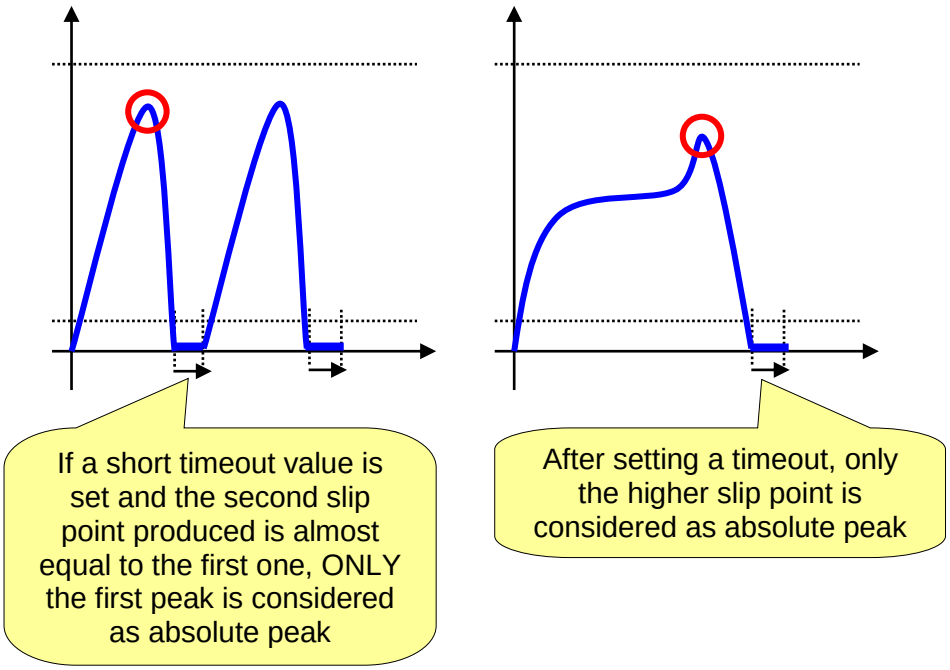
The "***Timeout***" defines the end of the test. When the torque goes and remains below the transducer minimum load (that is normally the 10% of the transducer full scale) for the given timeout, the test ends.



NOTE: The "***Timeout***" can be set from *100 ms* up to *5000 ms*. The default value is *100 ms*.

NOTE: For *slip-wrenches*, the operator should operate the wrench until the slip point is reached; once it is reached, the operator must stop rotating the wrench.

When a short timeout value is set (and the operator continues to rotate the wrench) more than one slip point is produced. In this case ONLY the absolute peak produces a test result. If the second slip point produced is almost equal to the first one, the first peak is considered as absolute peak (refer to the graph below):



12.2.2 Cycle Start Mode and Cycle Start Value

Setting the ***Cycle Start Mode*** to ***Automatic***, the Delta automatically sets the "*Cycle Start"* to the 10% of the capacity of the transducer connected.

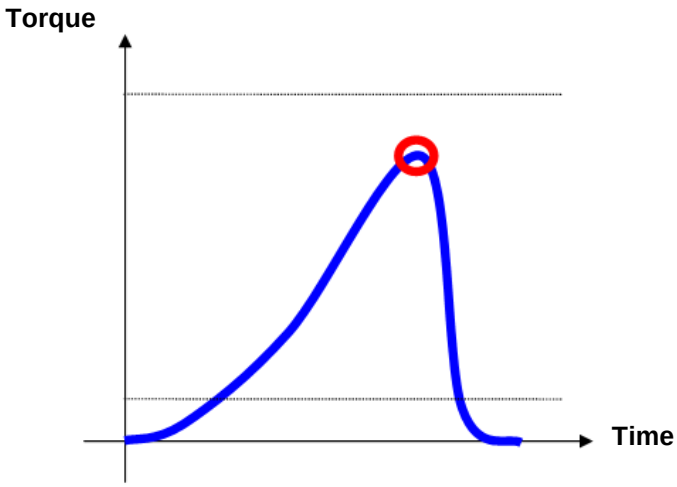
Setting the ***Cycle Start Mode*** to ***Manual***, the ***Cycle Start Value*** must be specified.

13 TESTING NUTRUNNERS

"***Nutrunners***" are all of those tools that provide real torque to the joint (like battery tools, pneumatic tools (not impulse) and electronic controlled tools).

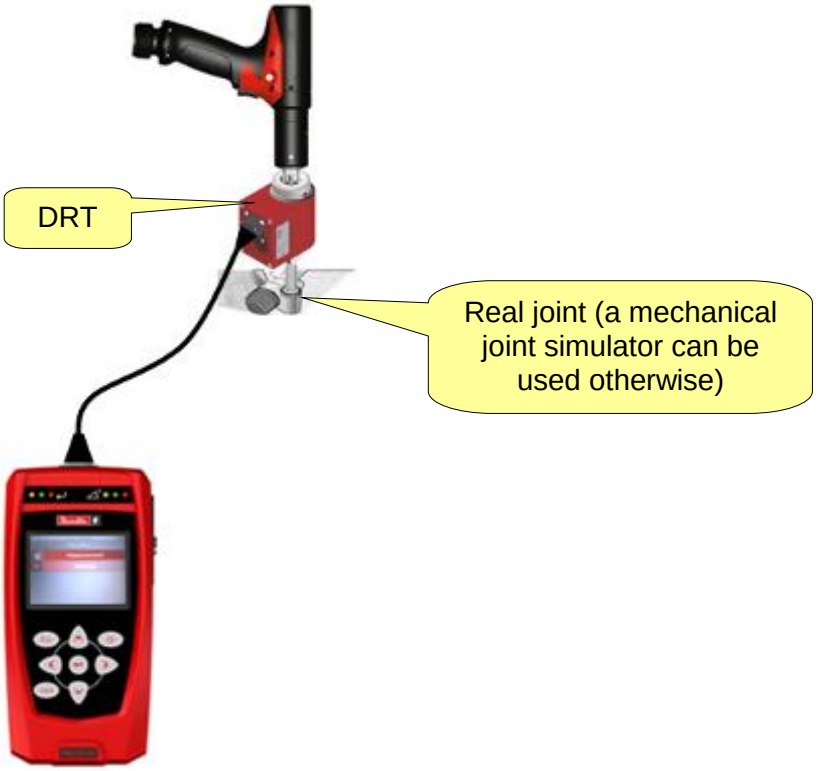


For *Nutrunner Test*, the torque result shown by the *Delta* is the peak value measured during the test.



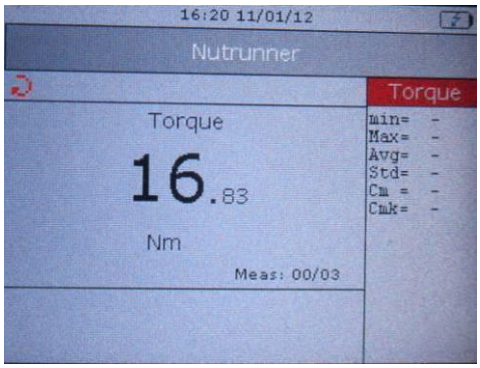
NOTE: In case of multiple peaks, the result is the first peak. To be detected as a *Peak*, this must satisfy the two thresholds specified (refer to the paragraph *"1st threshold and 2nd threshold (THR 1 and THR 2)"* for further details).

A *Nutrunner* is typically tested on a DRT (connected to the *Delta*) with a mechanical joint simulator:



A DRT on the real joint (or a mechanical joint simulator) can be used. This also provides the angle measurement:

During the test, the torque result (and the angle for ***Delta 6D/7D***) is displayed:



The LEDs are activated as follows:

OK (green) LED	**Delta 1D**: Torque peak detected. Torque status is marked as *OK*. **Delta 6D/7D**: The torque green LED is activated if the peak is detected. Torque result within the torque limits. Torque status is marked as *OK*. The angle green LED is activated if the angle is within the angle limits.
Low (yellow) LED	Torque (angle) below the minimum torque (angle).
High (red) LED	The following results give a *Not OK* result: - Torque over the transducer overload - Torque (angle) out from the limits (not for ***Delta 1D***) - Torque (angle) status is marked as *Not OK*

The buzzer is activated as follows:

Buzzer	High tone when green led is activated; otherwise, lower tone.

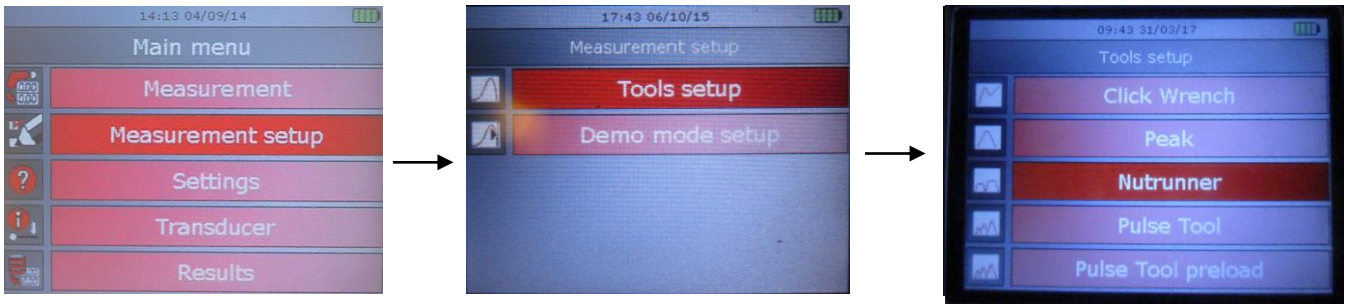
NOTE: The torque LEDs and/or angle LEDs are activated respectively if "*Only Torque*" and/or "*Only Angle*" are selected in correspondence of the *Check Type* in the *Main Pset parameters* (refer to the paragraph "*Main Parameter and Control Strategy*").

13.1 Test Setup for Nutrunner Test

- **For Delta 6D/7D**, all of the parameters described in this paragraph are stored inside the *Pset*. See below for more information about the specific parameters of the nutrunner test and refer to the paragraph "*Pset*" for further details about the Pset.

  For the *Quick Test* mode, the function is the same of the ***Delta 1D*** described below.

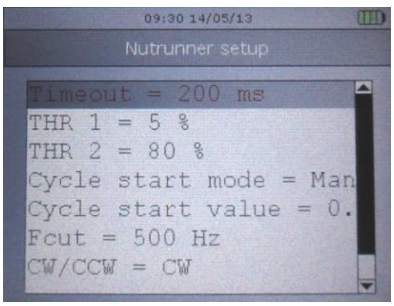
- **For Delta 1D** (and **Delta 6D/7D**) **Quick Test**, all of the parameters described in this paragraph are entered directly on the Delta menu, by selecting ***Measurement Setup*** → ***Tools setup*** → ***Nutrunner*** menu:



Delta 1D – Quick Test Setup

Delta 6D/7D - Quick Test Setup

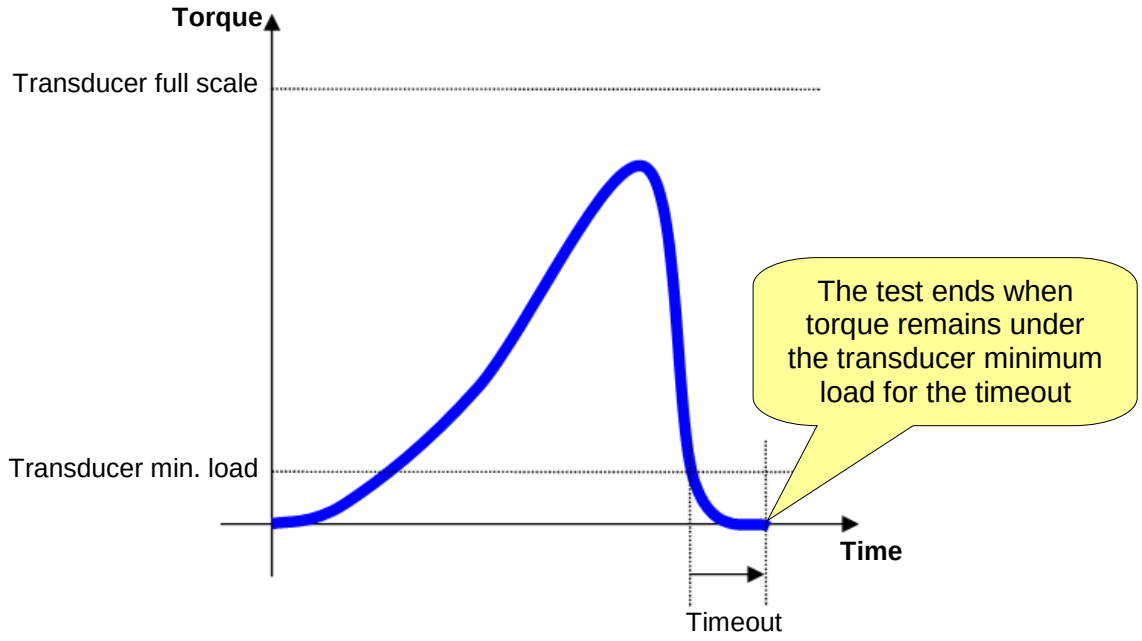
In both the above cases, the following screen is displayed:



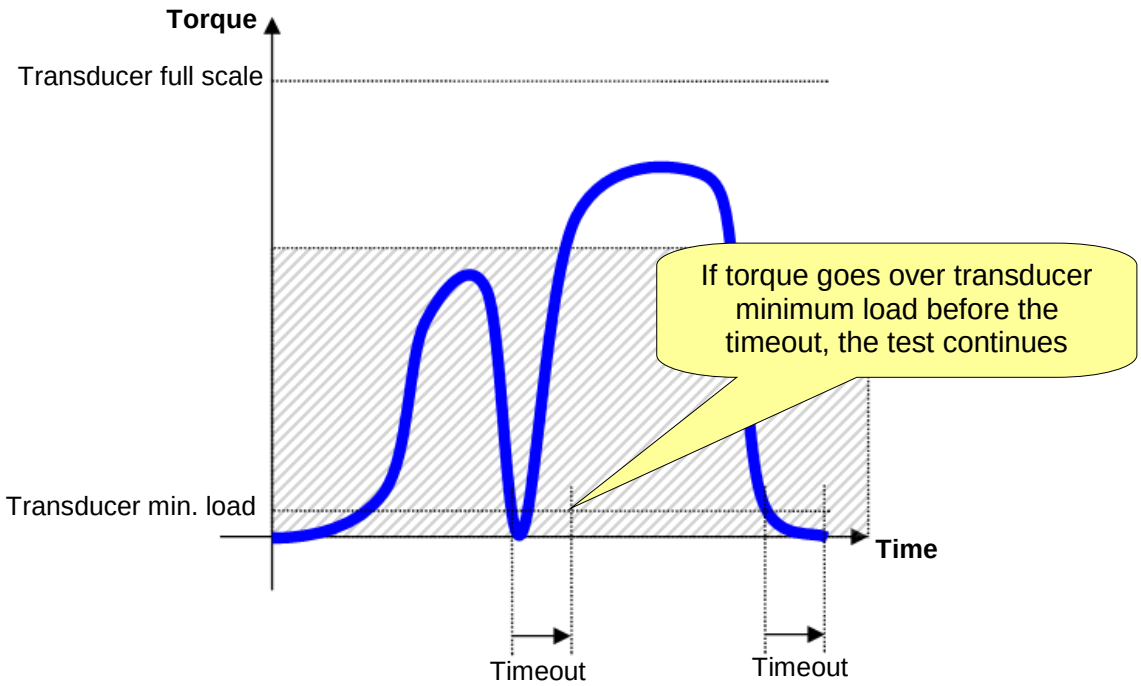
Scroll the parameters by means of the ***UP***/***DOWN*** keys; then click on ***Enter*** to edit.

13.1.1 Timeout

The "***Timeout***" defines the end of the test. When the torque goes and remains below the transducer minimum load (that is normally the 10% of the transducer full scale) for the given timeout, the test ends.



For two-steps tools, the "***Timeout***" allows the tool to switch between the two steps without ending the test.



NOTE: The "***Timeout***" can be set from *100 ms* up to *5000 ms*. The default value is *100 ms*.

13.1.2 Peak monitor

This setting can assume the following values:

- *First peak*: Use this option to have the maximum peak as requested result. This option makes the strategy work in the standard mode. See the “First peak” section for details.
- *Last peak*: Use this option to have the last peak as result even if this is lower than the maximum peak. See the “Last peak” section for details.

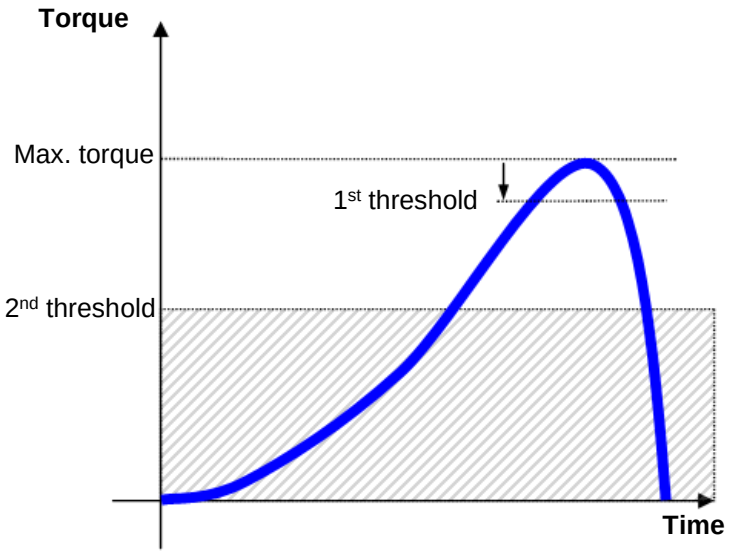
13.1.3 1st threshold and 2nd threshold (THR 1 and THR 2)

These two parameters are set in order to determine the behavior of the Nutrunner strategy. The use of these parameters changes according to the value set for **Peak monitor → First Peak** or **Peak monitor → Last Peak.**

13.1.3.1 First peak

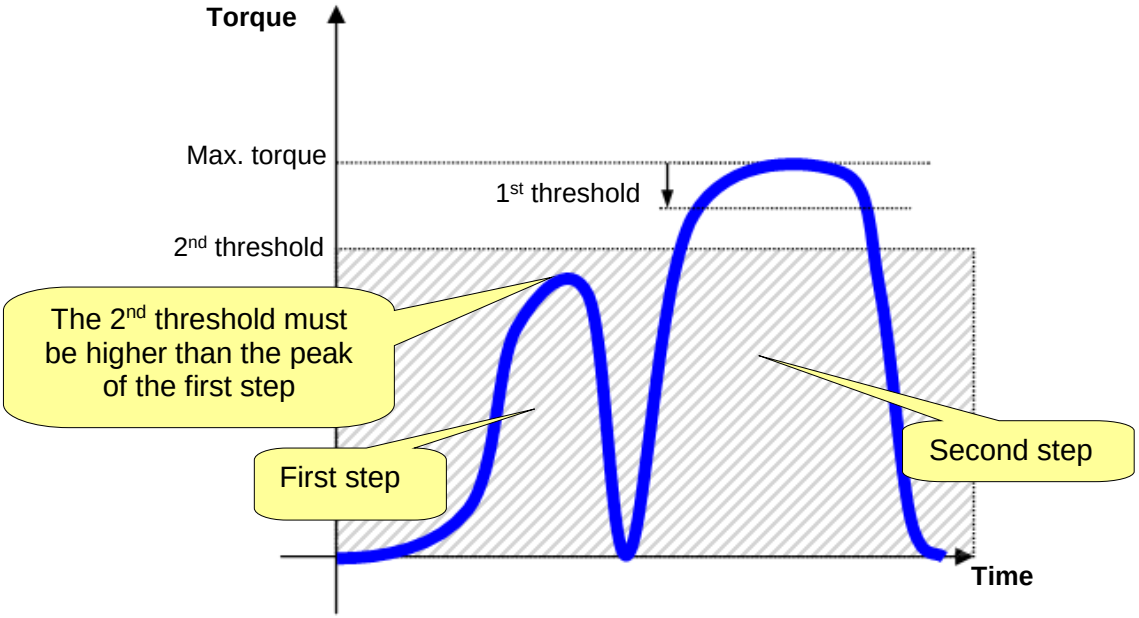
The two thresholds are used to setup the test for the type of tool under test.

The “*1st threshold”* is used to detect the peak value of the torque; the torque must continuously decrease at least by the specified value from the measured peak. It is calculated on the relative torque peak. The default value is 5%.



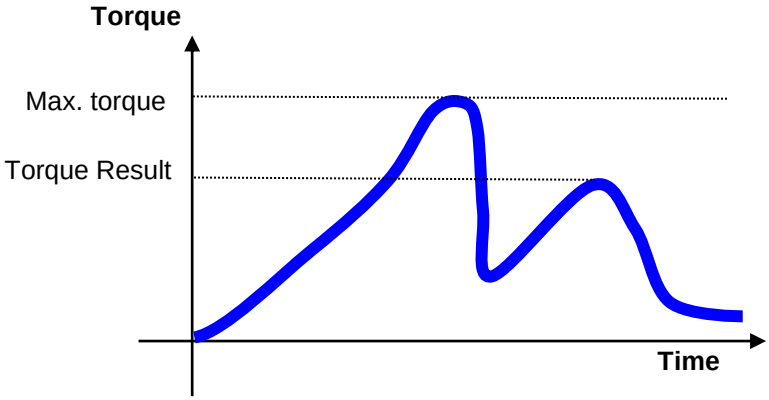
The *“2nd threshold”* is used to exclude from the analysis the part of the curve below a certain torque value. This could be useful to reject a portion of the tightening curve affected by mechanical noise and that may generate spurious results. The default value is 90% and it is calculated on the maximum torque value reached during the test. Under this specified threshold, the torque is not considered by the Delta. For instance, if the peak is 100 Nm and the *1st threshold* is set to 10%, the torque must go under 90 Nm. The default values for both 1st and 2nd threshold suit the behavior of generic, single step nutrunners.

For quickstep or two-step nutrunners, the *2nd threshold* is used to exclude the first step from the measurement; if not set properly, the peak of the first step is considered as result of the test:



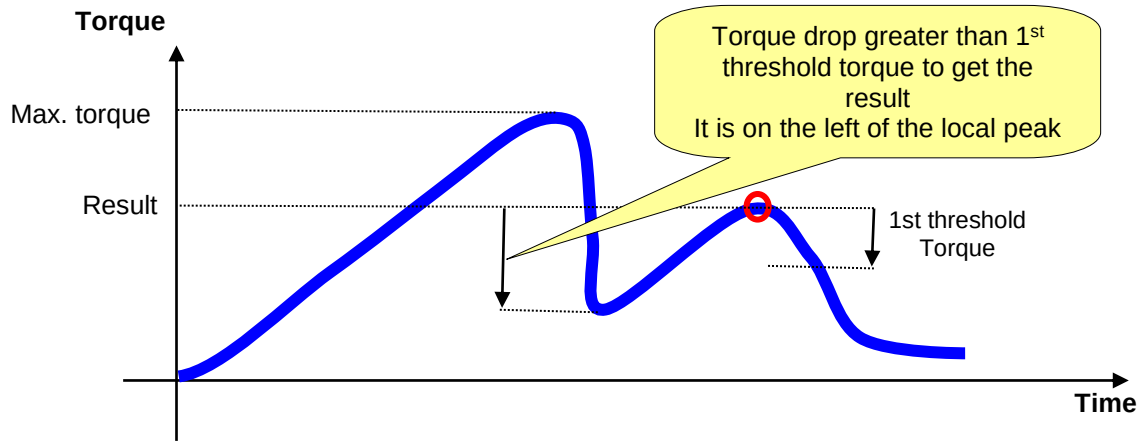
13.1.3.2 Last peak

This option is used mainly to detect the last peak of the tightening even if this is lower than the maximum peak:

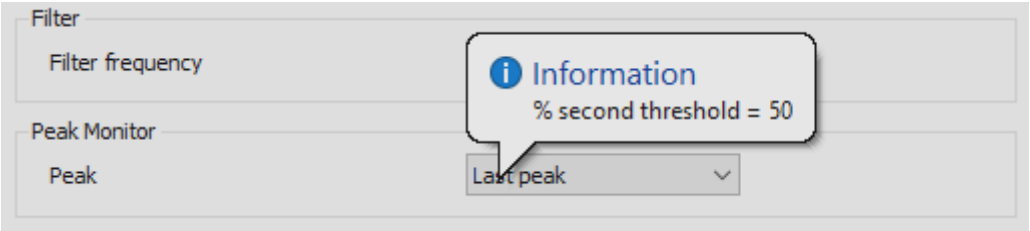


A typical scenario can be represented by the search of the last torque in self-tapping or special screws, where the last torque peak is considered the torque applied to the joint.

The "*1st threshold"* is used to detect the torque result; the torque must continuously decrease at least by the specified percentage value from the measured peak. The default value is 10%. For example, if the peak is 100 Nm and the *1st threshold* is set to 10%, the torque drop must be greater than 10 Nm, in this way torque must go under 90 Nm. In this case, the torque drop to determine whether a point is a result is at the left of the local maximum, as shown in the figure below:



The *"2nd threshold"* is used to exclude from the analysis the part of the curve below a certain torque value. This could be useful to reject a portion of the tightening curve affected by mechanical noise and that may generate spurious results. The default value is 50% and it is calculated on the maximum torque value reached during the test. Under this specified threshold, the torque is not considered by the Delta. If the "Last peak" option is selected, the following popup message is shown in DeltaQC:



NOTE: The "Last peak" option in the "Nutrunner" strategy is available only on Delta 6D and 7D for Psets belonging to the **Measurement** → **Tools** menu

NOTE: It is recommended to set the "End cycle time" at 2 sec when the "Last peak" option is enabled (see "Timeout options" for details)

13.1.4 Cycle Start Mode and Cycle Start Value

Setting the ***Cycle Start Mode*** to ***Automatic***, the Delta automatically sets the "*Cycle Start"* to the 10% of the capacity of the transducer connected.

Setting the ***Cycle Start Mode*** to ***Manual***, the ***Cycle Start Value*** must be specified.

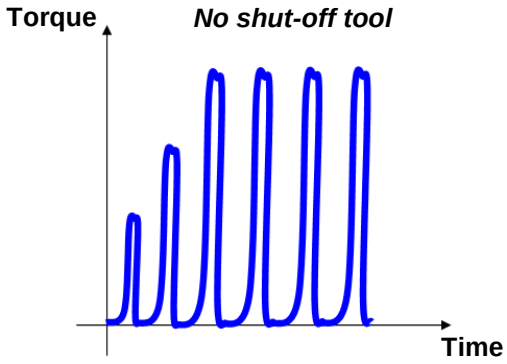
13.1.5 Filter frequency

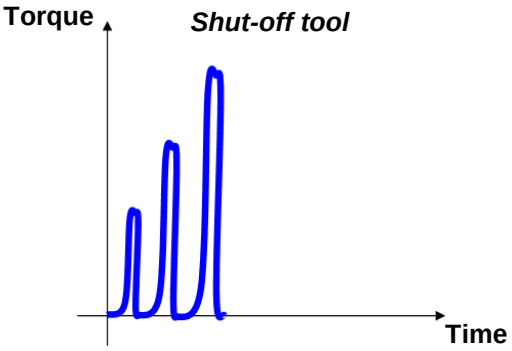
The "***Filter frequency***" can be set to 100, 200, 500, 1000, or 2000 Hz. This is applied to the samples measured by the torque transducer to filter the noise. The default value 500Hz. However, it may be necessary to increase the value for certain tools where the default value does not suit the specific tool characteristics.

14 TESTING PULSE TOOLS

"***Pulse Tools***" provide a series of pulses to tighten the joint.

A *Pulse Tool* may be tested on a PST connected to the *Delta*:





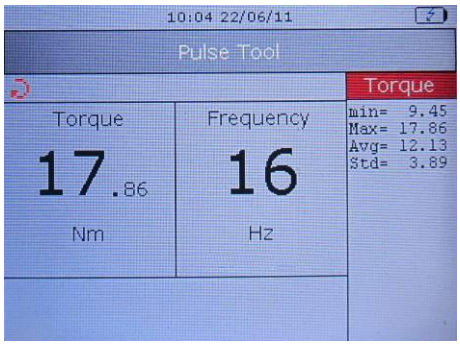
The test can be also performed on the real joint by adding a DRT between the tool and the joint.

In this case, the tool (with or without shut-off valve) is tested in the same configuration:

WARNING: ***"Impact Tools"*** cannot be tested on DRT / FCT.

During the test, the torque result is displayed.

The ***Delta 6D/7D*** models show the frequency of the pulses:



NOTE: The filter frequency for *Pulse Tools* test is *2 kHz*.

The LEDs are activated as follows:

OK (green) LED	**Delta 1D**: Peak value not exceeding the maximum transducer overload. Torque status is marked as *OK*. **Delta 6D/7D**: Peak within the limits. Torque status is marked as *OK.*
Low (yellow) LED	Torque detected below the minimum torque.
High (red) LED	The following results give a *Not OK* result: - Torque over the transducer overload - Torque out from the limits (not for ***Delta 1D***) - Torque status is marked as *Not OK*

The buzzer is activated as follows:

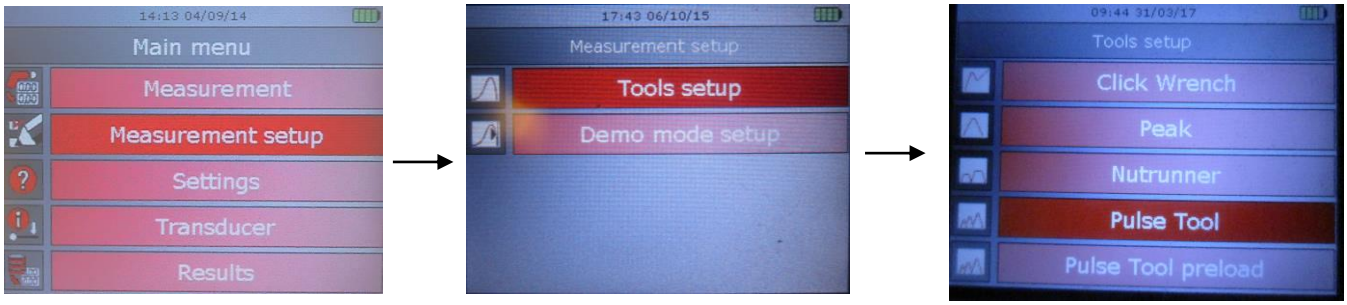
Buzzer	High tone when green led is activated; otherwise, lower tone.

14.1 Test Setup for Pulse Tool Test

- **For Delta 6D/7D**, all of the parameters described in this paragraph are stored inside the *Pset*. See below for more information about the specific parameters of the Pulse Tool test and refer to the paragraph "*Pset*" for further details about the Pset.

  For the *Quick Test* mode, the function is the same of the ***Delta 1D*** described below.

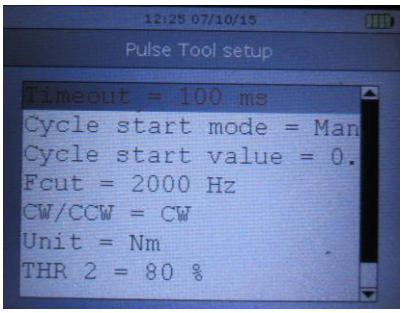
- **For Delta 1D** (and **Delta 6D/7D**) **Quick Test**, all of the parameters described in this paragraph are entered directly on the Delta menu, by selecting ***Measurement Setup*** → ***Tools setup*** → ***Pulse Tool*** menu:



Delta 1D – Quick Test Setup

Delta 6D/7D - Quick Test Setup

In both the above cases, the following screen is displayed:

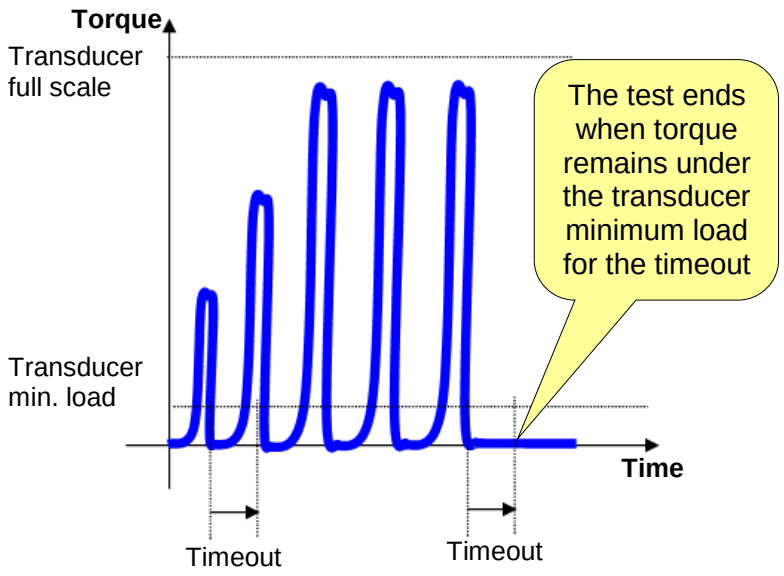


Scroll the parameters by means of the ***UP***/***DOWN*** keys; then click on ***Enter*** to edit.

14.1.1 Timeout

The "***Timeout***" defines the end of the test. When the torque goes and remains below the transducer minimum load (that is normally the 10% of the transducer full scale) for the given timeout, the test ends.

NOTE: The "***Timeout***" can be set from *100 ms* up to *5000 ms*. The default value is *100 ms*.



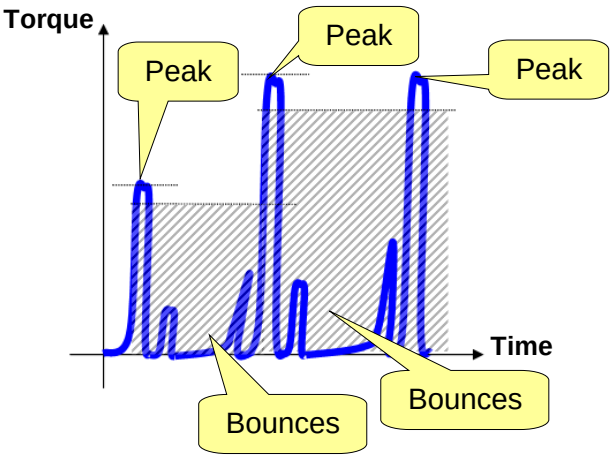
14.1.2 Cycle Start Mode and Cycle Start Value

Setting the ***Cycle Start Mode*** to ***Automatic***, the Delta automatically sets the "*Cycle Start"* to the 10% of the capacity of the transducer connected.

Setting the ***Cycle Start Mode*** to ***Manual***, the ***Cycle Start Value*** must be specified.

14.1.3 Threshold (THR 2)

The "***Threshold***" area is used in order to filter the curve for proper peak detection: this is useful for the frequency calculation. Once detecting every peak, all of the values under the threshold are discarded. This action filters all the bounces always present in a pulse tightening.



NOTE: The "*Threshold*" default value is 80%.

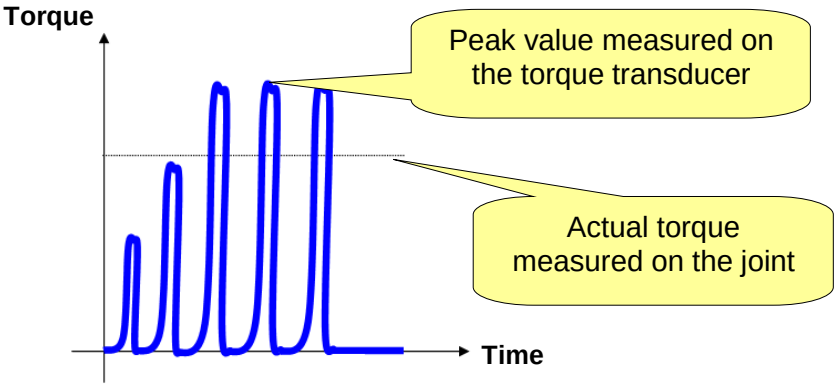
14.1.4 Torque coefficient (K)

Pulse Tools do not provide a continuous torque output; they generate a single high energy pulse with very short duration (≈ 1ms). This set of pulses results in the tightening of a fastener. The final torque reached cannot be measured directly (as for real torque tools), due to the physical characteristics of the tool. The reason is that the *Pulse Tools* provide a very high torque for such a short time that only a part of these peaks is translated into the tightening of the fastener (generating more clamping force).

This depends on many factors such as the bolt mass, friction, the stiffness of the joint, etc...

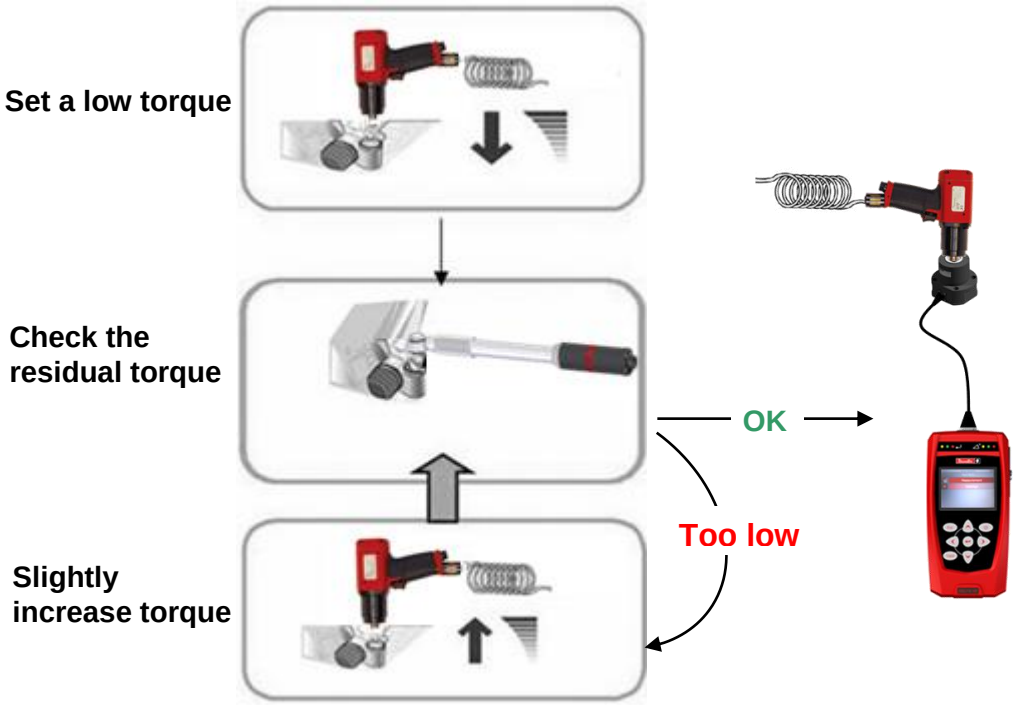
The torque coefficient is used to align the torque measured by the transducer with the real torque produced on the joint.

The torque produced on the real joint is normally lower (*ideally equal*) than the peak torque measured on the transducer. Therefore, this coefficient can be set to values between 100 and 10.000 (the value is entered in thousandths, thus 500 corresponds to 0.500 and 1000 correspond to 1.000).



The only way to evaluate the actual torque is to make a residual torque check on the real joint. The relation between the peak torque measured on the transducer and the actual torque on the joint is affected by all the components: the *Pulse Tools*, the adapters, the transducer and the joint itself.
If any of these components is changed, the relation peak torque – actual torque must be recalculated.

The following process must be used to regulate the *Pulse Tool* in order to provide the desired torque on the real joint and to calculate the proper coefficient K:



For instance, consider a target torque for the joint equal to 100 Nm. Once the tool regulation is made, the residual torque check is equal to 100 Nm.

If the torque measured on the transducer is equal to 120 Nm, the coefficient K corresponds to 100/120 = 0.83; due to the fact that the value is entered in thousandths, the coefficient K is equal to 830.

NOTE: The torque result is multiplied by the K coefficient, but the curves on the DeltaQC software show the torque values measured by the transducer, and not corrected by the K coefficient.

14.1.5 Filter frequency

The "***Filter frequency***" can be set to 100, 200, 500, 1000, or 2000 Hz. This is applied to the samples measured by the torque transducer to filter the noise. The default value 2000 Hz.

15 TESTING PULSE TOOLS WITH PRELOAD

This strategy is used to test the ELRT (Electric Low Reaction Tool) family. It is based on load measurements instead of torque ones. A conversion factor is used to evaluate the torque value starting from the measured load:

WARNING: ***"Impact Tools"*** cannot be tested on FCT.

During the test, both torque and load results are displayed:

NOTE: The default filter frequency for *Pulse Tool Preload* test is *2 kHz*.

The LEDs are activated as follows:

OK (green) LED	**Delta 1D**: Peak value not exceeding the maximum transducer overload. Torque status is marked as *OK*. **Delta 6D/7D**: Peak within the limits. Torque status is marked as *OK.*
Low (yellow) LED	Torque detected below the minimum torque.
High (red) LED	The following results give a *Not OK* result: - Torque over the transducer overload - Torque out from the limits (not for ***Delta 1D***) - Torque status is marked as *Not OK*

The buzzer is activated as follows:

Buzzer	High tone when green led is activated; otherwise, lower tone.

15.1 Test Setup for Pulse Tool Test Preloaded

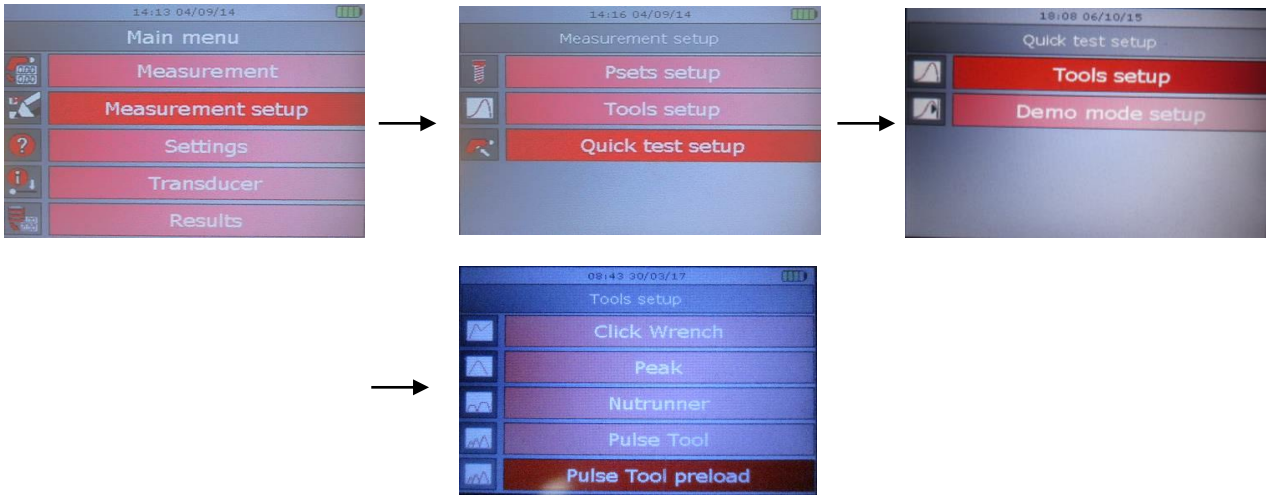
- **For Delta 6D/7D**, all of the parameters described in this paragraph are stored inside the *Pset*. See below for more information about the specific parameters of the Pulse Tool Preloaded test and refer to the paragraph "*Pset*" for further details about the Pset.

  For the *Quick Test* mode, the function is the same of the ***Delta 1D*** described below.

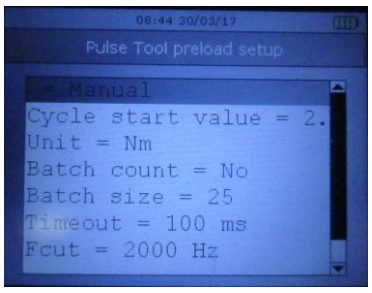
- **For Delta 1D** (and **Delta 6D/7D**) **Quick Test**, all of the parameters described in this paragraph are entered directly on the Delta menu, by selecting ***Measurement Setup*** → ***Tools setup*** → ***Pulse Tool*** menu:

Delta 1D – Quick Test Setup

Delta 6D/7D - Quick Test Setup



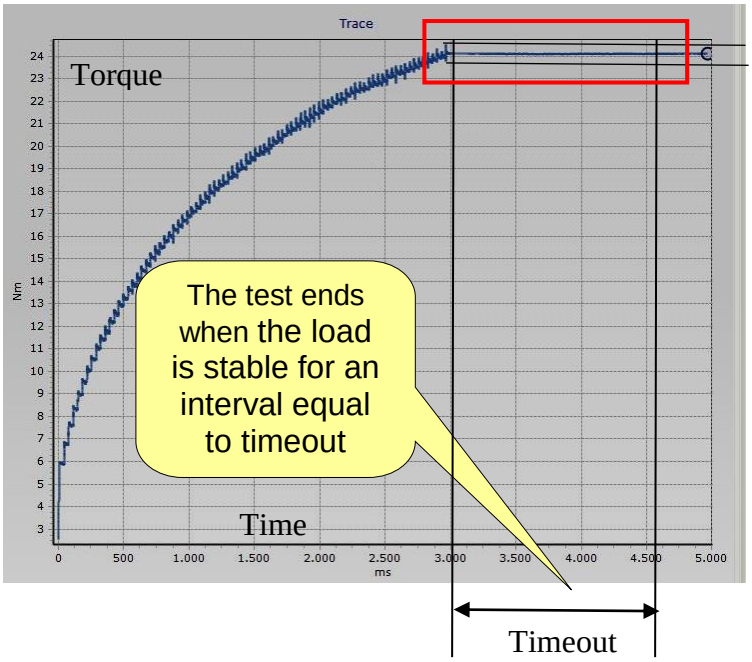
In both cases shown above, the following screen is displayed:



Scroll the parameters by means of the ***UP***/***DOWN*** keys; then click on ***Enter*** to edit.

15.1.1 Timeout

The "***Timeout***" defines the end of the test. When the load is stable for a time interval equal to ***Timeout*** value, the test ends.



NOTE: The "***Timeout***" can be set from *100 ms* up to *2000 ms*. The default value is *100 ms*.

15.1.2 Cycle Start Mode and Cycle Start Value

Setting the ***Cycle Start Mode*** to ***Automatic***, the Delta automatically sets the "*Cycle Start"* to the 10% of the capacity of the connected transducer.

Setting the ***Cycle Start Mode*** to ***Manual***, the ***Cycle Start Value*** must be specified.

15.1.3 Filter frequency

The "***Filter frequency***" can be set to 100, 200, 500, 1000, or 2000 Hz. This is applied to the samples measured by the torque transducer to filter the noise. The default value 2000 Hz.

15.1.4 K value

The K value is the conversion factor between load and torque. Since FCT is a force transducer, this is used to determine the torque result:

*Torque = K * Load * <Screw diameter>*

Where:

Torque	The torque value evaluated starting from the measured load value
K	Conversion factor
Load	Load measured by FCT
Screw diameter	FCT transducer screw diameter. This is automatically determined according to FCT full scale. For example: *FCT 30* Diameter: 12 mm *FCT 60* Diameter: 16 mm

NOTE: The ***K*** can be set from 0,078 up to 0,245.

In the case a ***K*** is lower than the minimum value allowed for a certain transducer, an error message is shown before entering the measurement screen.

15.1.4.1 K value evaluation

In order to determine the K value for the FCT to use for the current test, follow this procedure:

Required instrumentation:

- A power tool:
  - within the calibration period
  - with a full scale equal or higher than the required target torque.

Procedure

- Adjust the target torque of the power tool in order to reach the same value as the pulse tool target torque with a tightening speed of 10 RPM +/-10%
- Perform 25 tightenings on the FCT using the power tool
- For each tightening take note of:
  - The torque result of the power tool
  - The load result of the FCT

- Calculate:
  - The mean value T_m of the torque reached by the power tool
  - The mean value P_m of the preload measured by the FCT
- Calculate the value of K applying the following formula:

$$K_{TEST} = \frac{T_m[Nm]*1000}{P_m[N]* \ <FCTScrewdiameter[mm]>}$$

- Update the K value typing K_{TEST} into the FCT Pset.

16 TOOL CHECK: FREE ANGLE TEST

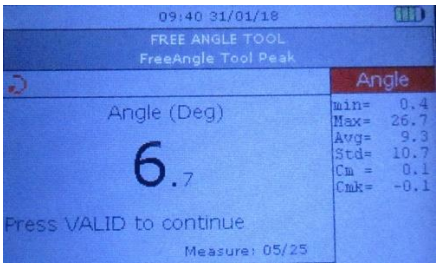
The *"Tool check: Free angle" strategy* gives the angle values measured by a transducer and check if the measured value is within the tolerance limits defined in the Pset.

NOTE: The *"Tool check: Free angle" strategy* is available only for *Delta 6D/7D* with a minimum firmware version equal to **2.7x**

NOTE: Use only transducers that measure angle.

The test result gives the angle value measured during the test.

During the test, the angle value is displayed:



The LEDs are activated as follows:

OK (green) LED	The angle is within the limits defined in the Pset. The angle status is marked as OK.
Low (yellow) LED	Angle value lower than the minimum value.
High (red) LED	Angle value upper than the maximum limit.

The buzzer is activated as follows:

Buzzer	High tone when green led is activated; otherwise, lower tone.

16.1 Test Setup for Free Angle Test

Below are the Pset parameters for the *"Tool check: Free Angle" strategy*:

- *Max angle*
- *Target angle*
- *Min angle*
- *Min Cm (angle)*
- *Min Cmk (angle)*

See the chapter "*Pset*" for further details about the parameters.

NOTE: The *"Tool check: Free Angle" strategy* is not available as quick test strategy.

NOTE: In the *online* mode, *"Tool check: Free Angle" strategy* is enabled only if the firmware version of the connected Delta device supports this strategy. Otherwise, the Pset with Toolcheck: Free Angle strategy is not sent to the device.

NOTE: In Tool details form it is necessary to select the "Nutrunner / Tool Peak" strategy to be able to link a Pset with "Free Angle" type. It is possible to link the same Tool both to the Pset with "Free Angle" type and to the Pset with "Nutrunner / Tool Peak" type.

17 QUALITY TEST ON JOINTS

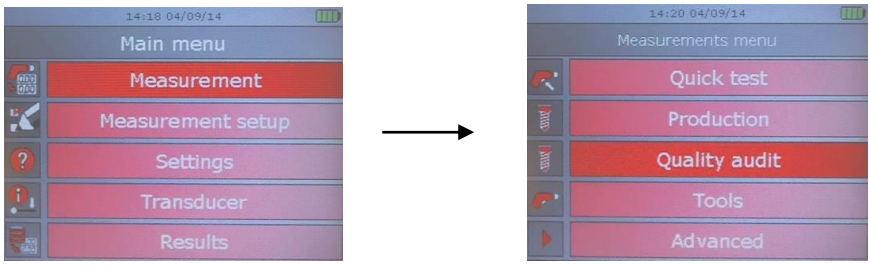
The ***Quality Test on Joints*** is applicable only for the ***Delta 7D***. The ***Delta 7D*** model provides a set of test strategies to evaluate the residual torque on a joint already tighten.

This test is normally run with the *Delta* connected to a *Q-AUDIT*, but a rotary transducer (for example a DRT) can be used as well; for *residual Torque Angle Automatic* only a *Q-AUDIT* can be used.

The strategies for evaluating residual torque check can be divided in three main categories:

- ***Breakaway (Residual Torque/Angle)***: this method measures the minimum torque to rotate the screw further.
- ***Residual Peak/ Torque***: this method simply measures the peak of the torque. The operator must stop as soon as the screw starts rotating.
- ***Loose and Tightening***: this method loosens the screw for a certain degrees and measures the torque necessary to tighten back the screw to the original position.

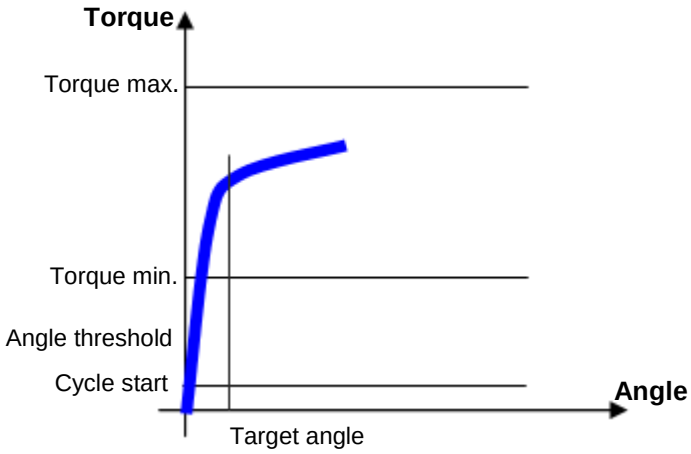
The *Psets* created for production strategies are available in the ***Measurement*** → ***Quality Audit*** menu:



NOTE: The paragraphs below describe in details how the **Delta 7D** performs the three strategies above mentioned.

17.1 Residual Torque/Angle

"Residual Torque/Angle" strategy evaluates the residual torque on a joint, by measuring the Torque at the target angle.
The target angle is set to few degrees, in order to detect the point where the bolt starts moving.



Define the ***torque limits*** for considering as *OK* the test result.

The ***Angle Threshold***, which must be greater than the ***Cycle start***, defines the point from which the angle measurement starts. The *Delta* measures the torque at the Target angle.

At the end of the test, the Delta display shows the breakaway point and also the torque peak value reached during the test; *the breakaway point is normally lower than the peak value*.

If the operator goes over the ***Change Screw*** value during the residual torque check, a message is shown on the display to indicate that the screw must be replaced with a new one.

The LEDs are activated as follows:

Low (yellow) LED	Torque result below the minimum torque.
OK (green) LED	Torque result within the limits.
High (red) LED	Torque result over the maximum torque.

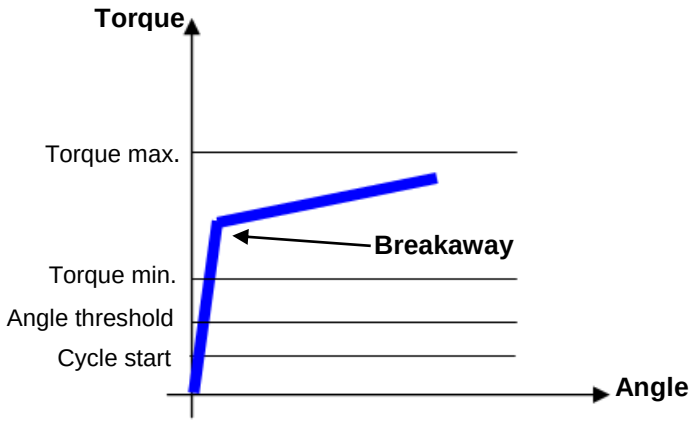
The buzzer is activated as follows:

Buzzer	High tone is emitted if test gives OK result (torque within the limits); if not, a low tone is emitted.

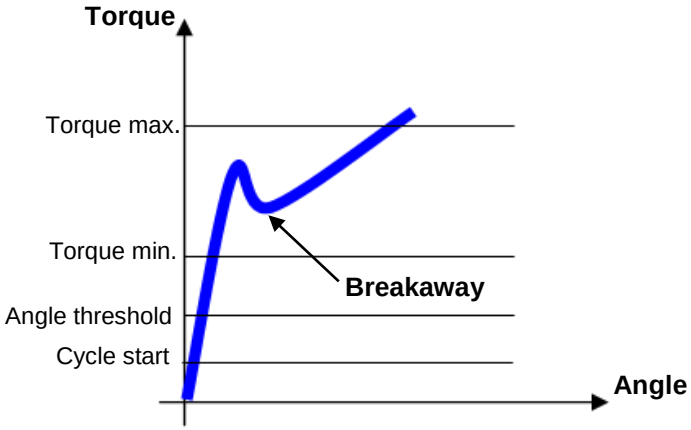
NOTE: The LEDs and buzzer are activated at the end of the tests.

17.2 Residual Torque/Angle Automatic

"Residual Torque/Angle Automatic" strategy evaluates the residual torque on a joint, by detecting it automatically on the base of the torque/angle trace.
Normally, during breakaway, there is a rapid change of the gradient of the torque/angle function when the bolt starts moving:



Sometimes, very high static friction is built into the joint (for instance, either for no lubrication or conical seat). In that case, as soon as the bolt moves, the torque decreases and the real residual torque is lower than the peak torque necessary to overcome the static friction:



In both the above cases, the Delta algorithm detects the proper breakaway point.
Define the ***torque limits*** for considering as *OK* the test result.

The ***Angle Threshold***, which must be greater than the ***Cycle start***, defines the point from which the angle measurement starts. The *Delta* measures the torque at the Target angle.

At the end of the test, the Delta display shows the breakaway point and also the torque peak value reached during the test; *the breakaway point is normally lower than the peak value*.

If the operator goes over the ***Change Screw*** value during the residual torque check, a message is shown on the display to indicate that the screw must be replaced with a new one.

The LEDs are activated as follows:

Low (yellow) LED	Torque result below the minimum torque, or breakaway point not detected.
OK (green) LED	Torque result within the limits.
High (red) LED	Torque result over the maximum torque.

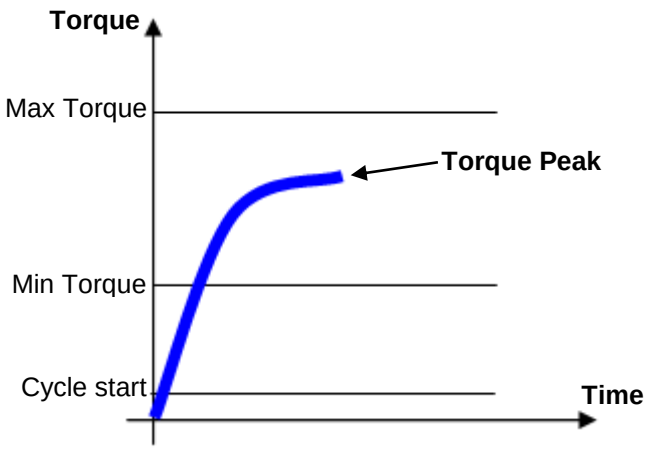
The buzzer is activated as follows:

Buzzer	High tone is emitted if test gives OK result (torque within the limits); if not, a low tone is emitted.

NOTE: The LEDs and buzzer are activated at the end of the tests.

17.3 Peak/Torque

"***Peak/Torque***" strategy evaluates the residual torque on a joint as the peak of the torque necessary to rotate the screw further. Since it does not recognize the breakaway point automatically, this method is not used for evaluating residual torque; it may be used in cases where the torque/angle method cannot be performed.



Simply specify the torque limits to evaluate for the breakaway point.

If the operator goes over the ***Change Screw*** value during the residual torque check, a message is shown on the display to indicate that the screw must be replaced with a new one.

The LEDs are activated as follows:

Low (yellow) LED	Torque below the minimum torque.
OK (green) LED	Breakaway point is detected (within torque limits).
High (red) LED	Torque over the maximum torque.

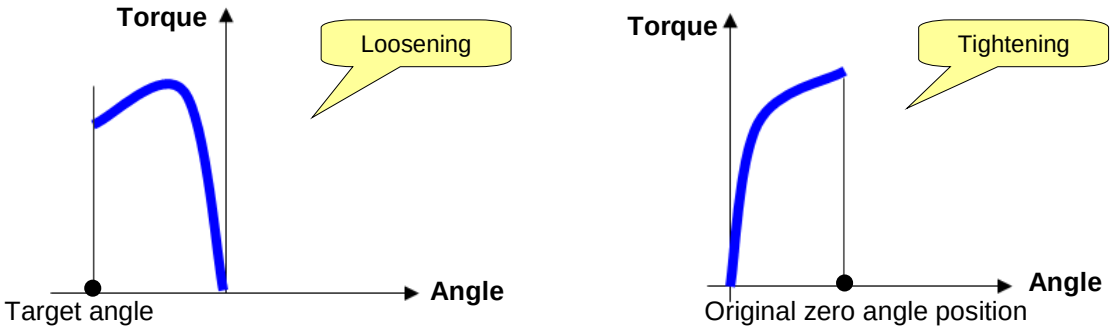
The buzzer is activated as follows:

Buzzer	High tone is emitted if breakaway point is detected (within torque limits); if not, a low tone is emitted.

NOTE: The LEDs and buzzer are activated at the end of the tests.

17.4 Loose and Tightening

Breakaway is by far the best and most commonly used method. But, when a bolt has been tightened some time ago and there is rust or other conditions that could increase static torque, the suggested evaluation method is to loosen the bolt up to the target angle and re-tighten it back to the “zero original position”.



Specify the torque limits. The residual torque result is the torque at the end of the retightening operation (measured when the original zero angle position is reached back).
The ***Target Angle*** is usually set to a few degrees; if it is set too high, torque during the opening phase could go under the cycle start value. In that case, the angle counting would stop, making the test impossible.

If the operator goes over the ***Change Screw*** value during the residual torque check, a message is shown on the display to indicate that the screw must be replaced with a new one

The Angle LED, Torque LED and buzzer devices are activated as follows:

ANGLE LED *(during the INTERMEDIATE steps of the test)*	
Green LED	• It lights when the Loosening Target Angle is reached (when the Re-tightening step starts, the Green LED turns off) • It lights when the Re-tightening Angle (original zero angle position) is reached, once the Loosening Target Angle has been crossed
Blinking Yellow LED	• It lights when the Loosening step is preceded by the Re-tightening step, causing a screw movement **NOTE**: The ***Blinking Yellow LED*** is matched with a warning beep

TORQUE LED *(at the END of the test)*	
Green LED	• It lights when the Loose and tightening process is successfully completed within Torque Limits

Yellow LED	• It lights when the Loose and tightening process is completed but the result is under the Minimum Torque **NOTE**: The following warning message is shown: "**Torque <**" • It lights when the operator is forced to release the tool because the Re-tightening step is erroneously preceded by the Loosening step, causing a screw movement **NOTE**: The following warning message is shown: "**Torque <**" "**Angle <**" • It lights when the tool is released by the operator (allowing the TIMEOUT to expire) once he applied a NEG and/or POS torque without any screw movement **NOTE**: The following warning message is shown: "**Torque <**" "**Angle <**" • It lights when the "Loose and tightening procedure" is not correctly executed: it may be that any mandatory steps (target angle, original zero angle position) are not reached **NOTE**: The following warning message is shown: "**Angle <**"
Red LED	• It lights when the "Loose and tightening procedure" is completed but the result is over the Maximum Torque **NOTE**: The following warning message is shown: "**Torque >"** • It lights when the "Loose and tightening procedure" is completed but the result is over the ***Change Screw*** value • It lights when the ***Overload*** condition occurs during the "Loose and tightening procedure"

BUZZER	
(during the INTERMEDIATE steps of the test)	
INTERMEDIATE TONE	• The device emits an *INTERMEDIATE TONE* buzzer when Loosening Target Angle is reached • The device emits an *INTERMEDIATE TONE* buzzer when Re-tightening Angle (original zero angle position) is reached (once Loosening Angle Target was reached)
(at the END of the test)	
HIGH TONE	• The device emits a *HIGH TONE* buzzer when "Loose and tightening procedure" is **OK**
LOW TONE	• The device emits a *LOW TONE* buzzer when "Loose and tightening procedure" is **NOK**

17.5 Residual Torque Strategies - VDI/VDE 2645 part 3

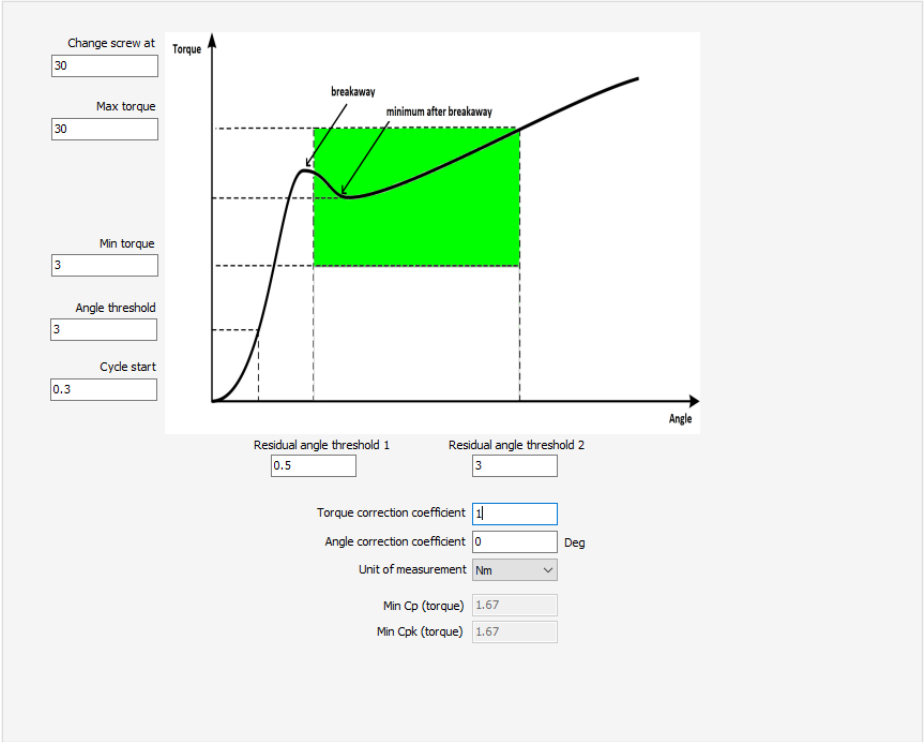
The recommended approach to the use of this set of strategies would be to choose the method (*Minimum after breakaway*, *Residual intersection*, *Slope change*) depending on a preliminary evaluation of the joint's torque/angle characteristic (shape) during the residual check.

Therefore, a joint pre-analysis phase is required to choose the most suitable strategy, tune correctly the angle thresholds / slope coefficient and make work the algorithm as desired. A brand new study and tuning of the settings needs to be done every time the joint type/setup that is going to check has changed. The same strategy setting, for example, can work well on a joint type (with a given stiffness and for a given torque level) but cannot work as desired on a different joint (with different stiffness and different characteristics).

17.5.1 Minimum after breakaway

The strategy *Minimum after breakaway* aims to search a local minimum within the angle interval set by the user (α1- α2). When the angle α2 is surpassed, the measuring interval is over (the user is warned via buzzer and angle LED on the Delta 7D) and he can stop tightening. If a candidate residual point was found then it is chosen as result, otherwise maximum torque measured during the cycle is shown and result will be Not detected.

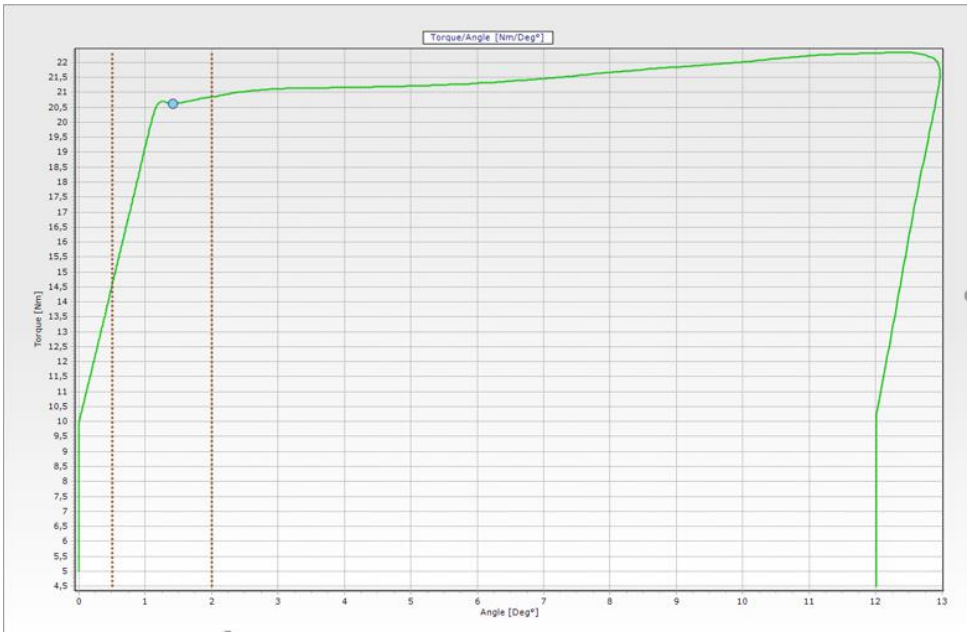
For a proper residual detection, we need to make sure that the breakaway and residual points are included in the (α_1- α_2) angle interval, also the operator must reach and overcome α_2 during the check.



Residual angle threshold 1 (α1)	Starting angle for measuring interval which the residual detection algorithm is applied in. It must be lower than α2.
Residual angle threshold 2 (α2)	Final angle for measuring interval which the residual detection algorithm is applied in. It must be higher than α1.

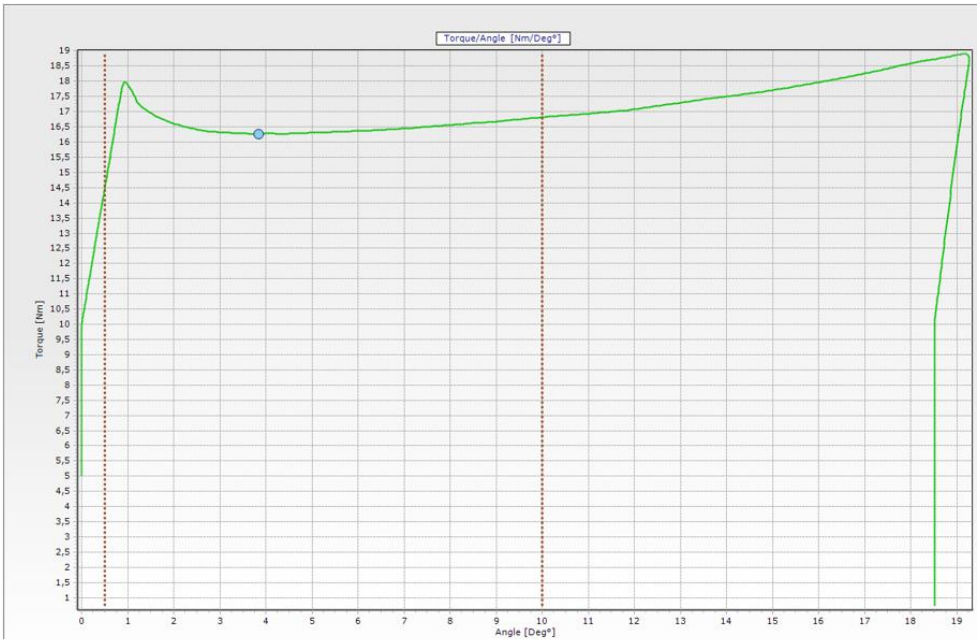
Here below some example of different residual detection with *Minimum after breakaway* strategy in different joints:

<u>Medium/Hard joint:</u>



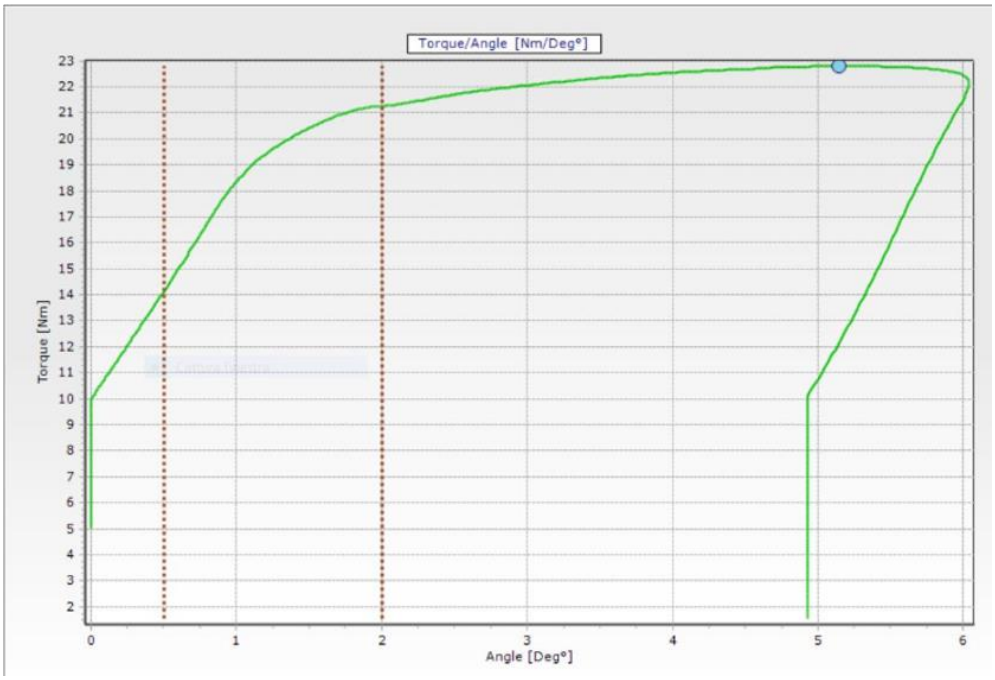
Angle thresholds set: α1 = 0.5° α2 = 2°

Soft Joint:



Angle thresholds: $\alpha_1 = 0.5°$ $\alpha_2 = 10°$

Not detected:



No minimum after breakaway detected→ Result NOT OK and torque peak marked on the curve

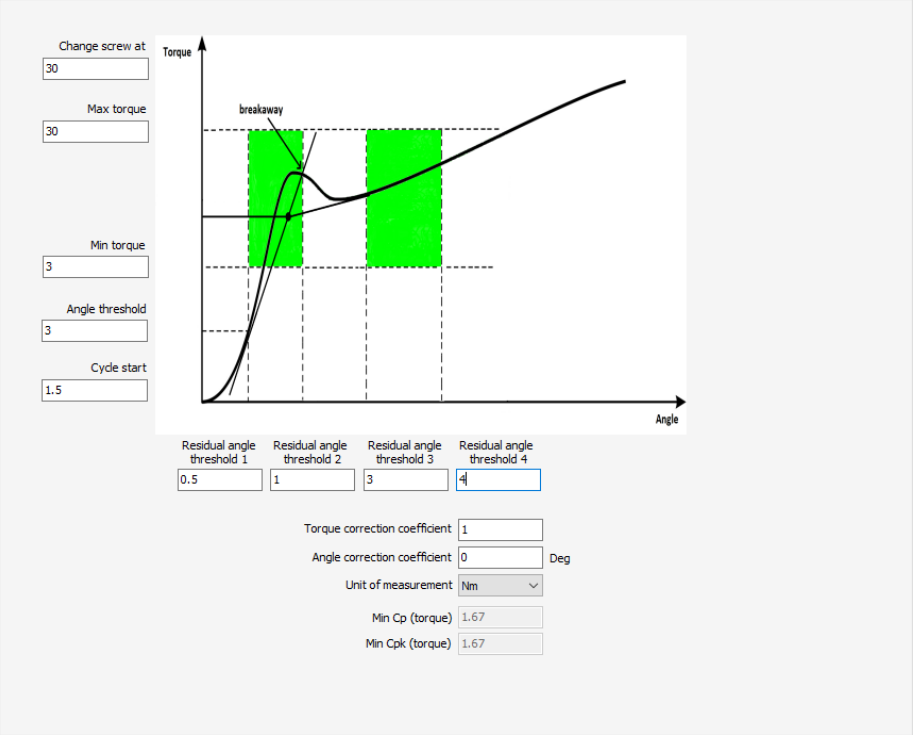
ANGLE LED	
Red LED	In case of overspeed

TORQUE LED	
Green LED	If the minimum is detected and it's in the window. Target angle is reached.
Yellow LED	• Blinking – when the minimum not is detected. • Permanent – when the torque is less than the minimum torque.
Red LED	Permanent – in the states in which the torque go beyond the window or in case of change screw or overload.

BUZZER	
HIGH TONE	Blinking with high frequency – when we reached the second angle threshold. Torque not in window or not detected.
LOW TONE	Blinking with low frequency – when we reached the second angle threshold and the result is in the window. The user must release the tightening.

17.5.2 Residual intersection

Estimating residual torque is not easy. There is no foolproof method for finding it out, since algorithms are very dependent on shape of torque/angle curve, so new strategies are very often created to calculate it more precisely on a specific kind of joints. The Residual intersection strategy is ideal to find the residual torque in curves with coinciding breakaway and residual points.

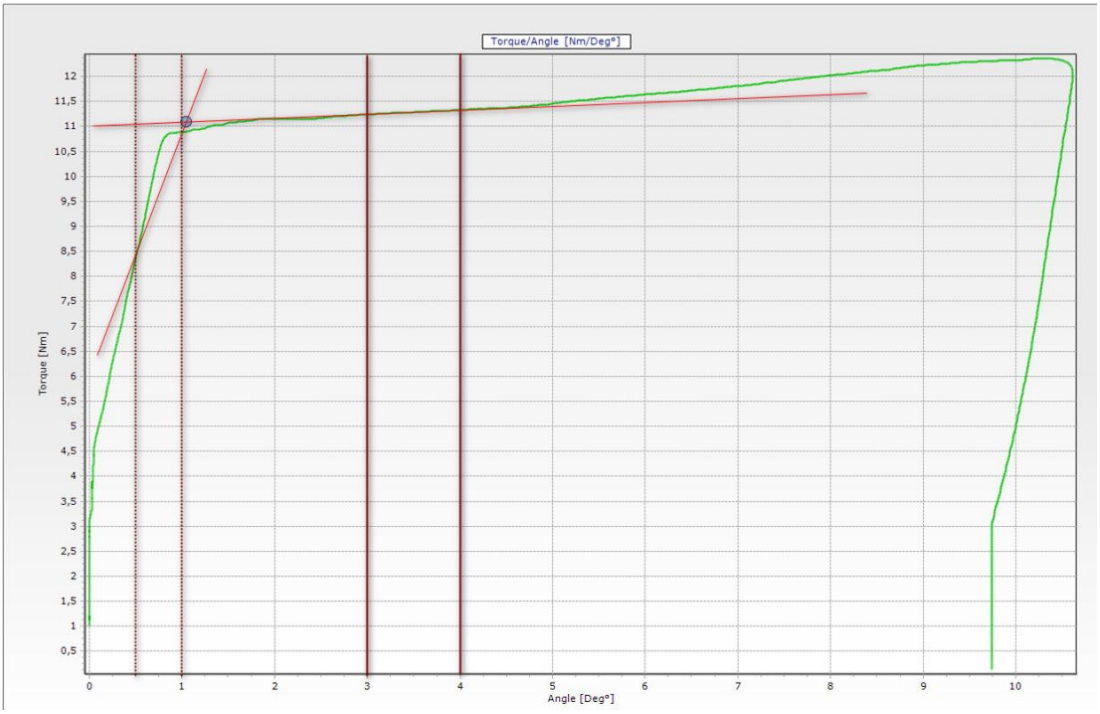


Residual angle threshold 1 (α1)	The starting angle for generation of the first intersection straight line. It must be lower than α2.
Residual angle threshold 2 (α2)	The final angle for generation the first intersection straight line. It must be higher than α1 and lower than α3.
Residual angle threshold 3 (α3)	The starting angle for generation of the second intersection straight line. It must be higher than α2 and lower than α4.
Residual angle threshold 4 (α4)	The final angle for generation the second intersection straight line. It must be higher than α3.

<u>How the strategy works?</u>

During the check, the intersection points of the curve with the 4 angle thresholds α1, α2, α3, and α4 are stored.

When angle level surpasses α4 threshold, the user is warned (through busser and angle LED) and can stop tightening. The four points (torque, angle) values are used as coordinates to find two lines passing through them (the first two points identify the first line, the third and the fourth pinpoint the second one). The intersection of thus straight lines is considered the residual point.



Angle thresholds: α1 = 0.5° α2 = 1° α3 = 3° α4 = 4°

ANGLE LED	
Green LED	• ***+ Torque LED Green*** – Within the angle and torque ranges • ***+ Buzzer*** – When is reached the fourth threshold and buzzer with blinking sound at low/high frequency if the value is outside/inside the window • ***+ Torque LED Red*** – When fourth threshold reached but actual torque is greater than maximum torque.

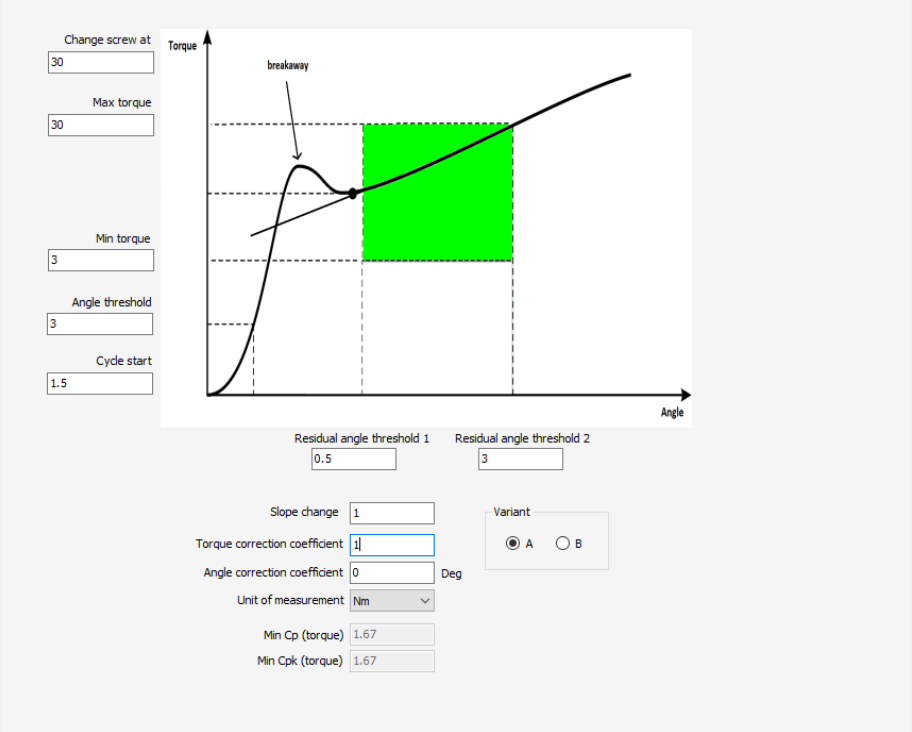
TORQUE LED	
Yellow LED	Blinking – when the minimum not is detected and in case of low residual torque.
Red LED	Permanent – over the maximum torque.

17.5.3 Slope Change

The residual slope change strategy can find the residual torque in either curves with coinciding breakaway and residual points or with not coinciding ones.

- The result is obtained after a post-processing applied to acquired data, which are examined backward starting from Alpha 2;

- Residual point is found when the ratio of the gradients (the one in α2 being the reference one) is greater than a set threshold (slope change). Given the multiplicative relation between the two gradients, if reference gradient is too flat, residual point might be not properly detectable.

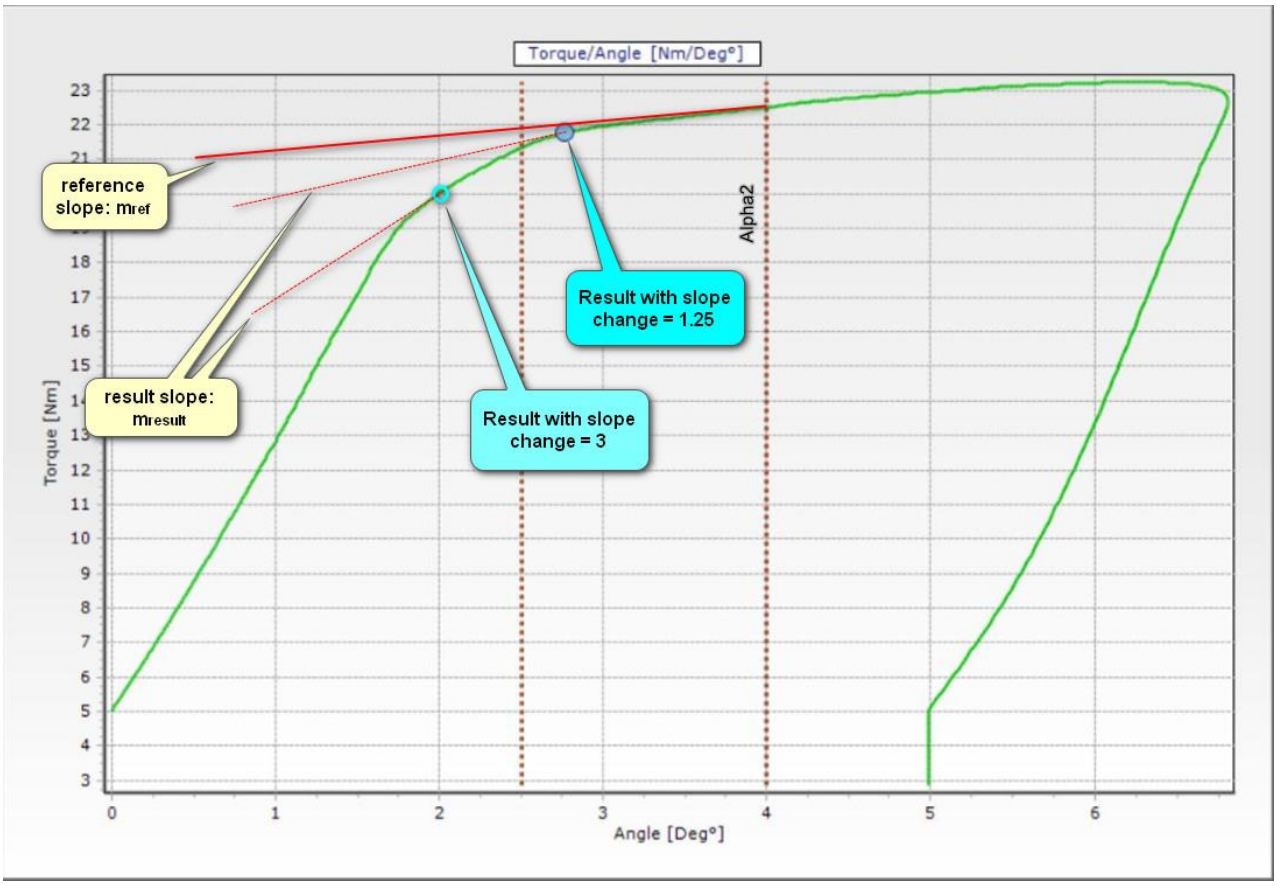


Residual angle threshold 1 (α1)	The starting angle for validation interval. Not crucial for algorithm's sake, but if the residual point is detected before Alpha 1, the test outcome will be NOK. It must be lower than α2.
Residual angle threshold 2 (α2)	The final angle of measuring interval. Here reversal post-processing begins to find the residual point. It must be higher than α1.
Variant A	The result is expected to be OK before the angle threshold α1
Variant B	The result is expected to be OK within the angle range α1 – α2

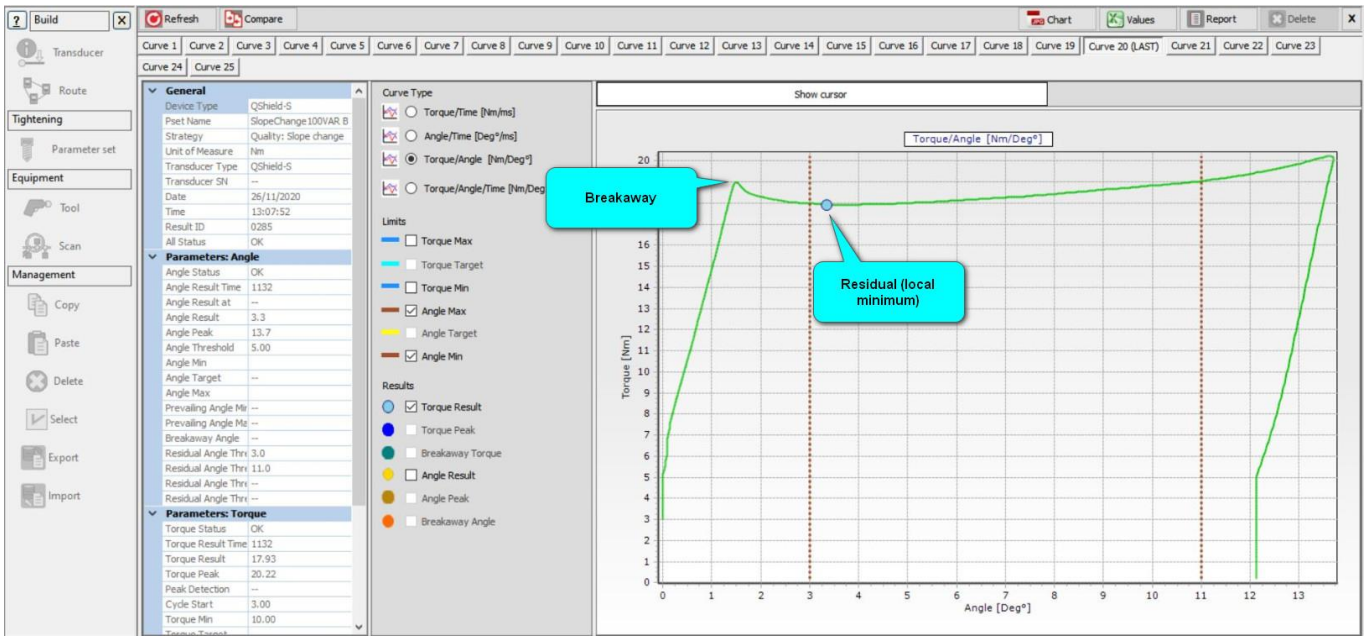
<u>How the strategy works?</u>

We have defined the slope change coefficient as ratio of the gradients: Slope Change = mresult/mref

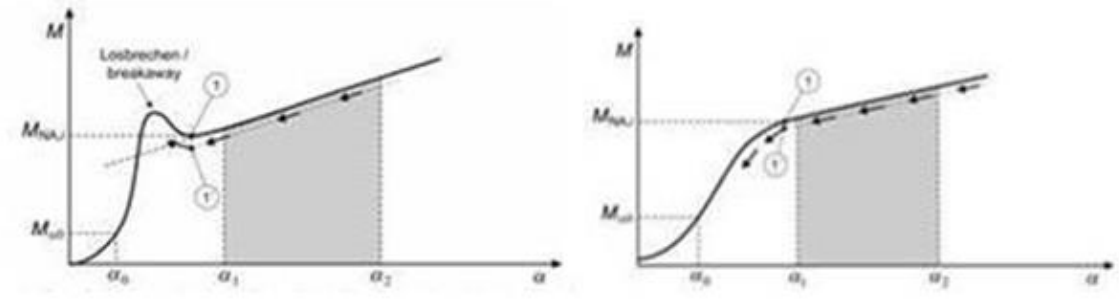
We can generally say that setting slope change =1 we can get a result nearer to the reference. Increasing the value of the slope change the algorithm will get the result as shown in the figure below:



In cases like the one shown below (curve with different Breakaway and Residual points), if the algorithm doesn't find between α2 and the local minimum a slope ratio surpassing the slope change set, then the result will be always taken in that local minimum.

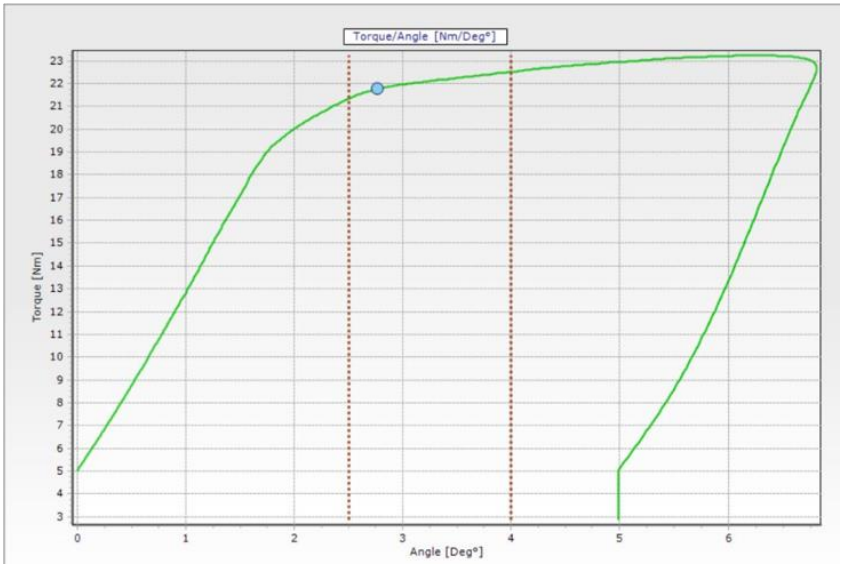


VARIANT A:

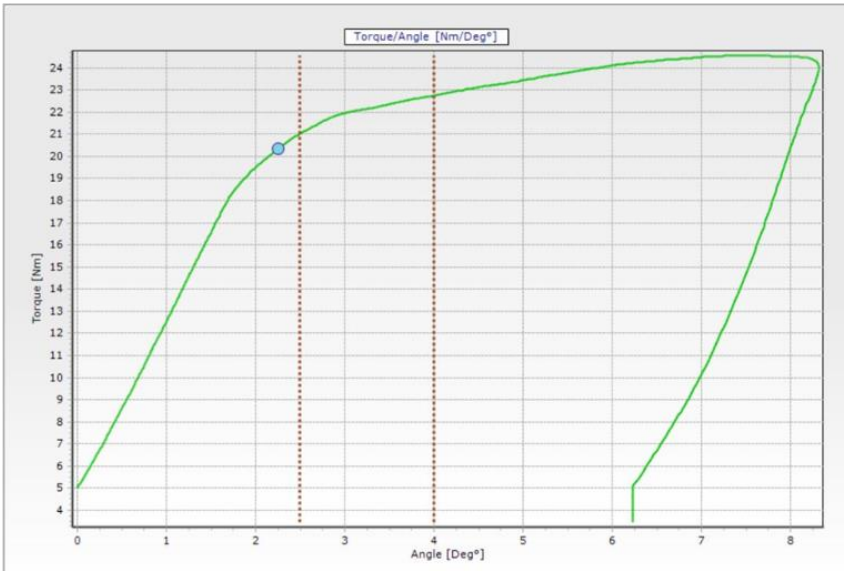


The result is expected to be OK before the angle threshold α1
Below some example.

These two joint checks have been carried out on **the same joint at the same torque level** with slope change strategy variant A:

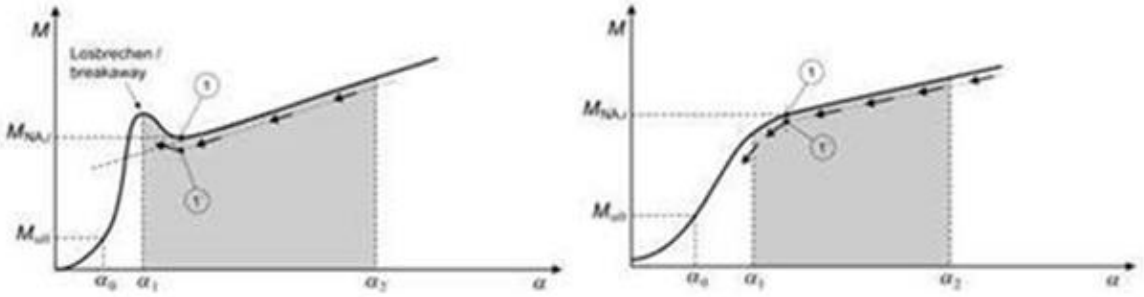


Slope change = 1.25
Result NOK since the residual point is detected between α1 and α2

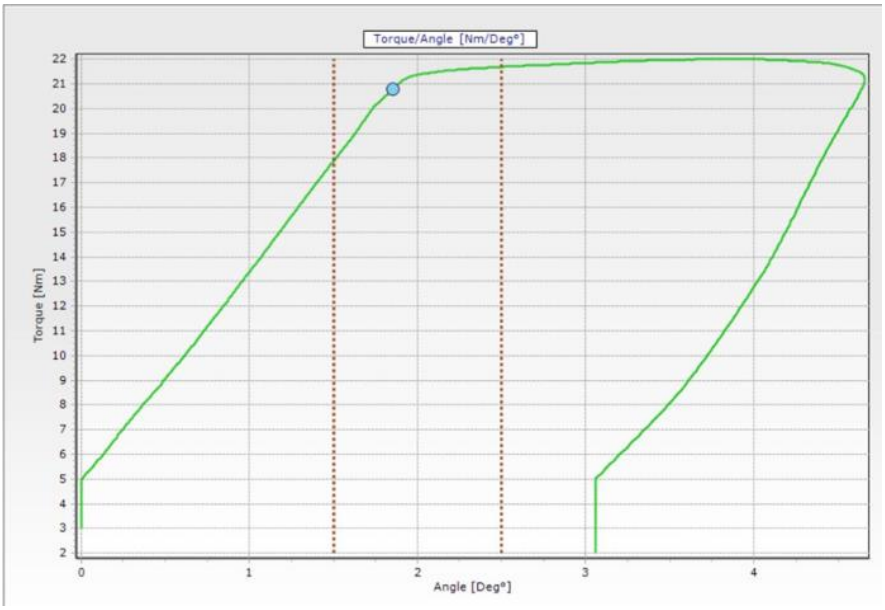


Slope change = 3
Result OK since the residual point is detected before α1

VARIANT B:



The result is expected to be OK within the angle range α1 - α2
Below an example.



Slope change = 1.5
Result OK since the residual point is detected between α1 and α2

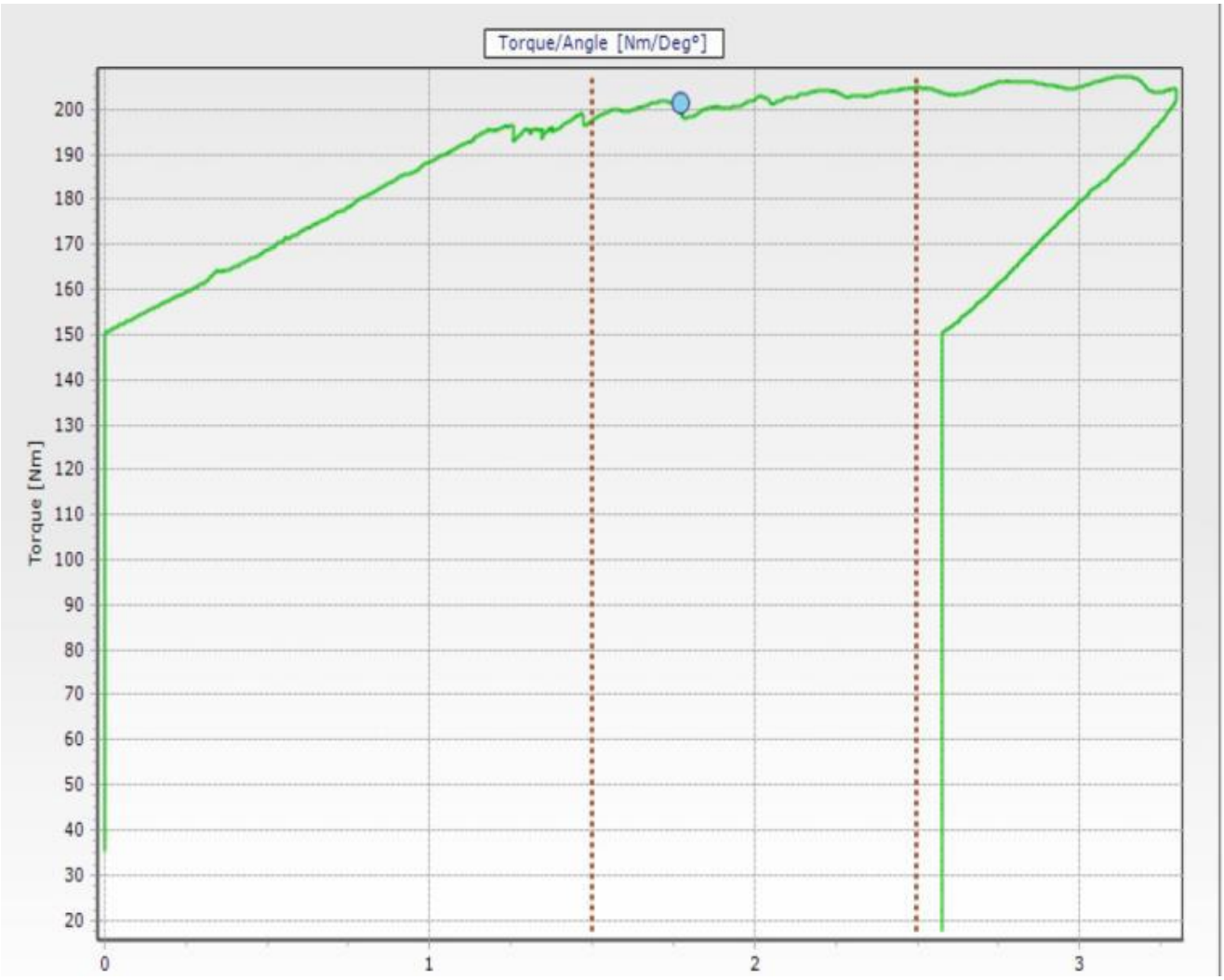
ANGLE LED	
Green LED	• ***+ Buzzer*** – Permanent – when the second angle threshold is reached, Buzzer with low frequency. The user must release the tightening. It is valuated the torque, if: - Residual torque below the torque window Torque LED – Yellow - In all other cases Torque LED – Green If release the tightening the Buzzer? - High tone Torque LED – Green - Low tone Torque LED – Yellow (low torque or torque not detected)
Red LED	Permanent – in case of overspeed.

TORQUE LED	
Red LED	Permanent – If the tightening exceeds the torque window.

BUZZER	
HIGH TONE	Blinking with high frequency – when we reached the second angle threshold. Torque not in window or not detected.
LOW TONE	Blinking with low frequency – when we reached the second angle threshold and the result is in the window. The user must release the tightening.

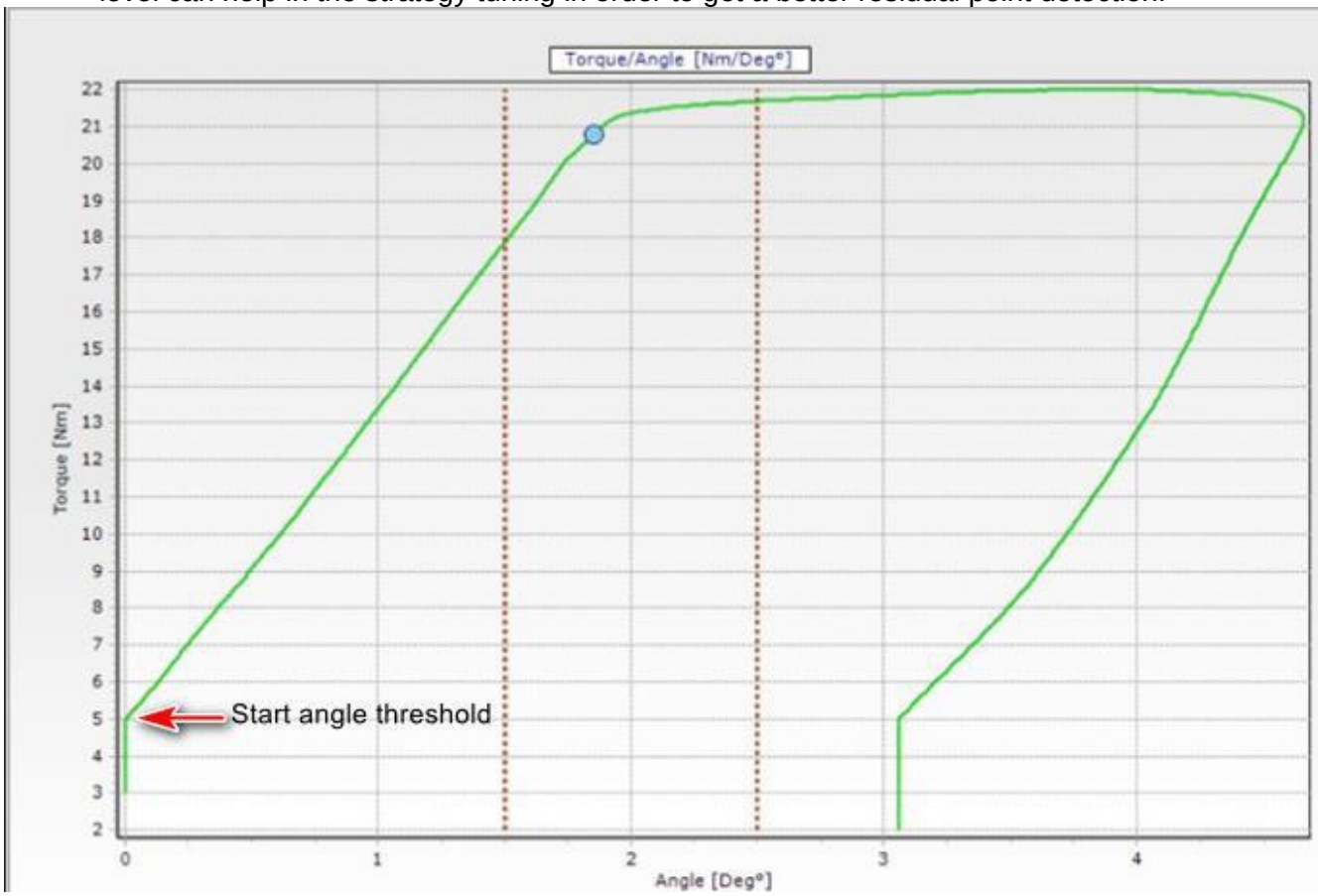
Limitation/suggestion

- A “noisy” torque/angle characteristic due, for example, to a not correct check execution or mistake of the operator during the residual check can lead to a not correct detection of the residual point (see figure below).



- In addition to αx angles the start angle threshold parameter should be taken in consideration in the tuning phase of the pset. As a rule the start angle threshold should normally be set at

about a half of the expected residual torque. Changing this point to a higher or lower torque level can help in the strategy tuning in order to get a better residual point detection.



18 JOINTS ANALYSIS

The ***Joints Analysis*** is applicable only for the ***Delta 7D***.

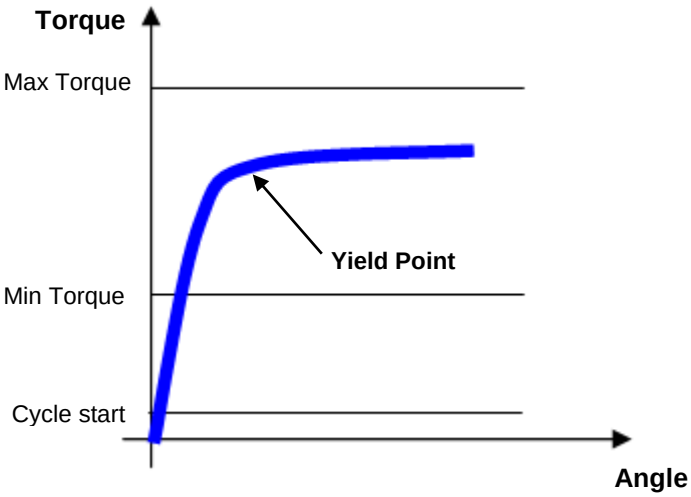
The ***Delta 7D*** model provides a test strategy (*Yield Point*) to evaluate the torque/angle characteristic of a joint.

18.1 Yield Point

The *Yield Point* test is normally executed with the *Delta* connected to a *Q-AUDIT*.

With this test strategy the *Delta* detects the *Yield Point* automatically.

The torque limits specify the range where the result is *OK*.



NOTE: The *Cycle start* must be set at least to 10% of the supposed *Yield Point*.

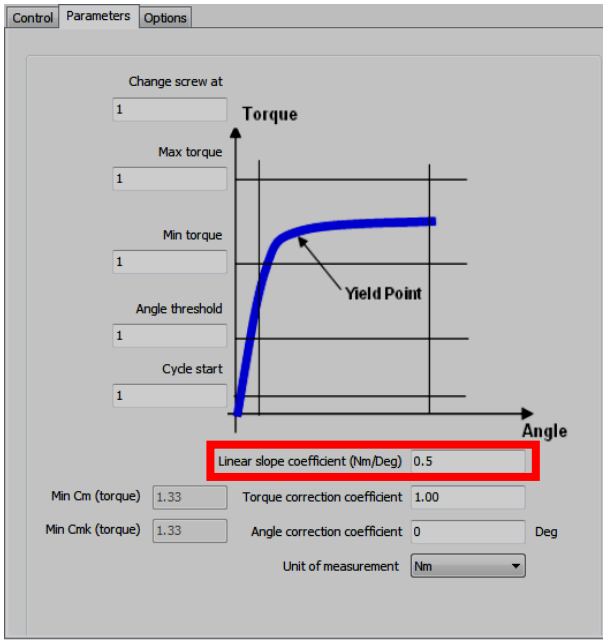
The *"Torque result"* may be one of the following options:

- If the *Yield Point* is detected (within torque limits), the result of the test is taken at the *Yield Point*.
- If the *Yield Point* is not detected, the result of the test is the maximum value.
- If the torque goes over the *Change Screw* value, the *Yield Point* is no longer detected and the torque result is the maximum torque.

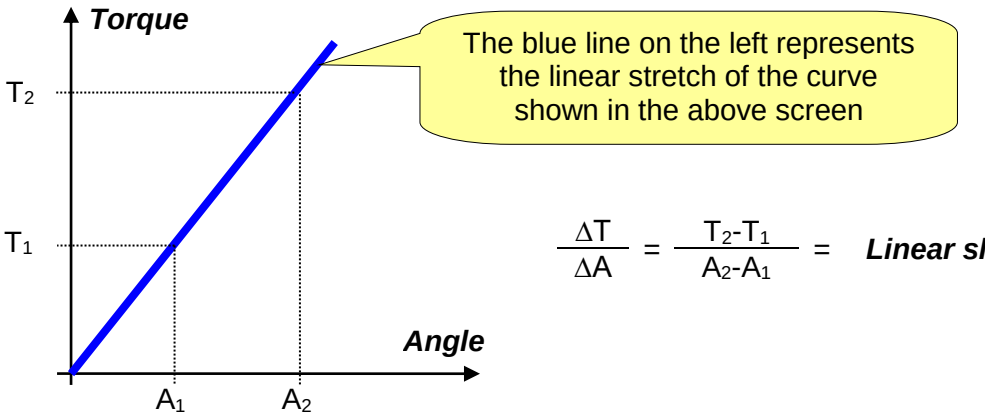
NOTE: **It is recommended to reach the *Yield Point* with a single tightening**; ratcheting is allowable provided that it is executed at the 50 ÷ 60 % (MAXIMUM) of the supposed Yield Point.

Working on DeltaQC software, after creating a *Pset*, select the *control strategy: "**Quality: Yield Point**"* (refer to the paragraph "*Main Parameters and Control Strategy*" for further details).

By selecting "*Parameters*" section (refer to the paragraph "*Torque/Angle Parameters*" for further details), the following screen is shown:



The "***Linear slope coefficient***", that characterizes the *Yield Point control strategy*, may be calculated (for each single joint, only after executing a trial test in order to get data for calculating it) as follows:



$$\frac{\Delta T}{\Delta A} = \frac{T_2 - T_1}{A_2 - A_1} = \textbf{\textit{Linear slope coefficient}}$$

The LEDs are activated as follows:

Low (yellow) LED	Torque result is either between the *Cycle Start* and the *Min. Torque* value or between *Min. Torque* and *Max. Torque* but the *Yield Point* has not been detected.
OK (green) LED	*Yield Point* is detected within torque limits.
High (red) LED	Torque result over *Max. Torque*.

The buzzer is activated as follows:

Buzzer	High tone is emitted if the result is *OK*; if not, a low tone is emitted.

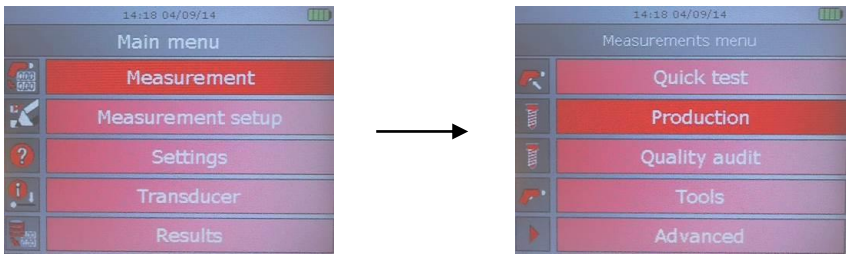
19 PRODUCTION TIGHTENING OPERATIONS

The ***Production Tightening Operations*** are applicable only for the ***Delta 7D***.

The ***Delta 7D*** model provides a set of test strategies to execute a tightening operation.

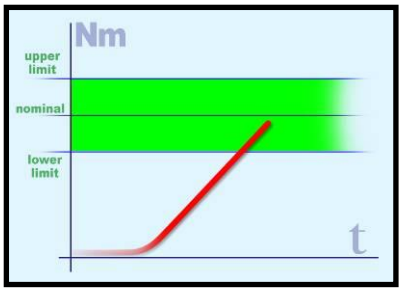
This test is normally run with the *Delta* connected to a Q-AUDIT, but a rotary transducer (for example a DRT) can be used as well.

The *Psets* created for *Production strategies* are available in the ***Measurement*** → ***Production*** menu:



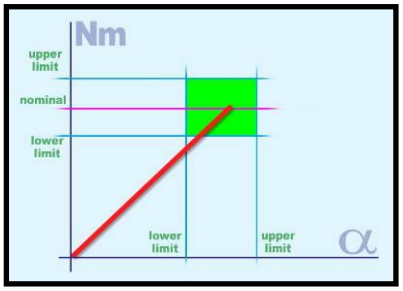
Production strategies can be divided into three main categories:

1. Tightening within torque limits



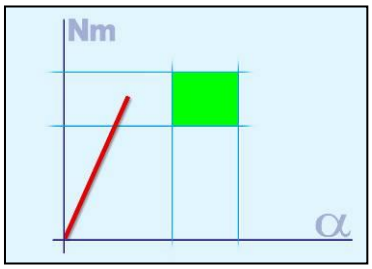
This is the easiest tightening method: it is enough to apply the torque within the limits (refer to the figure on the left).

2. Tightening within torque and angle limits (tightening to a window)



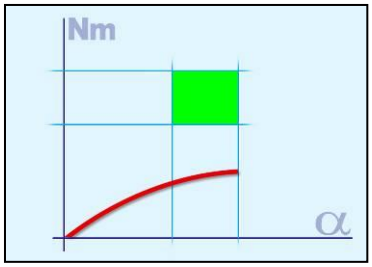
This is a more accurate method to tighten: in fact, additional information (angle) are used during the tightening process.
By means of this method you it is possible to detect possible problems on the joint (refer to the following list).

a) *Torque* is correct, but *angle* is too short:



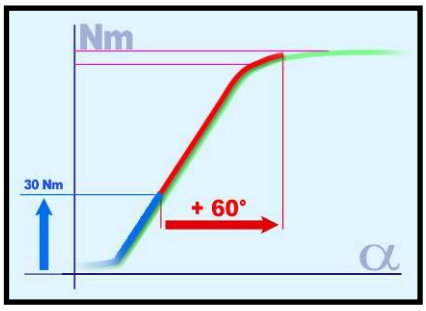
- Misalignment problem
- The hole is not completely threaded (or it is not deep enough)
- The bolt is stopped by oil in a dead hole
- There is dirt in the threads
- The threads are damaged
- The screw is already tightened

b) *Angle* is correct, but *torque* is too low:



- The thread may be stripped out
- The screw is too soft (tightened over yield)
- Unexpected low μ (friction coefficient)

3. Tightening with torque and additional angle rotation (torque + angle)



The bolt is first tightened to a certain torque and then it is further tightened to a specific angle.

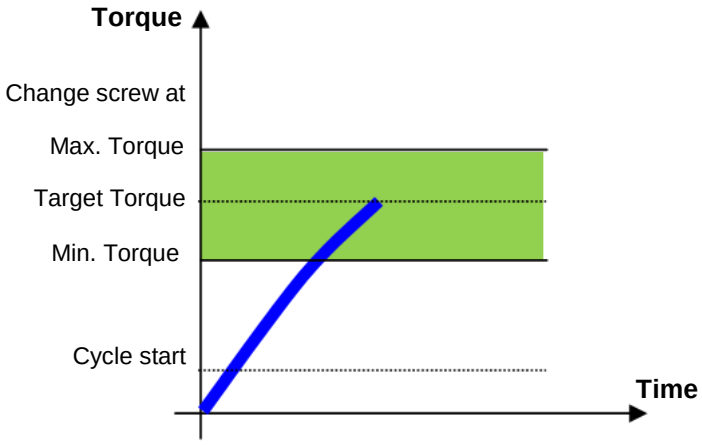
The goal is to stress the bolt over the *Yield Point*. Even with differences in the angle, the torque (causing clamping force) is quite consistent.
Sometime the joint is specially designed; consequently special experiments have been done (joint analysis) to be sure that strain is far away from the breaking point.

19.1 Production strategy

19.1.1 Torque Time

Torque Time strategy leads the operator in reaching the desired target torque, without any angle reading.

It is enough to define the *Cycle start*, *Minimum Torque*, *Target Torque* and *Maximum Torque*, and the *Change Screw at*.



The "*green area*" identifies the OK result area.

If the torque goes over the "*change screw*" value, a message is shown on the Delta display in order to advise the operator to replace the screw.

The torque result is the maximum torque measured during the tightening.

The Delta torque LEDs are activated as follows:

Low (yellow) LED	Torque lower than the minimum value.
OK (green) LED	Torque within the minimum torque and maximum torque.
High (red) LED	Torque over the maximum torque.

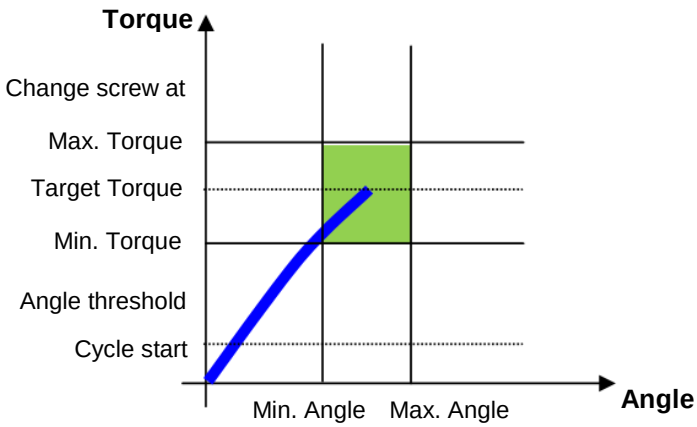
The buzzer is activated as follows:

Buzzer	The beep emitted by the buzzer starts when the torque goes over the *Cycle Start* value, and it increases its signal when approaching the target. At the end of the tightening operation three more beeps inform the operator of the end of the operation; if the torque goes over the maximum values, the beep is repeated at high frequency to indicate the error.

19.1.2 Torque & Angle

In ***Torque & Angle*** strategy the *OK* result is defined in a torque and angle window; it provides a more complete control on the tightening operation compared to the only ***Torque*** strategy.

The *Angle threshold* parameter is the threshold from which the angle measurement starts (normally set to 50% of the *Target Torque*).

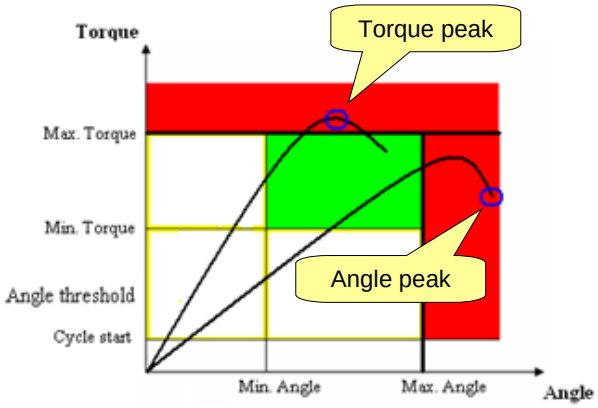


The "*green area*" defines the *OK* result area.

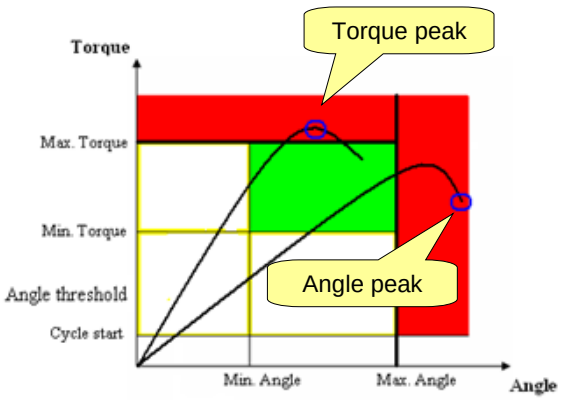
If the torque goes over the "*change screw*" value, a message is shown on the Delta display in order to advise the operator to replace the screw.

The ***Torque/Angle*** results may be as follows:

- If the *torque/angle* does not exceed the *torque/angle* limits, the result is taken at the torque peak or angle peak as specified in the *Pset* options.
- If the torque/angle goes over the limit, the result is taken as follows:



Torque peak selected in the Pset



Angle peak selected in the Pset

The Delta torque and angle LEDs are activated as follows:

Low (yellow) LED	Torque / angle lower than the minimum value.
OK (green) LED	Torque / angle within the minimum and maximum limits.
High (red) LED	Torque / angle over the maximum limits.

The buzzer is activated as follows:

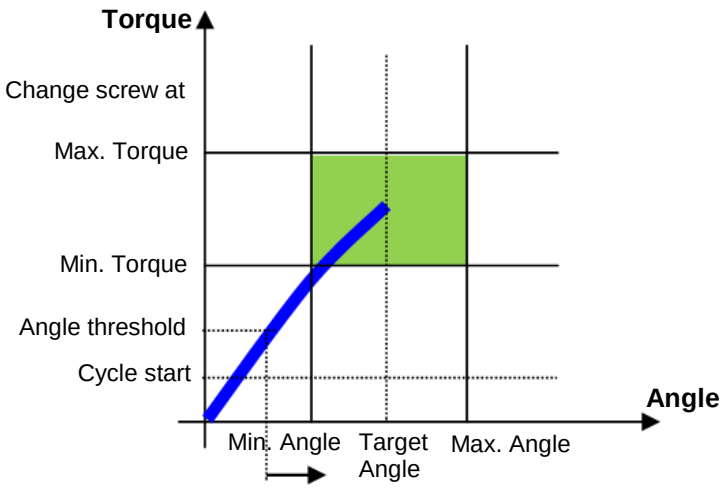
Buzzer	The beep emitted by the buzzer starts when the torque goes over the *Cycle Start* value, and it increases its signal when approaching the target. At the end of the tightening operation three more beeps inform the operator of the end of the operation; if the torque goes over the maximum values, the beep is repeated at high frequency to indicate the error.

19.1.3 Torque + Angle

Torque + Angle strategy leads the operator in reaching the desired target angle from a specified torque value.

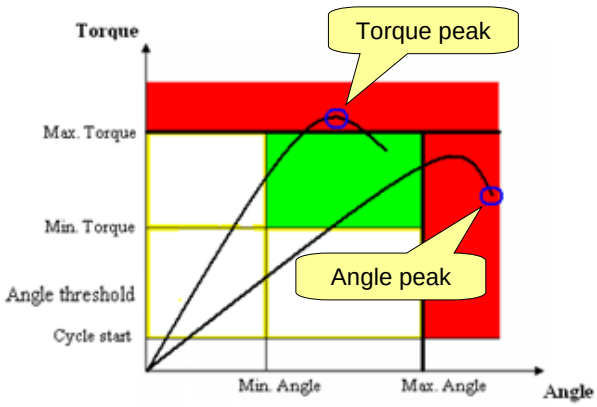
This strategy is similar to ***Torque & Angle*** strategy (refer to the paragraph "*Torque & Angle*" for further details); the *Target Angle* value is required instead of the *Target Torque*, and the progressive bar increases with the angle and not with the torque.

If the torque goes over the "*change screw*" value, a message is shown on the Delta display in order to advise the operator to replace the screw.

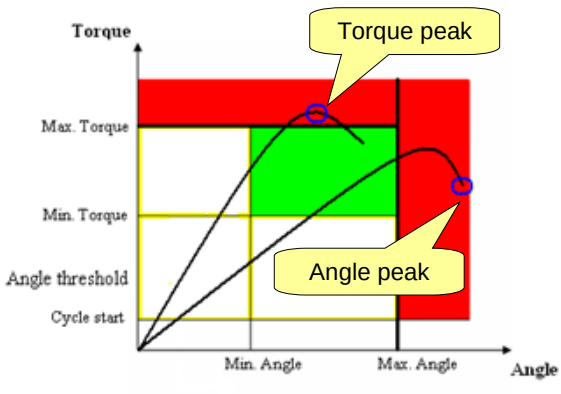


The ***Torque/Angle*** results may be as follows:

- If the *torque/angle* does not exceed the *torque/angle* limits, the result is taken at the torque peak or angle peak as specified in the *Pset* options.
- If the torque/angle goes over the limit, the result is taken as follows:



Torque peak selected in the Pset



Angle peak selected in the Pset

The Delta torque and angle LEDs are activated as follows:

Low (yellow) LED	Torque / angle lower than the minimum value.
OK (green) LED	Torque / angle within the minimum and maximum limits.
High (red) LED	Torque / angle over the maximum limits.

The buzzer is activated as follows:

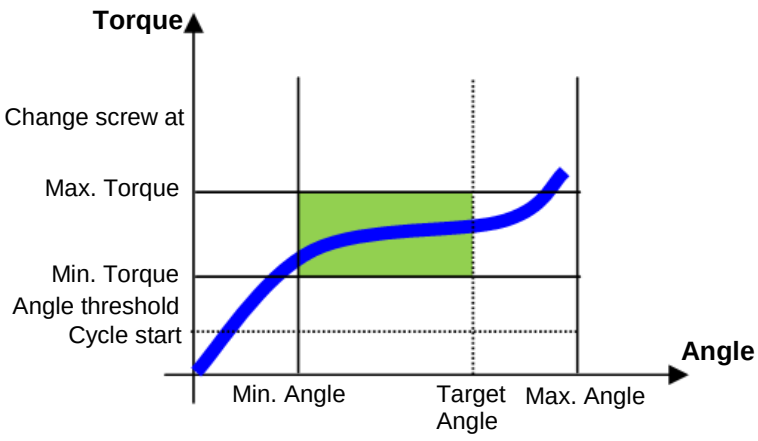
Buzzer	The beep emitted by the buzzer starts when the torque goes over the *Cycle Start* value, and it increases its signal when it is approaching the target angle. At the end of the tightening operation three more beeps inform the operator of the end of the operation; if the torque/angle goes over the maximum values, the beep is repeated at high frequency to indicate the error.

19.1.4 Prevailing torque

Prevailing Torque strategy executes a tightening where the torque must be within the minimum and maximum values during a predefined angle interval.

The *Angle threshold* parameter is the threshold from which the angle measurement starts.

The *Result* option in the *Pset* defines the result status (*OK* or *Not OK*) of the test:



- ***Average Torque***: The average torque in the *Min. Angle ÷ Target Angle* interval must be within the *Min. Torque* and *Max. Torque*.
- ***Instantaneous Torque***: All the torque values in the *Min. Angle ÷ Target Angle* interval must be within the *Min. Torque* and *Max. Torque*.

In both the above cases, the torque result is the average torque value measured in the *Min. Angle ÷ Target Angle* interval.
If the target angle is not reached, the torque and angle result is the maximum values measured, and the status is *Not OK*.
If the *Max. Angle* is exceeded, the status is *Not Ok*.

If the torque goes over the "*change screw*" value, a message is shown on the Delta display in order to advise the operator to replace the screw.

20 DELTA SETTINGS

Some of the settings can be configured directly from the *Delta* menu. Those settings change according to the *Delta* model.

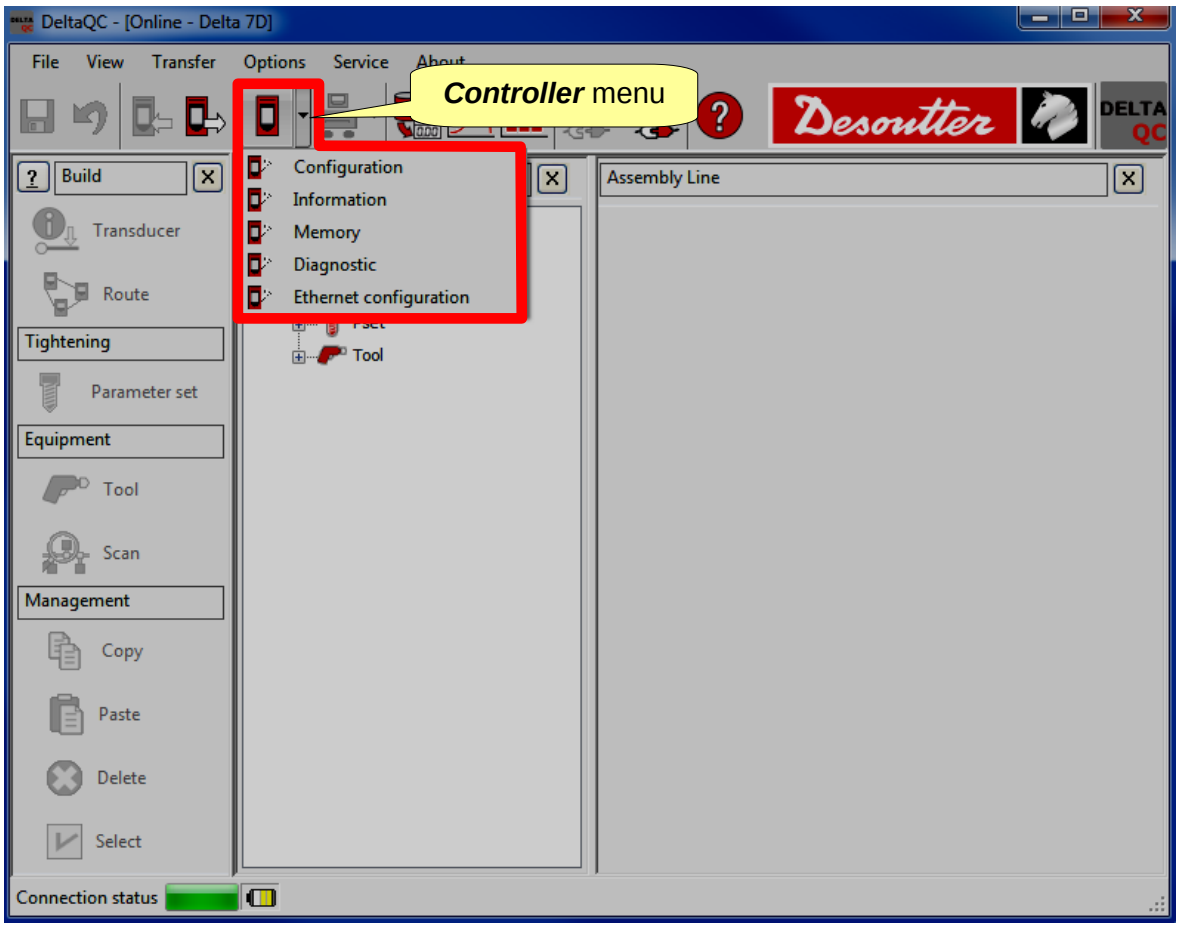
NOTE: Refer both to the paragraph "*Delta 1D Settings*" for further details about the settings of the *Delta 1D models* and to the paragraph "*Delta 6D/7D Settings*" for further details about the settings of the *Delta 6D/7D models*.

The following paragraphs show the Delta settings executed by means of the DeltaQC software. Some of them are the same settings settable from the device itself, while others can be set only by means of the software.

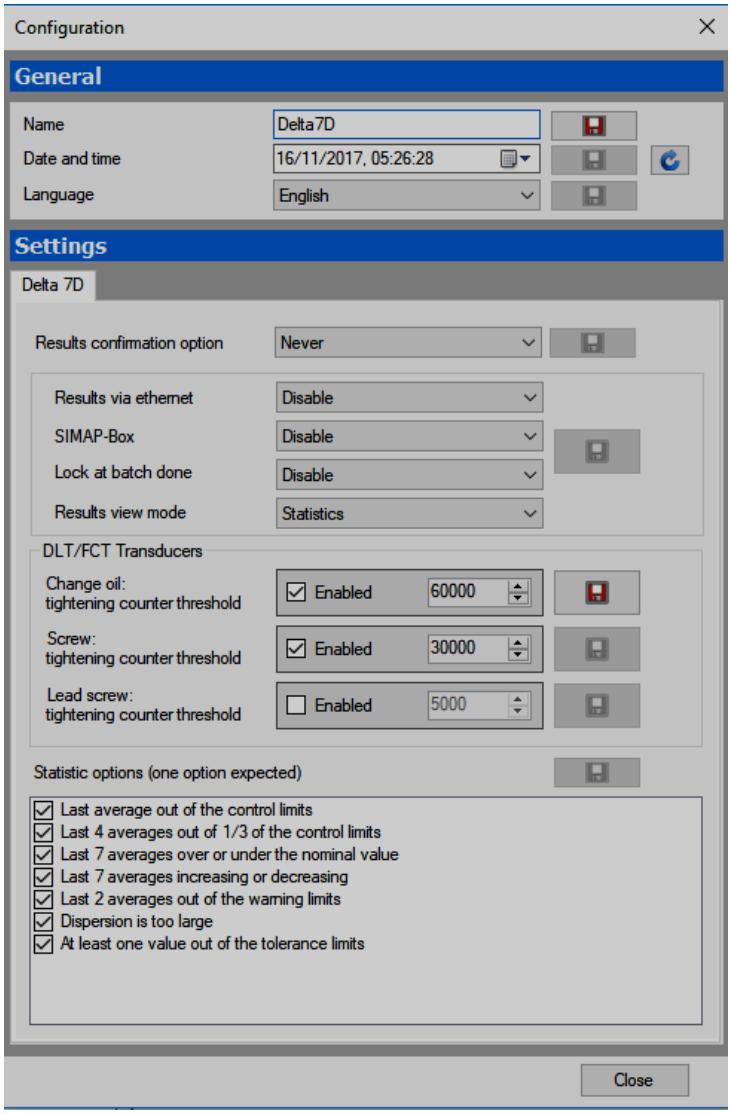
NOTE: Not all the Delta models support all of the settings described in this paragraph. Some of them may be not displayed if the firmware version does not support them.

20.1 Delta Controller Setup

The *Delta* settings are available in the ***Controller*** menu (refer to the screen below):

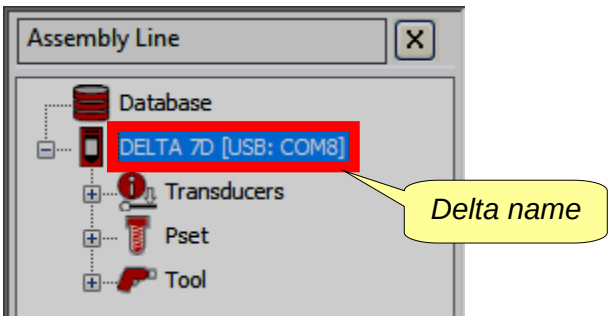


20.1.1 Configuration



Define the Delta settings (refer to the next paragraphs) and click on the **Save** icons ( ) to store the changes.

20.1.1.1 Delta name

Name	*Delta name* is reported in the *Assembly Line* area. 

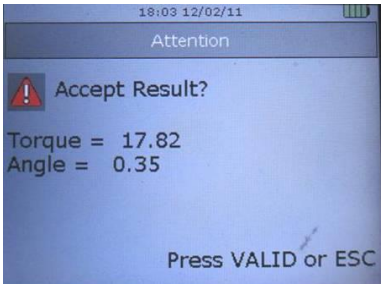
20.1.1.2 Delta date and time

Date and time	The time is shown on the main menu of the Delta display. The date and time are associated to the tightening results. Click on the Refresh icon () to align the Delta date and time to the date and time of the PC connected to the *Delta*.

20.1.1.3 Delta display Language

Language	Select the language of the *Delta* menu.

20.1.1.4 Result confirmation option

Result confirmation option	Select between the following option: ▪ ***Never***: All the tests executed are acquired as test result. ▪ ***Always***: At the end of each test, the *Delta* asks if the result must be considered or discarded. ▪ ***NOK only***: At the end of each *Not OK* test, the *Delta* asks if the result must be considered or discarded. The *Result confirmation* is shown on the display only for ***Always*** and ***NOK only*** *options* (refer to the following screen):  Click on ***Valid*** on the *Delta* keyboard to accept it, or ***Esc*** to discard. If the result is discarded, the batch count (if enabled) is not incremented.

20.1.1.5 Enabling the results via Ethernet

Results via Ethernet	By enabling this option, the *Delta* sends the test results for tool testing via Ethernet. The results are exported in the following format: **ZZZZ GG/MM/YY HH:mm:ss torque angle S\r\n** Where: - **ZZZZ** Counter, starting from 0001 and incremented after each result; it is reset when the test execution window is quit - **GG/MM/YY** Date (day/month/year) - **HH:mm:ss** Time (hours:minutes:seconds) - **torque** Torque result - **angle** Angle result - **S** Status: A if result is OK, R if Not OK - **\r** Carriage return - **\n** Line feed **NOTE**: Between torque, angle and status there are four space; if the angle is not included in the tightening, the angle filed and the four spaces are not present in the message. **NOTE**: By enabling the ***Results via Ethernet*** option, the ***SIMAP-Box*** function is automatically disabled.

20.1.1.6 Enabling the SIMAP-Box

SIMAP-Box	By enabling this option, the *Delta* sends the test results for tool testing to the SIMAP-Box by means of the serial port. The results are exported in the following format: **ZZZZ GG/MM/YY HH:mm:ss torque angle S\r\n** Where: - **ZZZZ** Counter, starting from 0001 and incremented after each result; it is reset when the test execution window is quit - **GG/MM/YY** Date (day/month/year) - **HH:mm:ss** Time (hours:minutes:seconds) - **torque** Torque result - **angle** Angle result - **S** Status: A if result is OK, R if Not OK - **\r** Carriage return - **\n** Line feed **NOTE**: Between torque, angle and status there are four space; if the angle is not included in the tightening, the angle filed and the four spaces are not present in the message. **NOTE**: By enabling the ***SIMAP-Box*** option, the ***Results via Ethernet*** function is automatically disabled. **NOTE**: By enabling the ***SIMAP-Box*** option, the serial port is no more available for the *CVI II Calibration* function; to calibrate the *CVI II*, the *SIMAP-Box* must be disabled

20.1.1.7 Lock at batch done option

Lock at batch done	If this flag is enabled, the message "*batch lock*" is shown at the end of the batch. If this flag is disabled, a new batch is started automatically by applying again torque to the transducer.

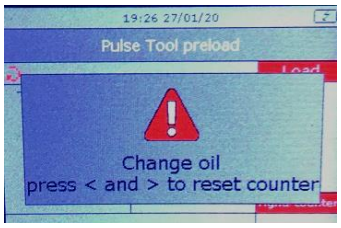
20.1.1.8 Results view mode

Results view mode	Select between the following option: ▪ ***Statistics***: Once a test is started, the statistic values are shown on the right of the screen. ▪ ***Last results***: Once a test is started, the values of the last results are shown on the right of the screen.

20.1.1.9 Barcode reader scan order

Barcode reader scan order	Select between the following option: ▪ ***Operation barcode first***: When the barcode is required for a Pset, the operation barcode is asked first. ▪ ***VIN first***: When the barcode is required for a Pset, the VIN barcode is asked first. In this case, the VIN will be associated to all the results acquired.

20.1.1.10 FCT Transducers

Change oil: tightening counter threshold	This option enables a warning pop up on the Delta display that is shown when a defined number of tightenings is made:  It warns the operator to change the oil of the FCT, and then to reset the tightening counter. ▪ Check the ***Enabled*** checkbox to enable this warning popup on Delta display. ▪ Set the number of tightenings necessary to show the ***Change oil*** warning. By default, the ***Change oil – tightening counter threshold*** is enabled and the value is set to 60000 tightenings for the FCT.

	NOTE: This popup is shown: • every time the FCT transducer is connected to Delta. • every time a Pulse tool preload Pset is selected. It is possible to reset this counter by following instructions reported in par. 5
Screw: tightening counter threshold	This option enables a warning pop up on the Delta display that is shown when the defined number of tightenings is made:  It warns the operator to replace the FCT screw and washer. ▪ Check the ***Enabled*** checkbox to enable this warning popup on Delta display. ▪ Set the number of tightening necessary to show the ***Change screw*** warning. By default, the ***Screw – tightening counter threshold*** is enabled and the value is set to 30000 tightenings for the FCT. **NOTE:** This popup is shown: • every time the FCT transducer is connected to Delta. • every time a Pulse tool preloaded Pset is selected. It is possible to reset this counter by following instructions reported in par. 5.
Lead screw: tightening counter threshold	This option enables a warning pop up on the Delta display that is shown when the defined number of tightenings is made:  It warns the operator to replace the DLT lead screw. ▪ Check the ***Enabled*** checkbox to enable this warning popup on Delta display. ▪ Set the number of tightening necessary to show the warning. By default, the ***Screw – tightening counter threshold*** is disabled and the default value is set to 5000.

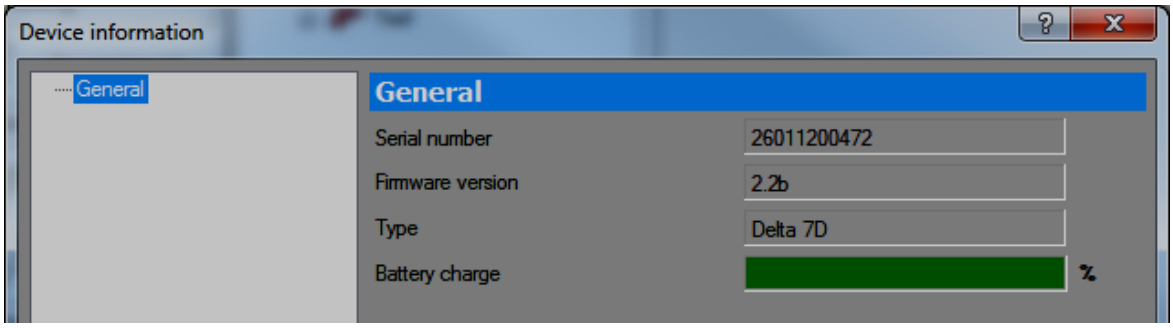
	NOTE: This popup is shown: • every time the DLT transducer is connected to Delta. • every time a Pulse tool preloaded Pset is selected. It is possible to reset this counter by following instructions reported in par. 5.

20.1.1.11 Statistic Control rules

Statistic options	Select the rules that must be applied to Statistic Process Control tests. Refer to the paragraph "*Statistic Process Control (SPC) test*" for further details.

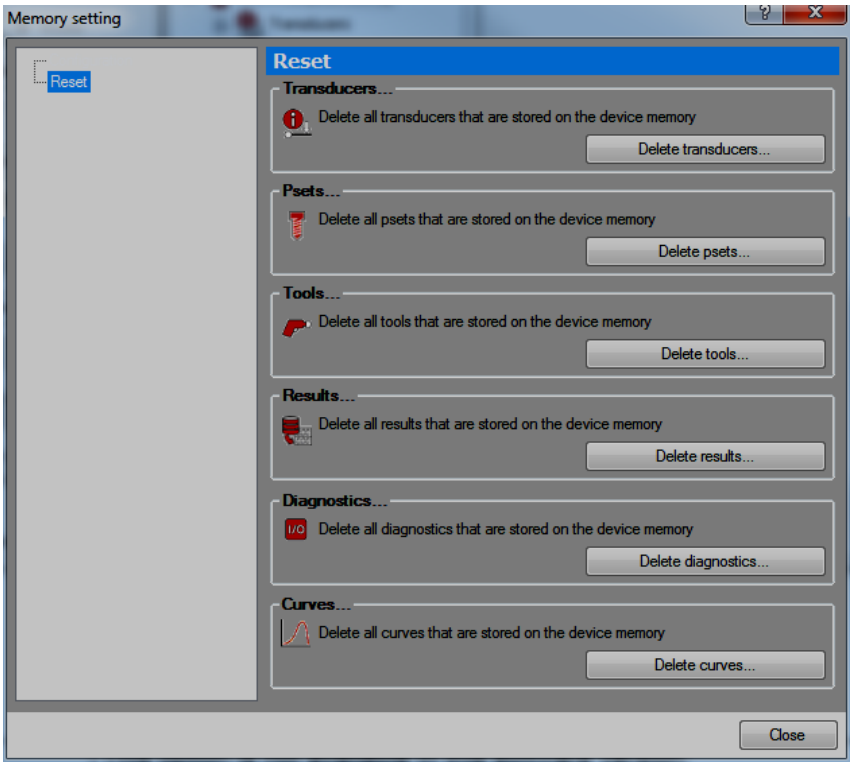
20.1.2 Information

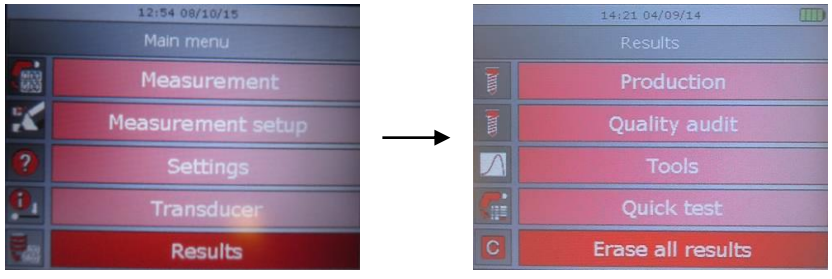
The "***Information***" screen provides some general information (for instance: *Serial number, Firmware version, Type* and *Battery charge status*):



20.1.3 Memory

From the "***Memory***" menu it is possible to delete all of the objects stored into the Delta memory.



Memory transducer	Delete all of the *Transducers* stored in the Delta memory (not from the database).
Pset	Delete all of the *Pset* stored in the Delta memory (not from the database).
Tools	Delete all of the *Tools* stored in the Delta memory (not from the database).
Results	Delete all of the *Results* stored in the Delta memory. It is also possible to delete all of the results stored in the delta, by selecting the ***Results*** → ***Erase all results*** menu:  Firstly press the ***Enter*** button on the Delta keyboard; finally press ***Valid*** to confirm or ***ESC*** to quit the operation.

Diagnostic	Erase the diagnostic test reports stored in the Delta memory.
Curves	Erase all of the curves stored in the Delta memory.

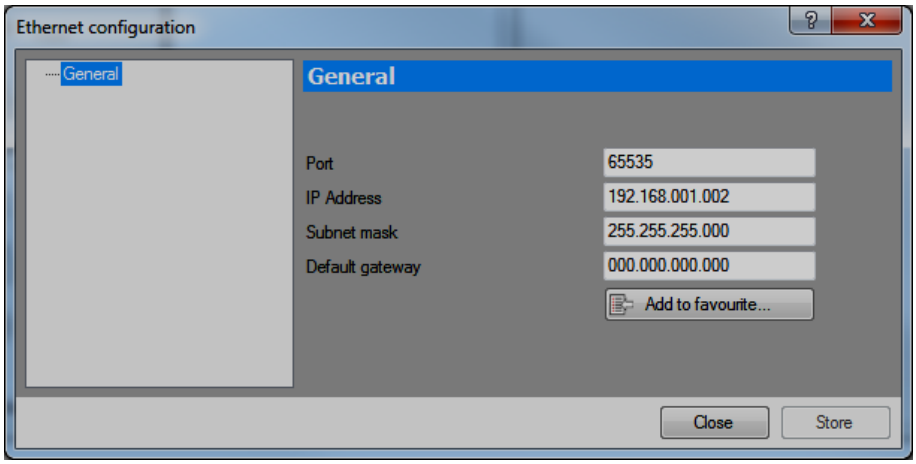
20.1.4 Diagnostic

The "***Diagnostic***" menu gives the reports of the diagnostic operations executed on the *Delta*.

NOTE: Refer to the paragraph "*Delta Diagnostic*" for further details.

20.1.5 Ethernet configuration

The "***Ethernet configuration***" menu allows the user to configure the network parameters in order to connect the *Delta* with DeltaQC software.



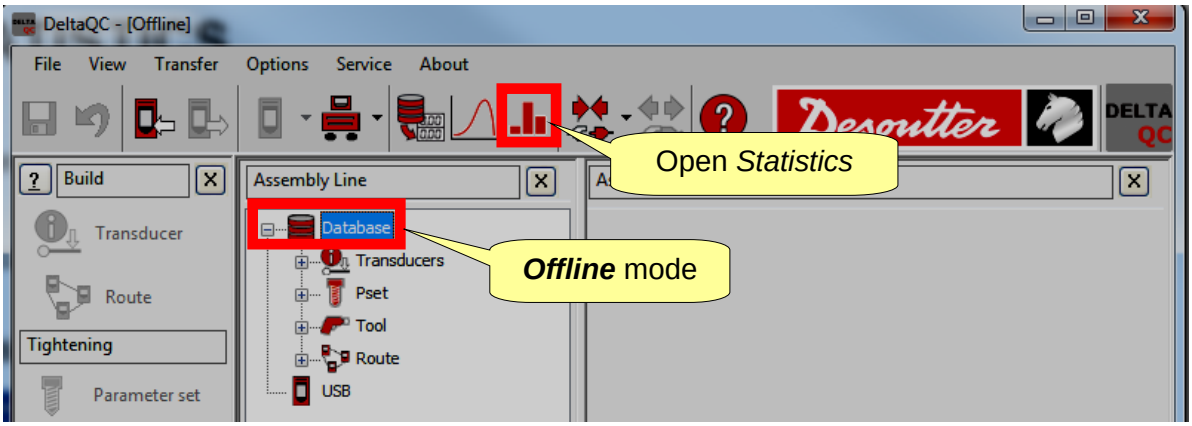
NOTE: Refer to the paragraph "*Connecting with the Delta*" for further details.

21 STATISTICS

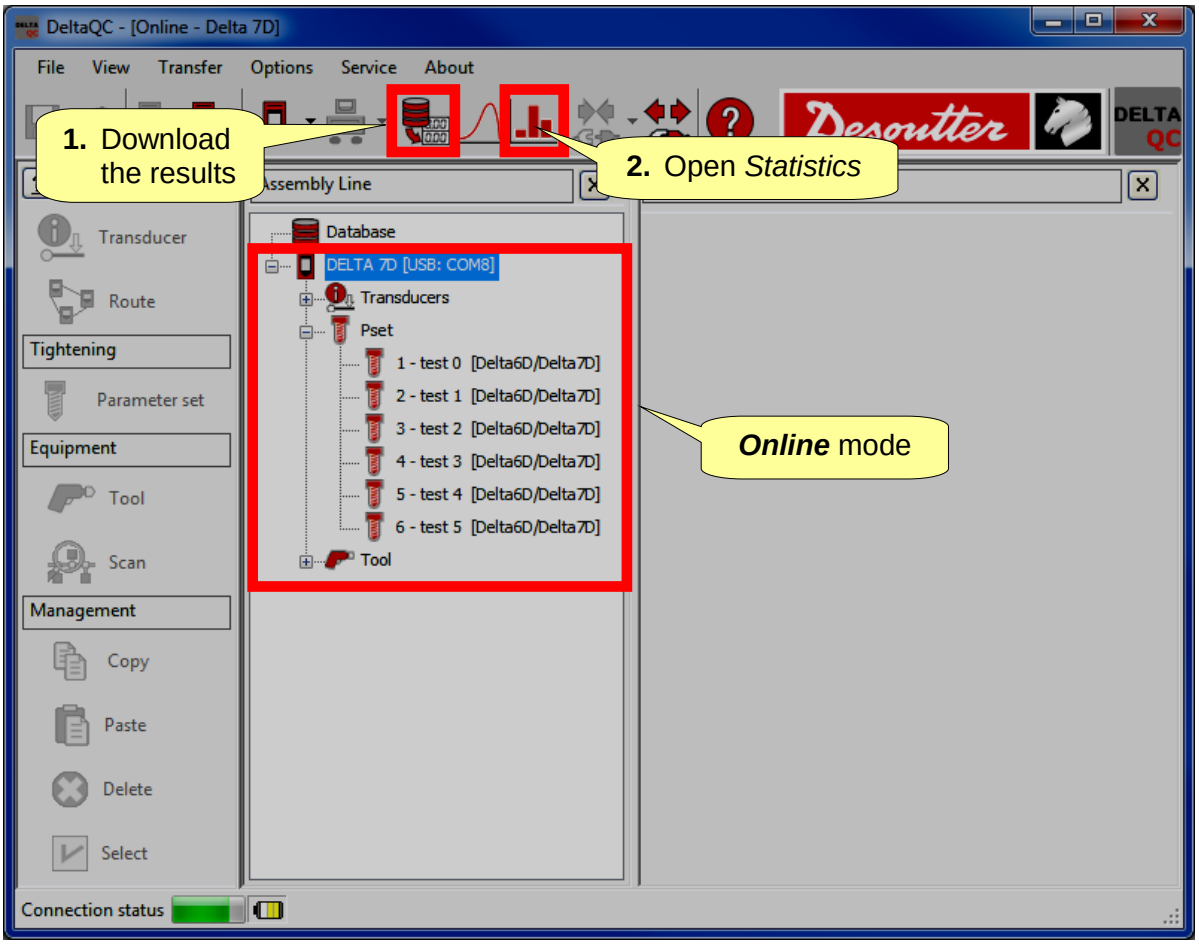
NOTE: The "***Statistics***" paragraph is not applicable to the ***Delta 1D***.

Statistics can be calculated either on the results stored inside the *Delta* or on the results located into the database:

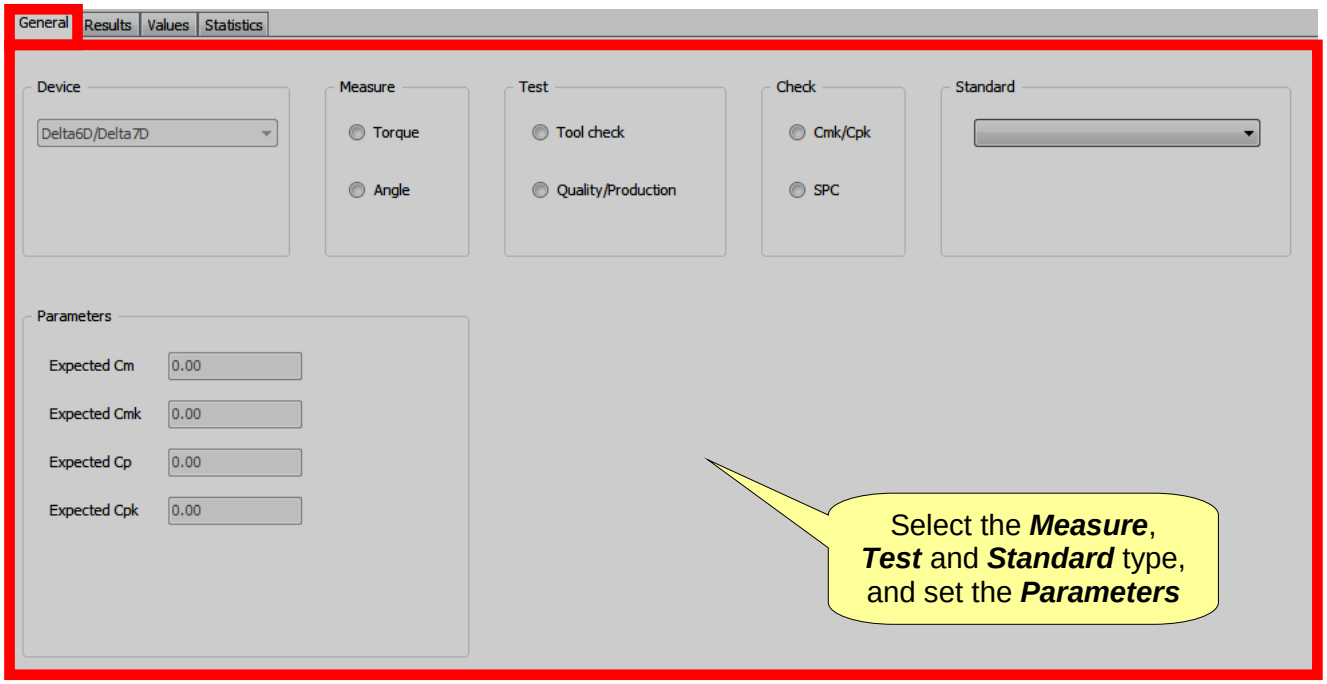
- **Database statistics**: In ***Offline*** mode, click ***Statistics***:



- **Delta statistics**: Connect to the *Delta*, download the results, and then click ***Statistics***:



When opening the *Statistics* page, the following screen is shown:



Select the ***General*** folder of the above screen.

When *offline*, select ***Delta6D/Delta7D*** to view statistics from the results produced by the Delta; if *online* (see the above screen), this *Device* field is automatically set to the **Delta6D/Delta7D**.

Select the ***Measure*** (***Torque*** and ***Angle***) on which to calculate the statistics.

Select the ***Test*** type between ***Tool check*** and ***Quality***

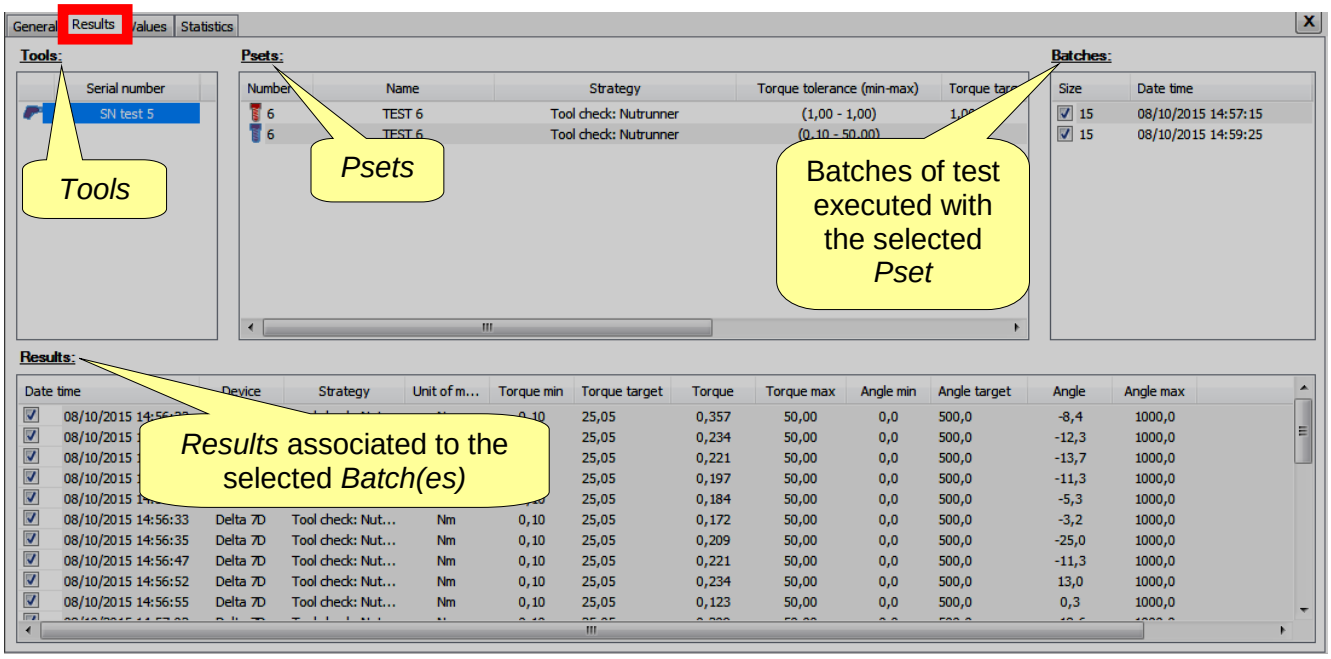
Select the ***Check*** type between ***Cmk/Cpk*** and ***SPC***.

Select the ***Standard*** between ***ISO***, ***CNOMO (E41.32.110N)***, ***NF (E 60-181)***, ***Normal Distribution Test (Shapiro-Wilk)***, ***Normal Distribution Test (Chi-Squared), Q54000:2004, Q54000:1990***. This field selects the method used to calculate the statistical parameters (refer to the next paragraphs of this chapter for further details about the statistical computation formulas used by the DeltaQC software).

Set the expected value (minimum values acceptable) for the parameters shown in the ***Parameters*** box.

NOTE: In the ***Parameter***s box, only the parameters applicable to the ***Test*** and ***Standard*** type selected are shown.

Once the ***General*** page is set, select the ***Results*** page:



Firstly, select a ***Tool***.

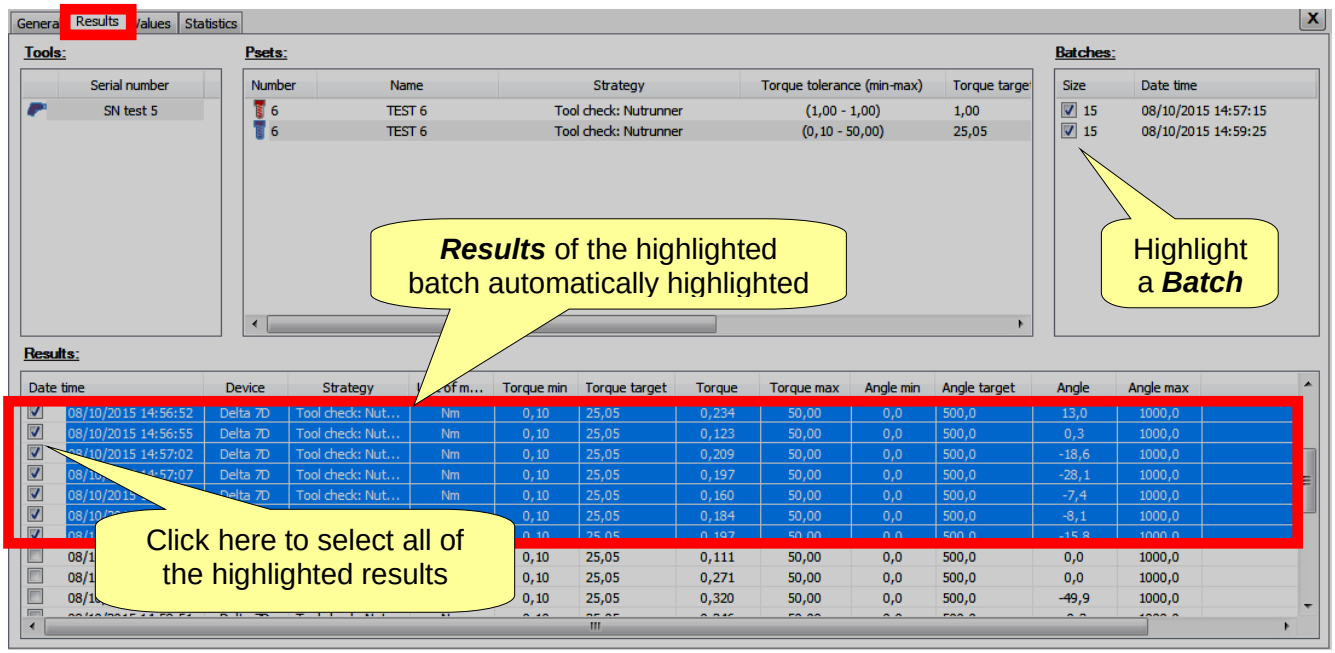
Then select a ***Pset***.

NOTE: The *Psets* shown are only the *Psets* associated to the selected *Tool*. If the ***Test*** type selected in the previous step is ***Quality/Production***, the ***Tool*** box is disabled.

Select one or more ***Batches*** containing the results of the tests executed with the selected *Pset*. Note that a multiple selection is valid only for batches with same ***Size*** (shown on the column on the right).

NOTE: For the *"Tool check: Free Angle" strategy*, select only one batch. Only a single selection is valid because the statistic report is based on a single batch execution.

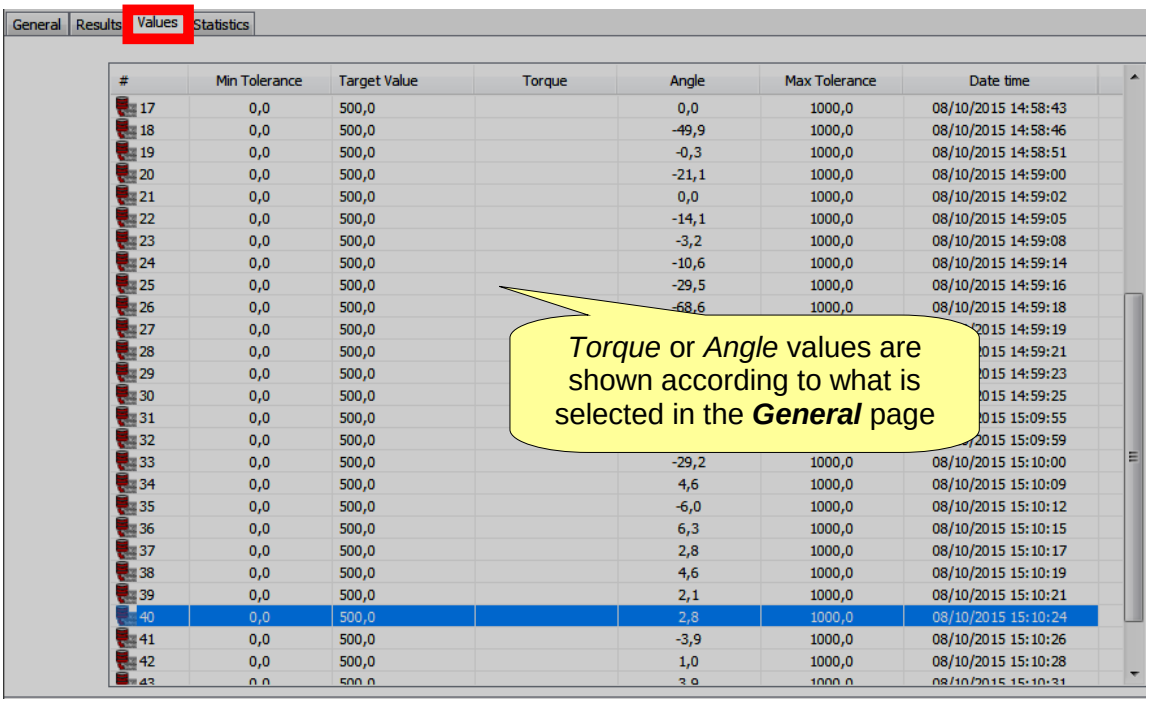
After selecting the *Statistic type* in the ***General*** section, in the ***Results*** section it is possible to show and select the results. Select here the results to be used to calculate the *statistics*. When all of the batches are selected, highlighting a batch makes all of the related results highlighted automatically, and it is possible to select all of them:



To select all of the results shown in the screen above, right-click one of it and select "***Select all***":

Date time	Device	Strategy	Unit of m...	Torque min	Torque target	Torque	Torque max	Angle min	Angle target	Angle	Angle max
08/10/2015 14:56:52	Delta 7D	Tool check: Nut...	Nm	0,10	25,05	0,234	50,00	0,0	500,0	13,0	1000,0
08/10/2015 14:56:55	Delta 7D	Tool check: Nut...	Nm	0,10	25,05	0,123	50,00	0,0	500,0	0,3	1000,0
08/10/2015 14:57:02	Delta 7D	Tool check: Nut...	Nm	0,10	25,05	0,209	50,00	0,0	500,0	-18,6	1000,0
08/10/2015 14:57:			Nm	0,10	25,05	0,197	50,00	0,0	500,0	-28,1	1000,0
08/10/2015 14:57:			Nm	0,10	25,05	0,160	50,00	0,0	500,0	-7,4	1000,0
08/10/2015 14:57:			Nm	0,10	25,05	0,184	50,00	0,0	500,0	-8,1	1000,0
08/10/2015 14:57:			Nm	0,10	25,05	0,197	50,00	0,0	500,0	-15,8	1000,0
08/10/2015 14:58:40	Delta 7D	Tool check: Nut...	Nm	0,10	25,05	0,111	50,00	0,0	500,0	0,0	1000,0
08/10/2015 14:58:43	Delta 7D	Tool check: Nut...	Nm	0,10	25,05	0,271	50,00	0,0	500,0	0,0	1000,0
08/10/2015 14:58:46	Delta 7D	Tool check: Nut...	Nm	0,10	25,05	0,320	50,00	0,0	500,0	-49,9	1000,0

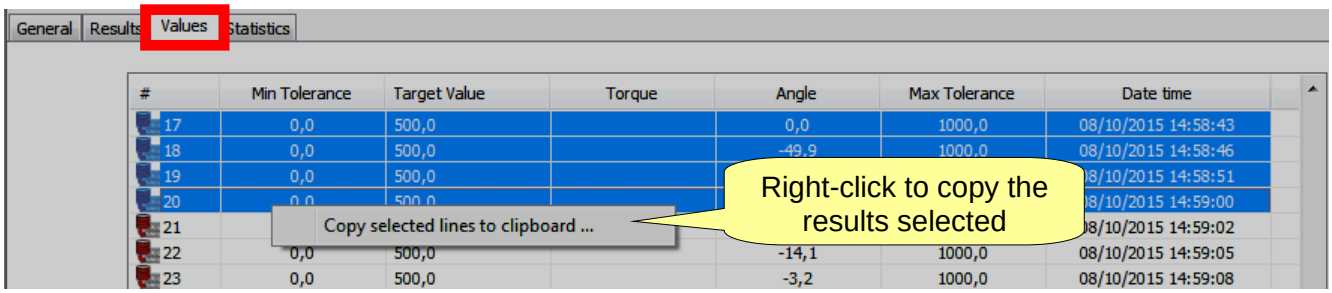
After setting the ***Results*** page, select the ***Values*** folder to load and show the results:



#	Min Tolerance	Target Value	Torque	Angle	Max Tolerance	Date time
17	0,0	500,0		0,0	1000,0	08/10/2015 14:58:43
18	0,0	500,0		-49,9	1000,0	08/10/2015 14:58:46
19	0,0	500,0		-0,3	1000,0	08/10/2015 14:58:51
20	0,0	500,0		-21,1	1000,0	08/10/2015 14:59:00
21	0,0	500,0		0,0	1000,0	08/10/2015 14:59:02
22	0,0	500,0		-14,1	1000,0	08/10/2015 14:59:05
23	0,0	500,0		-3,2	1000,0	08/10/2015 14:59:08
24	0,0	500,0		-10,6	1000,0	08/10/2015 14:59:14
25	0,0	500,0		-29,5	1000,0	08/10/2015 14:59:16
26	0,0	500,0		-68,6	1000,0	08/10/2015 14:59:18
27	0,0	500,0				2015 14:59:19
28	0,0	500,0				2015 14:59:21
29	0,0	500,0				2015 14:59:23
30	0,0	500,0				2015 14:59:25
31	0,0	500,0				2015 15:09:55
32	0,0	500,0				2015 15:09:59
33	0,0	500,0		-29,2	1000,0	08/10/2015 15:10:00
34	0,0	500,0		4,6	1000,0	08/10/2015 15:10:09
35	0,0	500,0		-6,0	1000,0	08/10/2015 15:10:12
36	0,0	500,0		6,3	1000,0	08/10/2015 15:10:15
37	0,0	500,0		2,8	1000,0	08/10/2015 15:10:17
38	0,0	500,0		4,6	1000,0	08/10/2015 15:10:19
39	0,0	500,0		2,1	1000,0	08/10/2015 15:10:21
40	0,0	500,0		2,8	1000,0	08/10/2015 15:10:24
41	0,0	500,0		-3,9	1000,0	08/10/2015 15:10:26
42	0,0	500,0		1,0	1000,0	08/10/2015 15:10:28

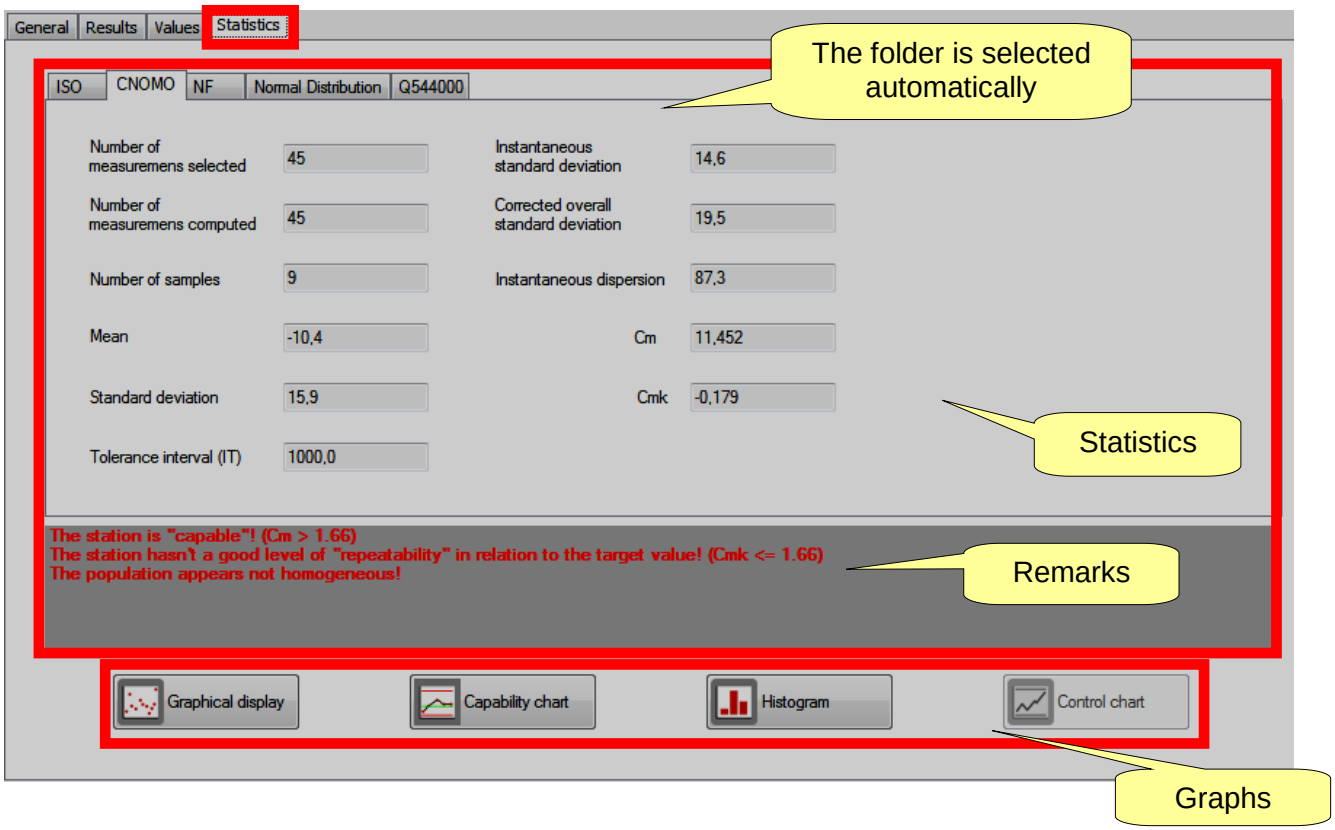
NOTE: After any change in the previous windows (for instance, changing the statistic type or including different batches), click again on this folder to load the relevant results to be shown in the next folder (***Statistics***).

Right-click the table to copy the results selected in the clipboard:



#	Min Tolerance	Target Value	Torque	Angle	Max Tolerance	Date time
17	0,0	500,0		0,0	1000,0	08/10/2015 14:58:43
18	0,0	500,0		-49,9	1000,0	08/10/2015 14:58:46
19	0,0	500,0				8/10/2015 14:58:51
20	0,0	500,0				8/10/2015 14:59:00
21						8/10/2015 14:59:02
22	0,0	500,0		-14,1	1000,0	08/10/2015 14:59:05
23	0,0	500,0		-3,2	1000,0	08/10/2015 14:59:08

Once the three previous pages have been properly set, the statistics and reports for the selected results are shown in the ***Statistics*** page:

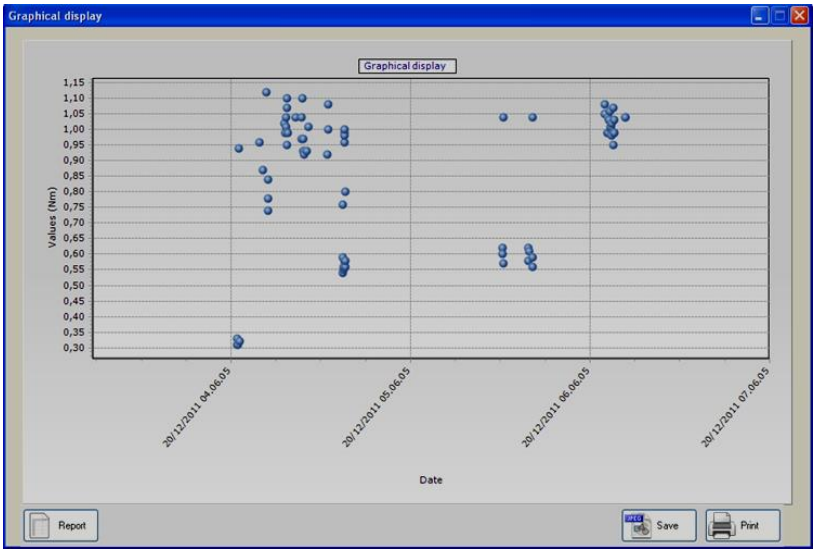


This window selects automatically the folder ISO, CNOMO, NF or Normal Distribution, according to what has been selected previously (in the ***General*** page). The main window shows the statistics associated to the results (refer to the paragraph "*Statistical Computation*" for further details).

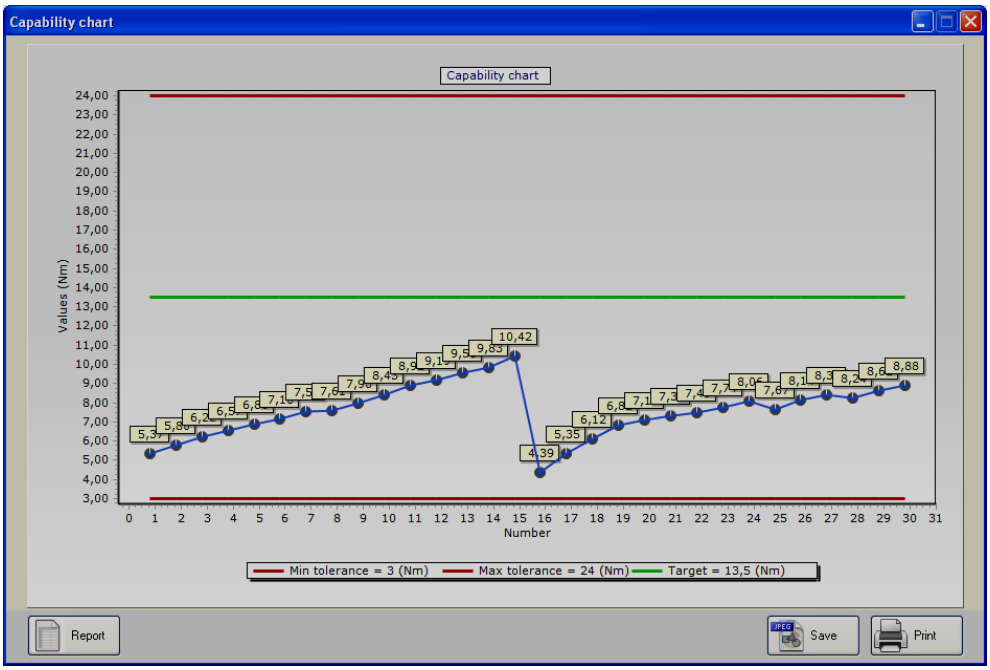
In the bottom part of the above screen, the user can choose one of four graphs.

In each graph, it is possible to zoom an area by selecting it with the mouse, and browse the zoomed view right-clicking and moving the mouse.

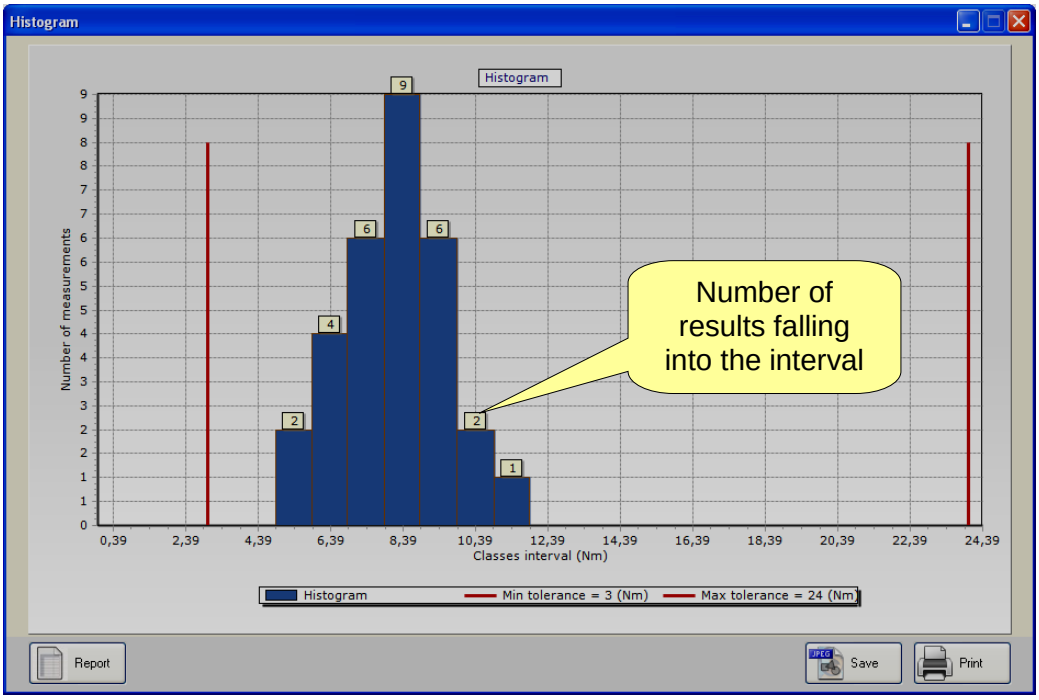
The ***Graphical display*** shows all of the results versus the date of the test:



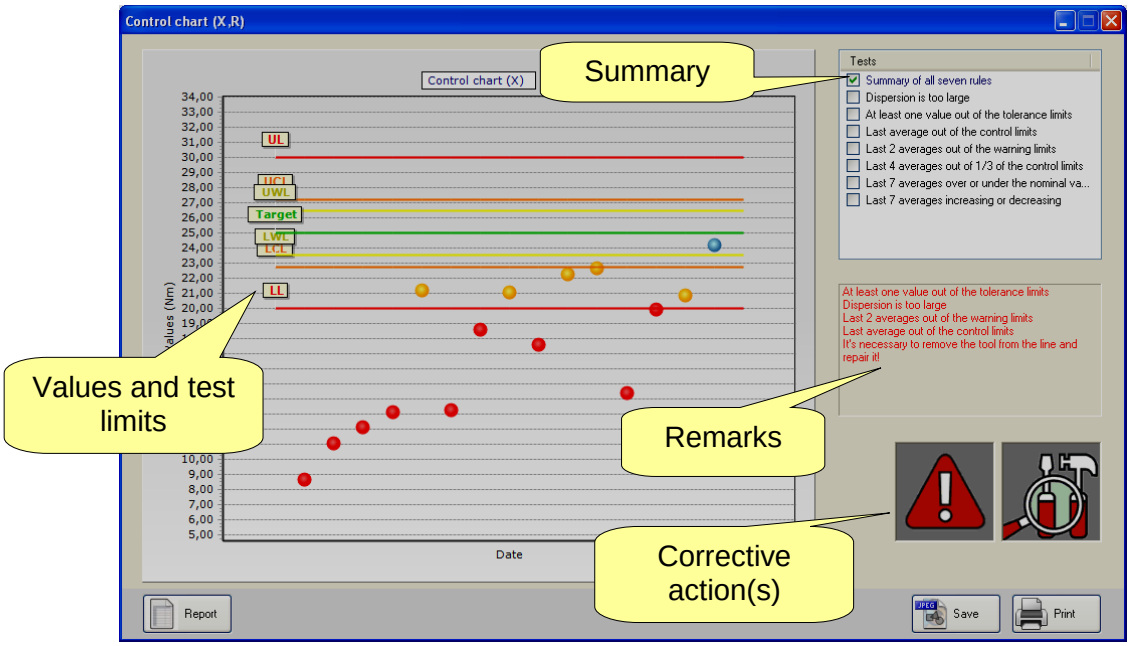
The ***Capability chart*** shows all of the results in sequence:



The ***Histogram*** shows all of the results in a histogram graph detailing how many result fall into a certain interval:



The ***Control chart*** shows the X,R graphs for the statistic control tests:



The summary shows all of the results with the test target and limits values (note that if a set of tests was performed in a Cm-Cmk test having batch number over ten, only the last ten results of that batch are considered).

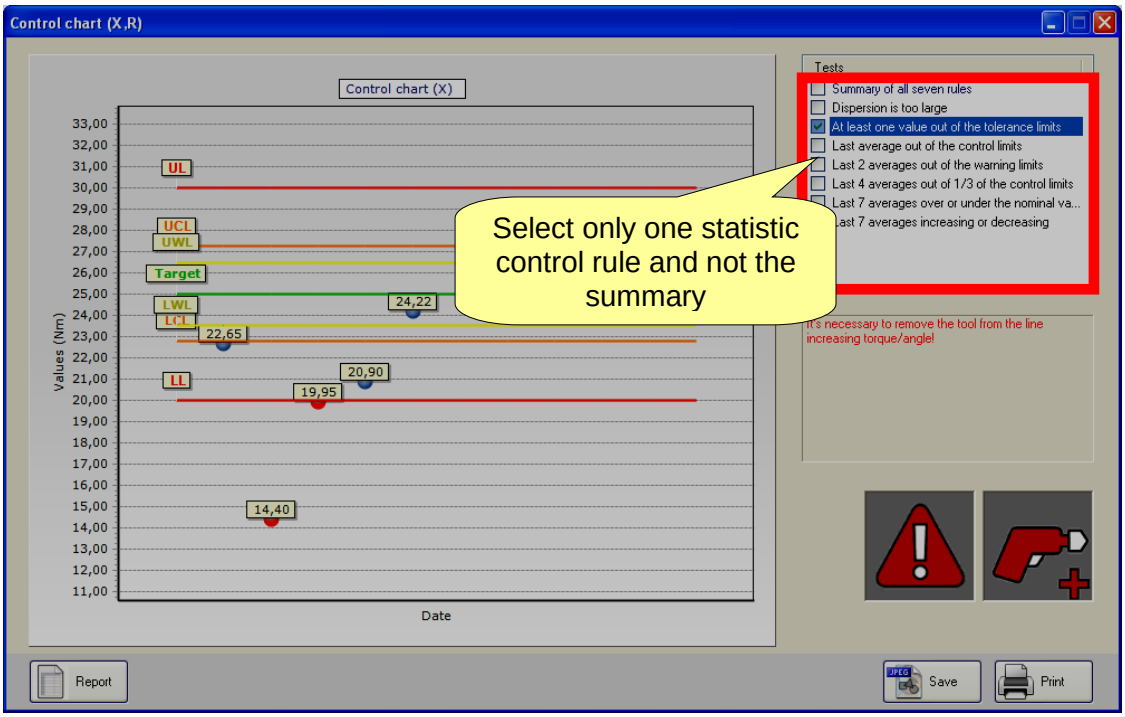
On the right the ***Remarks*** box details which rule(s) has been failed the test.

NOTE: All of the seven rules are considered here, while on the Delta it is possible to enable/disable the various rules.

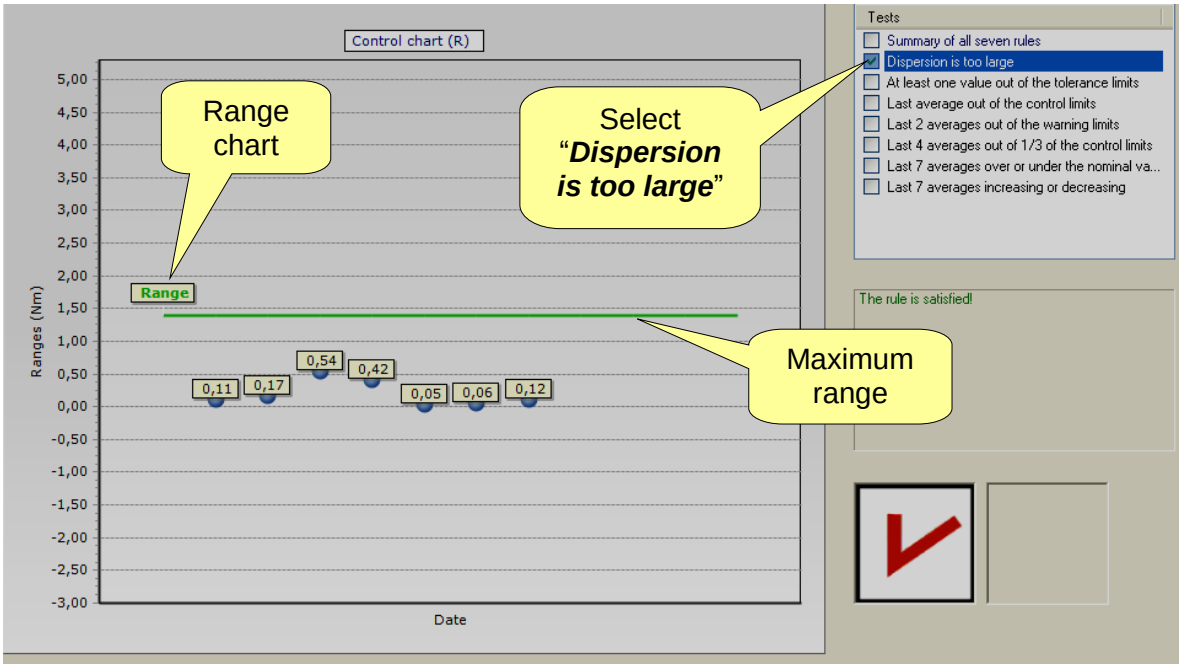
The ***Corrective action*** icons show if the tool/process is OK, or if it needs to be recalibrated increasing or decreasing the torque. The exclamation mark is shown when the values are out of the tolerance limit: thus the tool/process must be stopped for repair. If the exclamation mark is not shown, the corrective action should be taken to prevent errors, but the tool/process is still within the tolerance limits.

NOTE: Refer to the paragraph "*Statistic Process Control (SPC) test*" for further details.

By selecting only one statistic control rule and not the summary, the graph shows only the relevant data:



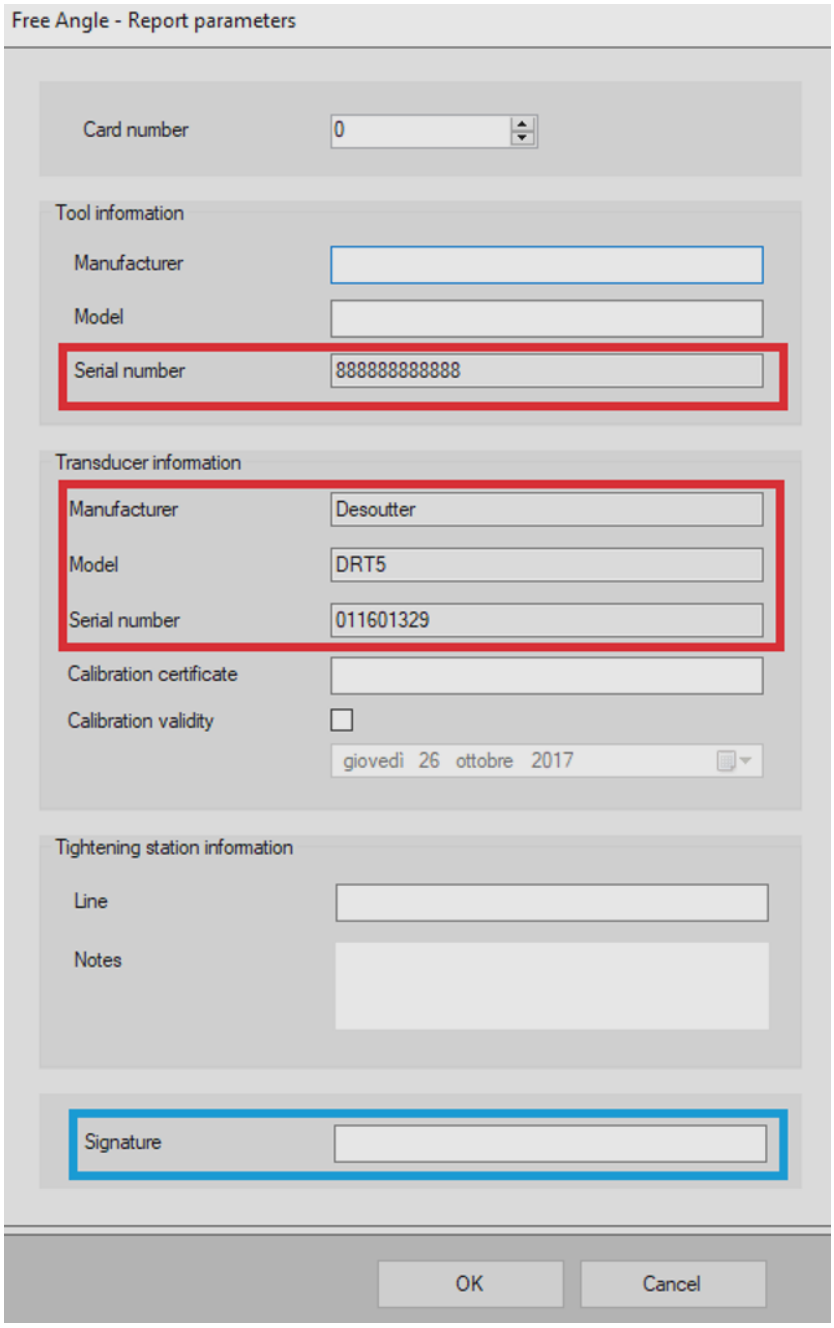
By selecting the rule "***Dispersion is too large***", the R (range) graph is shown:



In the above chart the result is ***OK*** if the last range is within the range limit.

In case of *"Tool check: Free Angle" strategy*, in the bottom part of the ***Statistics*** page, only the ***Report*** button is available.

Click ***Report*** button; the following ***Free Angle – Report parameters*** dialog box is displayed:



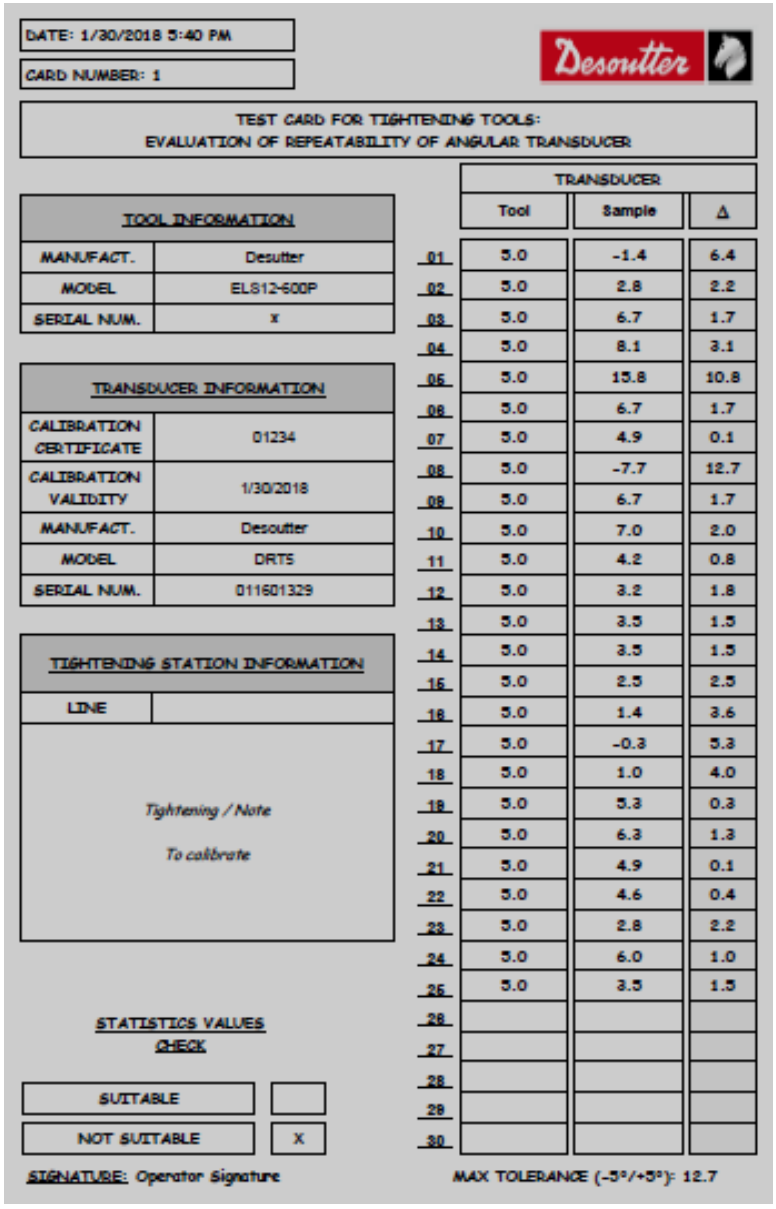
In the ***Free Angle – Report parameters*** dialog box, the following information are read-only parameters:

- *Tool information section – Serial number*
- *Transducer information section – Manufacturer*
- *Transducer information section – Model*
- *Transducer information section – Serial number*

Enter the missing parameters manually, according to customers need.

It is mandatory to enter the ***Signature***.

Below is a report sample:



DATE: 1/30/2018 5:40 PM

CARD NUMBER: 1

TEST CARD FOR TIGHTENING TOOLS:
EVALUATION OF REPEATABILITY OF ANGULAR TRANSDUCER

TOOL INFORMATION	
MANUFACT.	Desoutter
MODEL	ELS12-600P
SERIAL NUM.	x

TRANSDUCER INFORMATION	
CALIBRATION CERTIFICATE	01234
CALIBRATION VALIDITY	1/30/2018
MANUFACT.	Desoutter
MODEL	DRTS
SERIAL NUM.	011601329

TIGHTENING STATION INFORMATION	
LINE	

Tightening / Note

To calibrate

STATISTICS VALUES CHECK

SUITABLE	
NOT SUITABLE	X

SIGNATURE: Operator Signature

	TRANSDUCER		
	Tool	Sample	Δ
01	5.0	-1.4	6.4
02	5.0	2.8	2.2
03	5.0	6.7	1.7
04	5.0	8.1	3.1
05	5.0	15.8	10.8
06	5.0	6.7	1.7
07	5.0	4.9	0.1
08	5.0	-7.7	12.7
09	5.0	6.7	1.7
10	5.0	7.0	2.0
11	5.0	4.2	0.8
12	5.0	3.2	1.8
13	5.0	3.5	1.5
14	5.0	3.5	1.5
15	5.0	2.5	2.5
16	5.0	1.4	3.6
17	5.0	-0.3	5.3
18	5.0	1.0	4.0
19	5.0	5.3	0.3
20	5.0	6.3	1.3
21	5.0	4.9	0.1
22	5.0	4.6	0.4
23	5.0	2.8	2.2
24	5.0	6.0	1.0
25	5.0	3.5	1.5
26			
27			
28			
29			
30			

MAX TOLERANCE (-5°/+5°): 12.7

On the right of the above report, the *Tool* column shows the target angle, the *Sample* column shows the angle result and the *Delta (Δ)* column shows the difference between the target angle and the angle result.

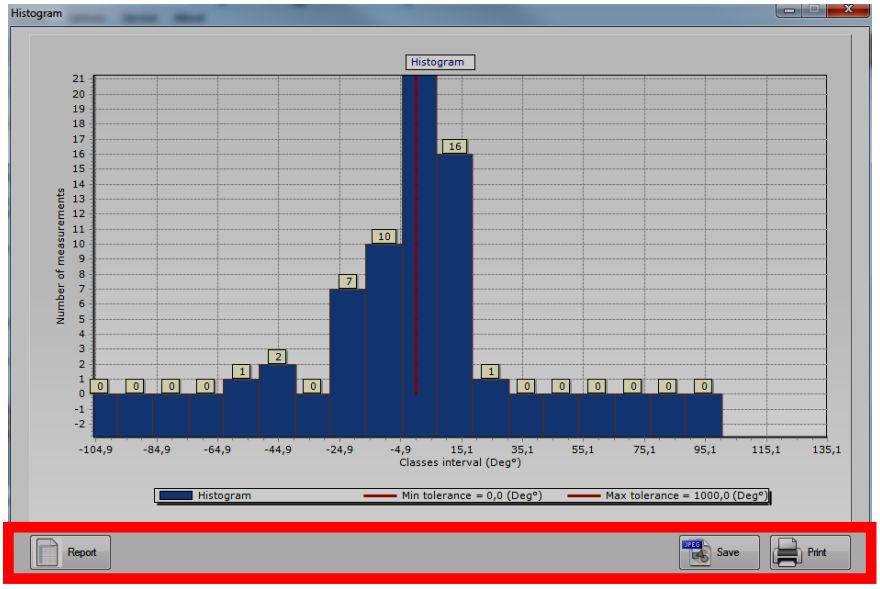
The *Max Tolerance* is fixed to -5°/+5° degrees.

The statistic check is either suitable (if all the *Delta (Δ)* between the target angle and the angle result are within the angle limits) or not suitable (if one or more *Delta (Δ)* between the target angle and the angle result are out the angle limits).

NOTE: Download the report in one of the supported languages (*English, French, German, Italian, Spanish* and *Chinese*).

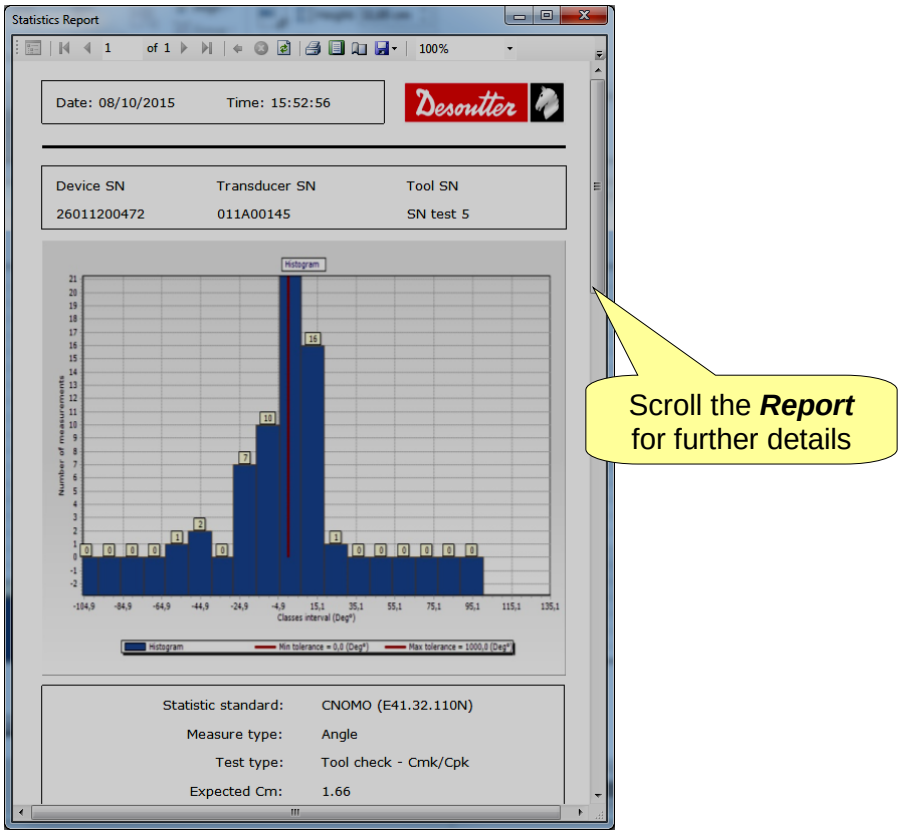
21.1 Exporting the Graph

Each graph shown above provides few commands to create/export/print the report:



Click on ***Save*** to export the graph into a JPEG file, or ***Print*** to print the graph.

Click on ***Report*** to create the following report:



This report shows detailed information about the results. The toolbar in the upper area of this report provides commands to print the report, or to export it into an Excel or PDF file.

21.2 Statistical Computation

21.2.1 Real time statistics on the Delta display

Mean value (average): $\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$

Standard deviation: $\sigma = \sqrt{\frac{1}{n-1}\left[\left(\sum_{i=1}^{n} X_i^2\right) - n\overline{X}^2\right]}$

Minimum value (Min): $\min = \min(X_i)\ ,\ 1 \le \boldsymbol{i} \le \boldsymbol{n}$

Maximum value (Max): $\max = \max(X_i)\ ,\ 1 \le \boldsymbol{i} \le \boldsymbol{n}$

Cm, ***Cmk***, ***Cpk***, ***CAM***: Refer to the next paragraphs.

21.2.2 CNOMO standard E41.32.110N

Instantaneous standard deviation: σ_i

Estimated from the mean range $\overline{W}$ of the samples of 5 measurements which form the population.

$$\sigma_i = \frac{\overline{W}}{d5}$$

Where:

$$\overline{W} = \frac{\sum W}{K}$$

W = range of measurements on each sample = max. value - min. value

K = number of samples of 5 measurements

$d5 = 2.326 - \frac{1.645 \times 0.864}{\sqrt{K}}$, coefficient for a 95% confidence threshold.

Instantaneous dispersion: D_i

$$D_i = 6 \times \sigma_i$$

Process capability: CAM

$$CAM = \frac{IT}{D_i}$$

Where:

IT (Tolerance Interval) = Max. tolerance - Min. tolerance

Testing the homogeneity of the population:

Each sample of measurements W must comply with:

$$\overline{W} < 0.643 \times \frac{IT}{CAMcdc}$$

Standard deviation: σ

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \overline{x})^2}{N-1}}$$

Where:

$$\overline{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$ (population mean)

x_i = population value

N = number of measurements of the population

Corrected overall standard deviation: σ_0

$$\sigma_0 = C \times \sigma$$

Where:

C is a function of the number of samples:

Number of samples	Coefficient C
3	1.51
4	1.41
5	1.34
6	1.28
7	1.26
8	1.24
9	1.22
10	1.21
11	1.19
12	1.18
13	1.17
14	1.17
15	1.16
16	1.15
17	1.15
18	1.14
19	1.14
20 to 22	1.13
23 to 25	1.12
26 to 31	1.11
32 to 35	1.10
36 to 44	1.09
45 to 51	1.08

Coefficient of position and dispersion: Cpk

$$C_{pk} = \min\left[\frac{Tol_{\max} - \overline{X}}{3\sigma_0}, \frac{\overline{X} - Tol_{\min}}{3\sigma_0}\right]$$

The station is “capable” if the CAM is higher than the “specified CAM”.

The setting is correct if the Cpk is higher than the “specified Cpk”.

21.2.3 ISO standard

Standard deviation: σ

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \overline{x})^2}{N-1}}$$

Where:

$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$ (population mean)

x_i = population value

N = number of measurements of the population

Process Capability: C_p

$$Cp = \frac{IT}{6\sigma}$$

Where:

IT (Tolerance Interval) = Max. tolerance - Min. tolerance

σ = Standard deviation

Coefficient of position and dispersion: C_{pk}

$$C_{pk} = \min\left[\frac{Tol_{\max} - \bar{X}}{3\sigma}, \frac{\bar{X} - Tol_{\min}}{3\sigma}\right]$$

21.2.4 NF standard E 60-181

s_{ie} = estimator of the intrinsic standard deviation for each mode number, where $2 \le e \le k$ (k is the number of samples).

$S_{ie} = \sqrt{\frac{\sum_{i=1}^{N}(x_{ie} - \bar{x}_e)^2}{N-1}}$; $\bar{x}_e = \frac{\sum_{i=1}^{N} x_{je}}{N}$ (where N is the size of the sample)

$S_i = \sqrt{\frac{1}{k}\sum_{e=1}^{N} S_{ie}{}^2}$; $D_i = 6 \times S_i$

$CAM = \frac{IT}{D_i}$ (where IT (Tolerance Interval) = Max. tolerance - Min. tolerance)

$$S_p = \sqrt{\frac{\sum_{i=1}^{N}\left(x_i - \bar{x}\right)^2}{N-1}} \; ; \; \bar{x}_e = \frac{\sum_{i=1}^{N} x_j}{N}$$

$$C_{pk} = \min\left[\frac{Tol_{\max} - \bar{X}}{3\sigma}, \frac{\bar{X} - Tol_{\min}}{3\sigma}\right]$$

$$Cap = \frac{IT}{6S_p}$$

21.2.5 Normal Distribution Test: Population under 50 measurements (Shapiro-Wilk test)

1) Calculation of S^2:

$S^2 = \sum_{i=1}^{N}\left(x_i - \bar{x}\right)^2$ (where $\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$ and N is the number of measurements of the population)

2) Calculation of b:

$$b = \sum_{i=1}^{K} a_i \times d_i$$

Where: $d_i = X_{N-i+1} - X_i$

a_i: See table below

K= N/2 if N is even, and K= (N-1)/2 if N is odd

I/N	15	20	25	30	35	40	45	50
1	0.5150	0.4734	0.4450	0.4254	0.4096	0.3964	0.3850	0.3751
2	0.3306	0.3211	0.3069	0.2944	0.2834	0.2737	0.2635	0.2574
3	0.2495	0.2565	0.2543	0.2487	0.2427	0.2368	0.2313	0.2260
4	0.1878	0.2085	0.2148	0.2148	0.2127	0.2098	0.2065	0.2032
5	0.1353	0.1686	0.1822	0.1870	0.1883	0.1878	0.1865	0.1847
6	0.0880	0.1334	0.1539	0.1630	0.1673	0.1691	0.1695	0.1691
7	0.0433	0.1013	0.1283	0.1415	0.1487	0.1526	0.1545	0.1554
8	0.0000	0.07111	0.1046	0.1219	0.1317	0.1376	0.1410	0.1430
9		0.0422	0.0823	0.1036	0.1160	0.1237	0.1286	0.1317
10		0.0140	0.0610	0.0862	0.1013	0.1108	0.1170	0.1212

I/N	15	20	25	30	35	40	45	50
11		0.0000	0.0403	0.0697	0.0873	0.0986	0.1062	0.1113
12			0.0200	0.0537	0.0739	0.0870	0.0959	0.1020
13			0.0000	0.0381	0.0610	0.0759	0.0860	0.0932
14				0.0227	0.0484	0.06510	0.0765	0.0846
15				0.0076	0.0361	0.0546	0.0673	0.0764
16				0.0000	0.0239	0.0444	0.0584	0.0685
17					0.0119	0.0343	0.0497	0.0608
18					0.0000	0.0244	0.0412	0.0532
19						0.0146	0.0328	0.0459
20						0.0049	0.0245	0.0386
21						0.0000	0.0163	0.0314
22							0.0081	0.0244
23							0.0000	0.0174
24								0.0104
25								0.0035

3) Calculation of W:

$$W = \frac{b^2}{S^2}$$

Could be a 5% probability that there is not a normal distribution if W is lower than W95 given in the following table:

N	W95
15	0.881
20	0.905
25	0.918
30	0.927
35	0.934
40	0.940
45	0.945
50	0.947

21.2.6 Normal Distribution Test: Population under 50 measurements (Chi-Squared test)

1) Distribute into classes of at least 4 or 5 measurements.

2) Calculate the mean and standard deviation mean:

$$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

Standard deviation:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N-1}}$$

3) Calculate for each class limit l_i:

$$u_i = \frac{l_i - \bar{x}}{\sigma}$$

4) Calculate:

$$\chi_i = \sum \frac{(n_i - n_i')^2}{n_i'}$$

Where:

n = number of measurements in class i

n' = theoretical number of measurements for a normal distribution

$$n_i' = N[F(u_i) - F(u_{i-1})]$$

F(u_i): Reduced table of normal distribution

Could be a 5% probability that there is not a normal distribution if χ^2 is higher than χ^2 given in table below:

d	χ^2
1	3.84
2	5.99
3	7.81
4	9.49
5	11.07
6	12.59

d	χ^2
7	14.07
8	15.51
9	16.92
10	18.31
11	19.67
12	21.03
13	22.36
14	23.68
15	25.00
16	26.30
17	27.59
18	28.87
19	30.14
20	31.41

21.2.7 Q544000

Q544000_1990:

The ***dispersion*** for the j-th group is calculated as follows:

$W_j = Max_j - Min_j$

Where:

Max_j is the maximum value in the samples of the j-th group.

Min_j is the minimum value in the samples of the j-th group.

The ***average value*** of the W_j is calculated as follows:

$$\overline{W} = \frac{\sum W_j}{K}$$

The σ_i is calculated as follows:

$$\sigma_i = \frac{\overline{W}}{dn*}$$

Where:

dn* is calculated from the following table based on the number of samples:

N	dn*	C
10	0.500	1.64
12	0.555	1.55
14	0.598	1.48
16	0.632	1.43
18	1.097	1.40
20	1.412	1.37
24	1.468	1.32
28	1.521	1.30
30	1.746	1.28
35	1.789	1.26
40	1.824	1.24
50	1.877	1.21

And σ_i refers to the whole set of samples.

The σ_0 is calculated as follows:

$$\sigma_0 = C \cdot \sigma$$

Where:

C is given in the table above

$$\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\left(X_i - \overline{X}\right)^2}$$

NOTE: σ_0 is used as threshold for σ_i; if σ_i is greater than σ_0, then $\sigma_1 = \sigma_0$

CAM is calculated as follows:

$$CAM = \frac{UTL - LTL}{6\sigma_i}$$

Where:

LTL is the lower tolerance limit

UTL is the upper tolerance limit

The C_{mk} is calculates as follows:

$$C_{mk} = \min\left[\frac{UTL - X_m}{3\sigma_0}, \frac{X_m - LTL}{3\sigma_0}\right]$$

Where X_m is the average of the sample

Q544000_2004:

The ***dispersion*** for the j-th group is calculated as follows:

$$W_j = Max_j - Min_j$$

Where:

Max_j is the maximum value in the samples of the j-th group.

Min_j is the minimum value in the samples of the j-th group.

The ***average value*** of the W_j is calculated as follows:

$$\overline{W} = \frac{\sum W_j}{K}$$

The σ_i is calculated as follows:

$$\sigma_i = \frac{\overline{W}}{dn}$$

Where dn is calculated from the following table based on the number of samples:

N	dn
10 ÷ 16	1.128
18	1.693
20 ÷ 28	2.059
30 ÷ 100	2.326
110 ÷ 5000	3.078

NOTE: σ_i refers to the whole set of samples.

CAM is calculated as follows:

$$CAM = \frac{UTL - LTL}{6\sigma_i}$$

Where

LTL is the lower tolerance limit

UTL is the upper tolerance limit

The average of the M_j is calculated as follows:

$$M_j = \frac{\sum X_{ij}}{N}$$

Where:

X_{ij} is the i-th sample of the j-th group.

Considering M_{min} and M_{max} as the minimum and maximum averages, the C_{mk} is calculates as follows:

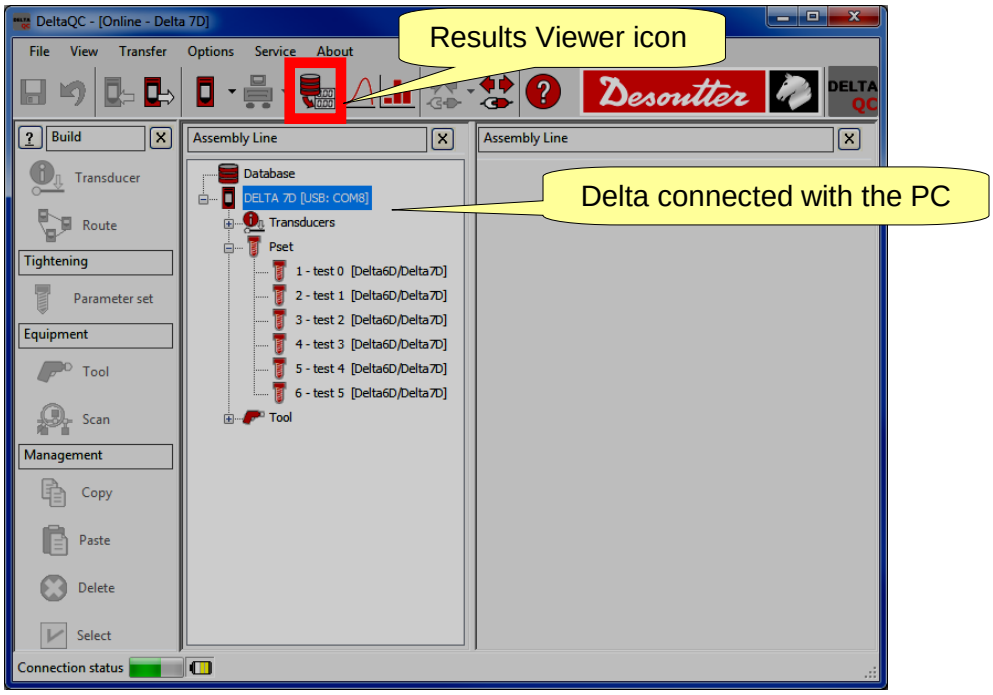
$$C_{mk} = \min\left[\frac{M_{\min} - LTL}{3\sigma}, \frac{UTL - M_{\max}}{3\sigma}\right]$$

22 RESULTS VIEWER

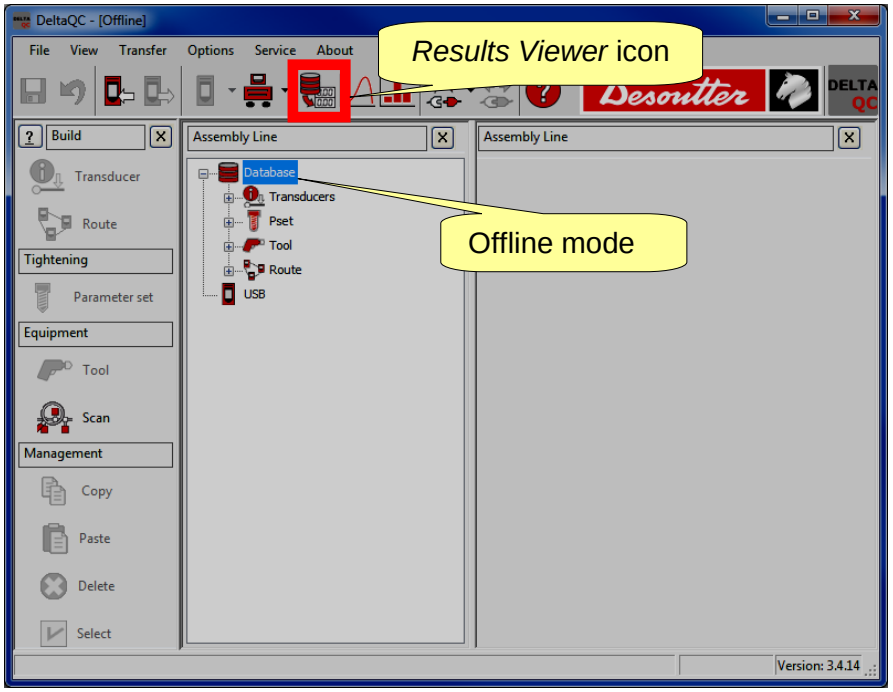
The ***Results Viewer*** function allows the user to retrieve the results from the Delta or from the database.

The *Delta 6D/7D* can store up to 5000 results, while the *Delta 1D* can store up to 1000 results; when the memory is full the new results overwrite the oldest results stored.

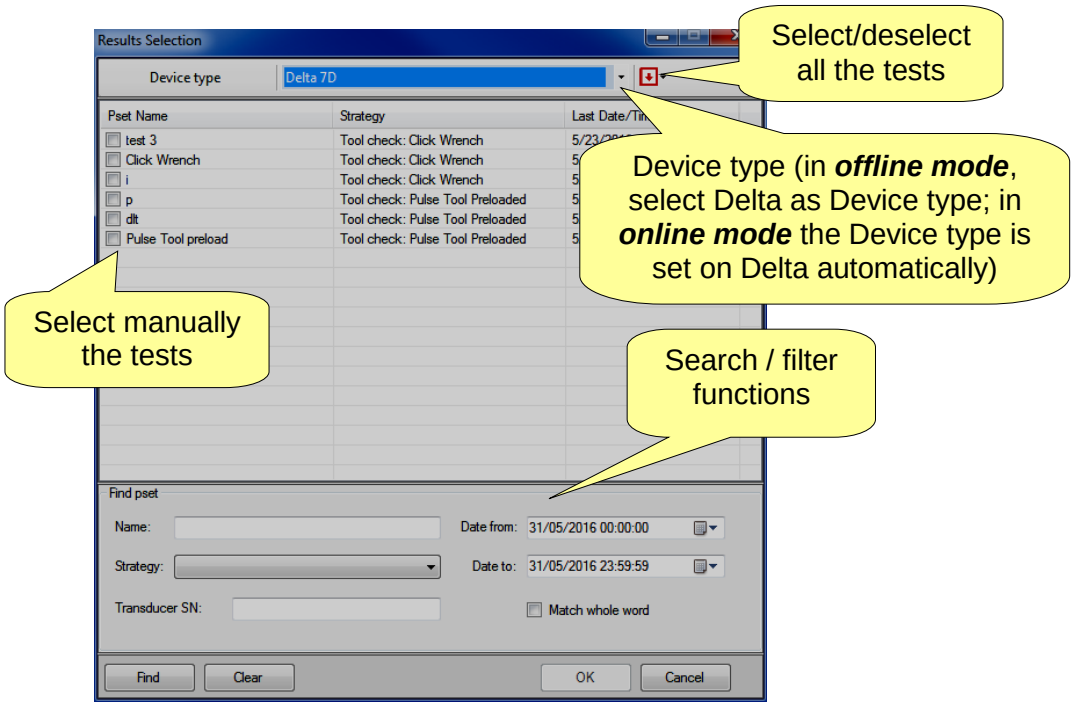
To view the results stored on the Delta, connect the instrument to the DeltaQC software and select the *Result Viewer* icon:



To view the results downloaded from the Delta and stored into the database, work in *Offline* mode:

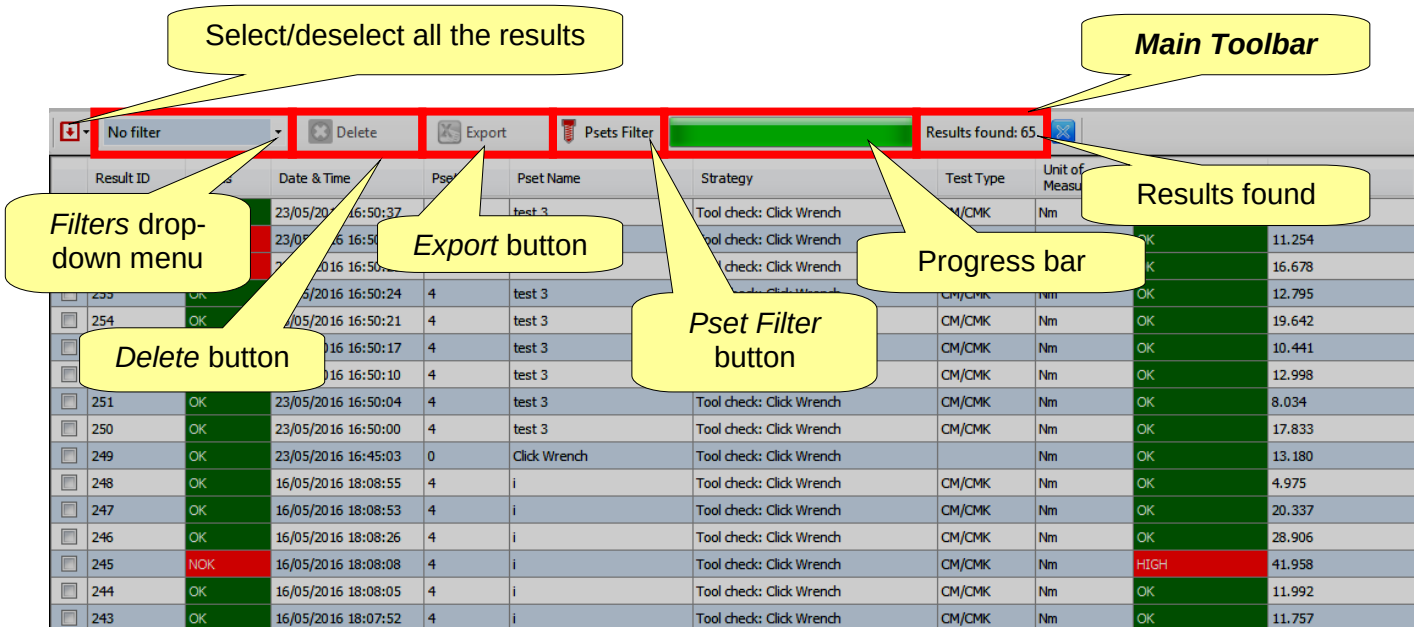


When clicking on the ***Result Viewer*** icon, the following screen is shown:



Select the ***Device type*** (when working *offline*, otherwise the instrument connected is automatically selected) and the tests to be reviewed. Finally click on ***OK***.

The following "***Results Viewer*** *page*" is shown:



Click on a column heading in order to organize the results according to the column selected.

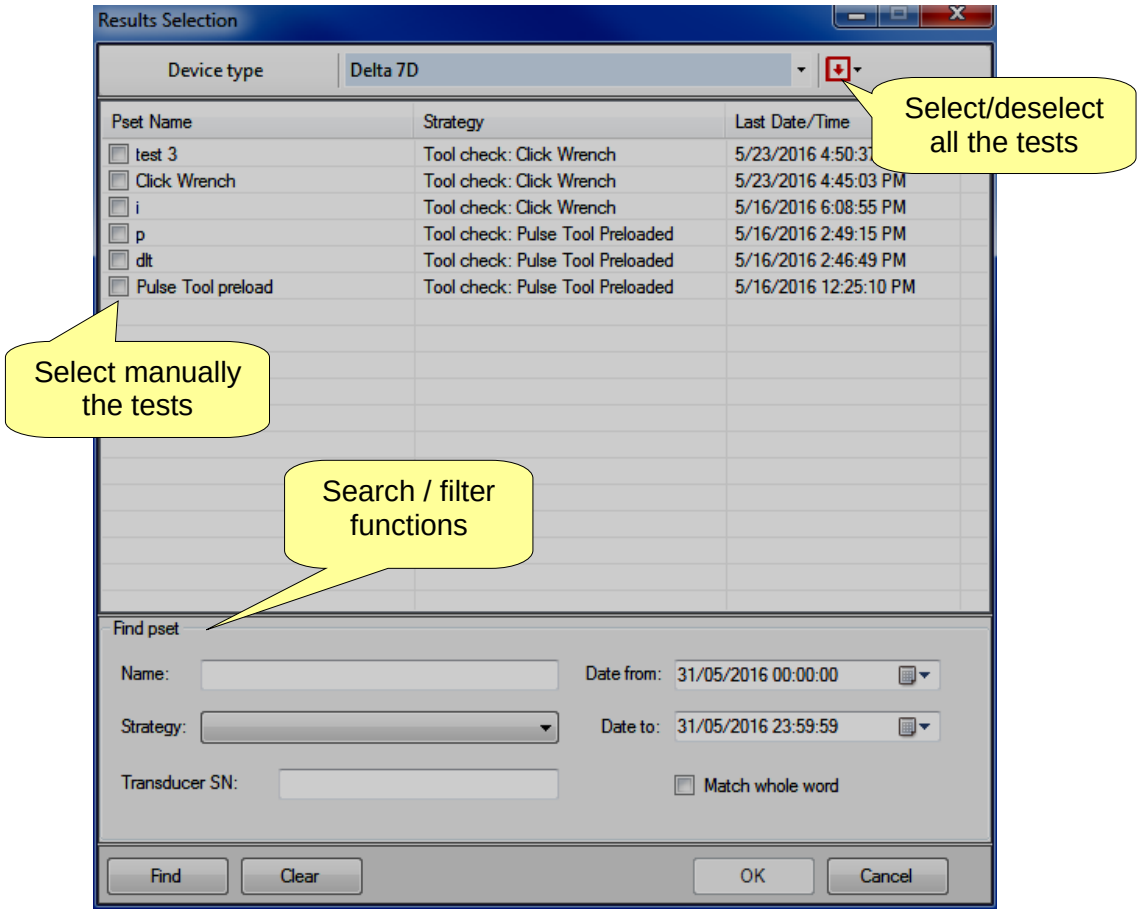
All the information related to the tightening operation is displayed in the whole set of columns.

When working connected with the *Delta*, if an item (*Tool* or *Pset*) has been deleted after the test execution, the related row is marked as "***deleted***".

The *Main Toolbar* (refer to the above screen) allows the user to customize the ***Results Viewer*** *page*. Furthermore, it provides important data.

The "*Filters drop-down menu*" (refer to the above screen), filters the results according to customer needs. It is possible to display the results after selecting among the following options: ***No Filter***, ***Status OK***, ***Status KO***, ***Torque status OK***, ***Torque status KO***, ***Angle status OK***, ***Angle status KO***.

The "*Pset Filter*" button (refer to the above screen), allows the user to filter the results according to the test that made them.
After clicking on "*Pset Filter*" button, the following pop-up is shown:



Select the test to be reviewed and click on ***OK***.

The "*Progress bar*" and the "*Results found*" options provide important data related to the results.

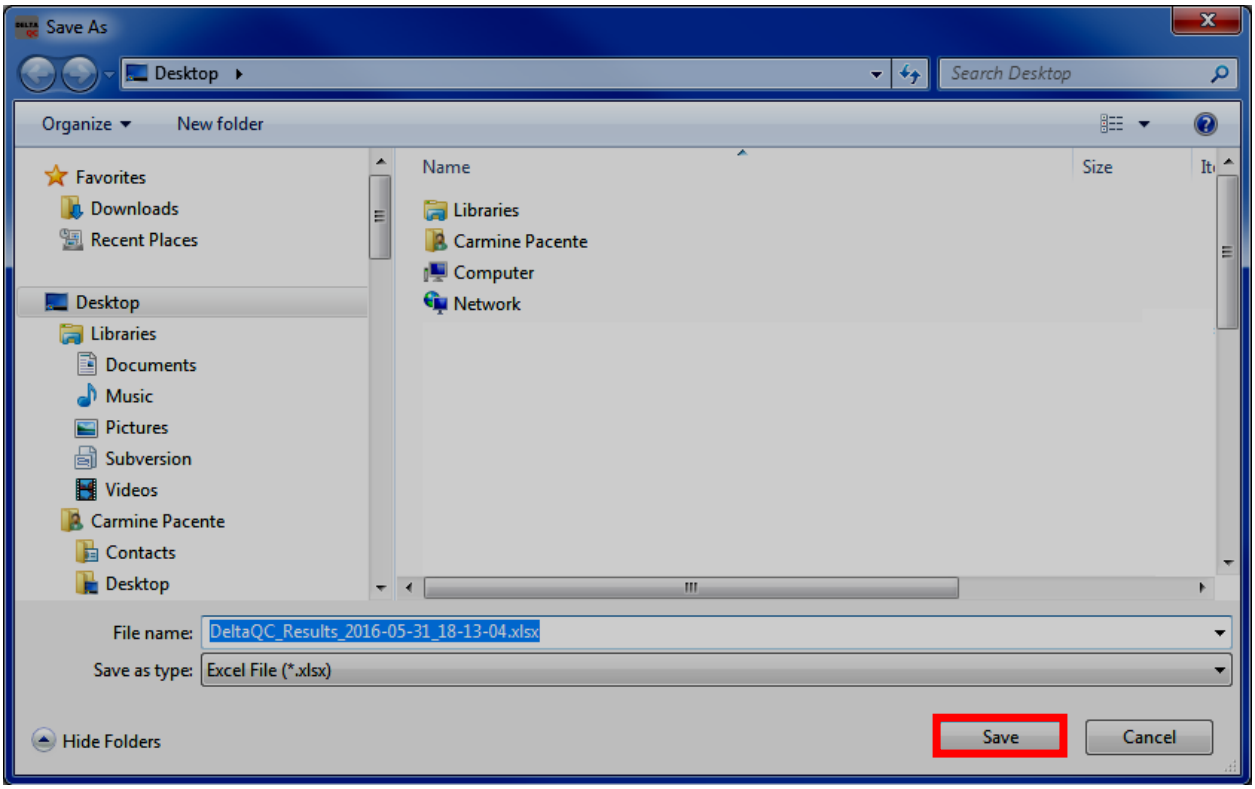
The "*Progress bar*" (refer to the above screen) is a graphical control element used to visualize the progression of the results downloaded: when it is totally green, all the results are downloaded.

The "*Results found*" option (refer to the above screen) indicates the number of results either performed (*Online* mode) or stored into the database (*Offline* mode).

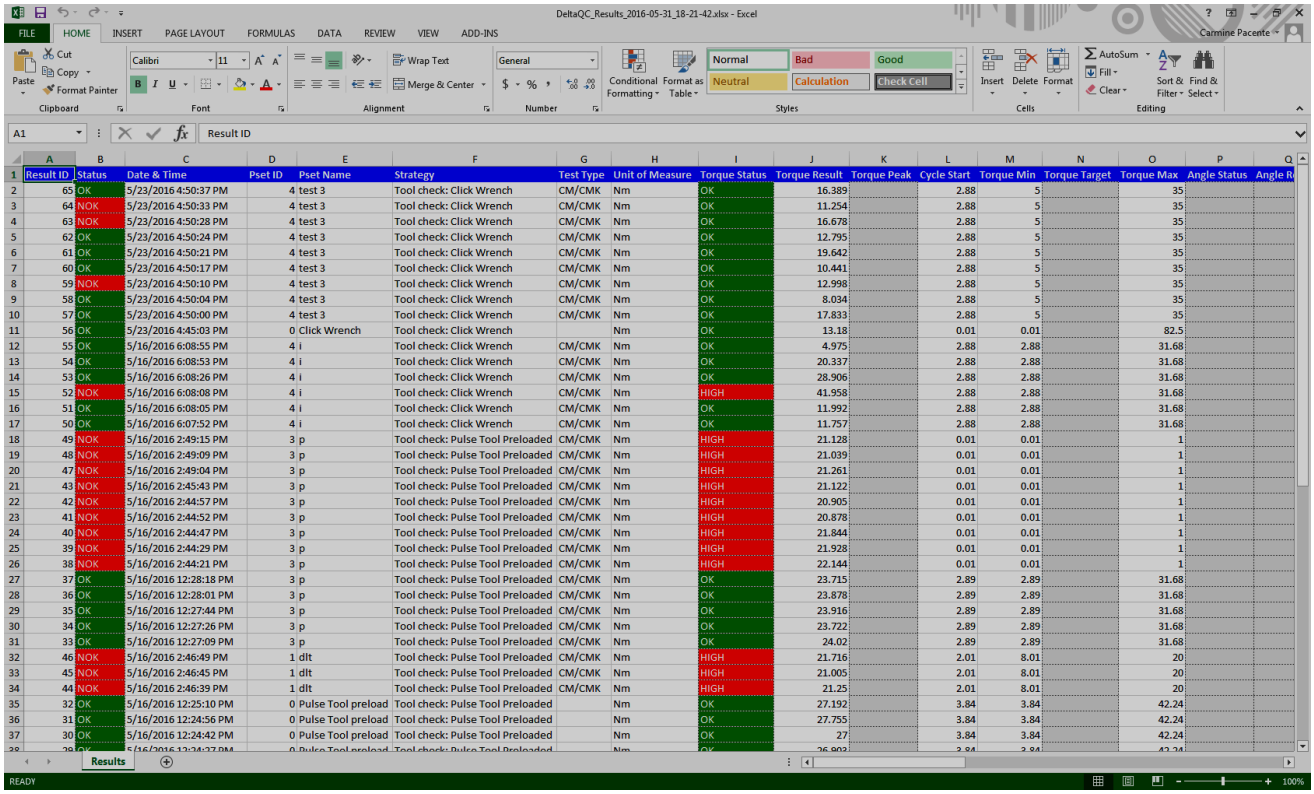
The "*Delete*" button (refer to the above screen) discards the selected item(s).

NOTE: The "*Delete*" button is available ONLY working in *Offline* mode.

The "*Export*" button (refer to the above screen) allows the user to save the results list in an Excel (.xlsx) file. Manually select the result(s) to be saved. Then click on "*Export*" button; the following window is shown:



The *File name* is automatically assigned, even if it is editable according to customer needs. Select the *Destination Folder* and click on ***Save***.
The *Excel file* is automatically open:



Result ID	Status	Date & Time	Pset ID	Pset Name	Strategy	Test Type	Unit of Measure	Torque Status	Torque Result	Torque Peak	Cycle Start	Torque Min	Torque Target	Torque Max	Angle Status
65	OK	5/23/2016 4:50:37 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	16.389		2.88	5		35	
64	NOK	5/23/2016 4:50:33 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	11.254		2.88	5		35	
63	NOK	5/23/2016 4:50:28 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	16.678		2.88	5		35	
62	OK	5/23/2016 4:50:24 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	12.795		2.88	5		35	
61	OK	5/23/2016 4:50:21 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	19.642		2.88	5		35	
60	OK	5/23/2016 4:50:17 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	10.441		2.88	5		35	
59	NOK	5/23/2016 4:50:10 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	12.998		2.88	5		35	
58	OK	5/23/2016 4:50:04 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	8.034		2.88	5		35	
57	OK	5/23/2016 4:50:00 PM	4	test 3	Tool check: Click Wrench	CM/CMK	Nm	OK	17.833		2.88	5		35	
56	OK	5/23/2016 4:45:03 PM	0	Click Wrench	Tool check: Click Wrench		Nm	OK	13.18		0.01	0.01		82.5	
55	OK	5/16/2016 6:08:55 PM	4	i	Tool check: Click Wrench	CM/CMK	Nm	OK	4.975		2.88	2.88		31.68	
54	OK	5/16/2016 6:08:53 PM	4	i	Tool check: Click Wrench	CM/CMK	Nm	OK	20.337		2.88	2.88		31.68	
53	OK	5/16/2016 6:08:26 PM	4	i	Tool check: Click Wrench	CM/CMK	Nm	OK	28.906		2.88	2.88		31.68	
52	NOK	5/16/2016 6:08:08 PM	4	i	Tool check: Click Wrench	CM/CMK	Nm	HIGH	41.958		2.88	2.88		31.68	
51	OK	5/16/2016 6:08:05 PM	4	i	Tool check: Click Wrench	CM/CMK	Nm	OK	11.992		2.88	2.88		31.68	
50	OK	5/16/2016 6:07:52 PM	4	i	Tool check: Click Wrench	CM/CMK	Nm	OK	11.757		2.88	2.88		31.68	
49	NOK	5/16/2016 2:49:15 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.128		0.01	0.01		1	
48	NOK	5/16/2016 2:49:09 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.039		0.01	0.01		1	
47	NOK	5/16/2016 2:49:04 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.261		0.01	0.01		1	
43	NOK	5/16/2016 2:45:43 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.122		0.01	0.01		1	
42	NOK	5/16/2016 2:44:57 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	20.905		0.01	0.01		1	
41	NOK	5/16/2016 2:44:52 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	20.878		0.01	0.01		1	
40	NOK	5/16/2016 2:44:47 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.844		0.01	0.01		1	
39	NOK	5/16/2016 2:44:29 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.928		0.01	0.01		1	
38	NOK	5/16/2016 2:44:21 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	22.144		0.01	0.01		1	
37	OK	5/16/2016 12:28:18 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	OK	23.715		2.89	2.89		31.68	
36	OK	5/16/2016 12:28:01 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	OK	23.878		2.89	2.89		31.68	
35	OK	5/16/2016 12:27:44 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	OK	23.916		2.89	2.89		31.68	
34	OK	5/16/2016 12:27:26 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	OK	23.722		2.89	2.89		31.68	
33	OK	5/16/2016 12:27:09 PM	3	p	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	OK	24.02		2.89	2.89		31.68	
46	NOK	5/16/2016 2:46:49 PM	1	dlt	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.716		2.01	8.01		20	
45	NOK	5/16/2016 2:46:45 PM	1	dlt	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.005		2.01	8.01		20	
44	NOK	5/16/2016 2:46:39 PM	1	dlt	Tool check: Pulse Tool Preloaded	CM/CMK	Nm	HIGH	21.25		2.01	8.01		20	
32	OK	5/16/2016 12:25:10 PM	0	Pulse Tool preload	Tool check: Pulse Tool Preloaded		Nm	OK	27.192		3.84	3.84		42.24	
31	OK	5/16/2016 12:24:56 PM	0	Pulse Tool preload	Tool check: Pulse Tool Preloaded		Nm	OK	27.755		3.84	3.84		42.24	
30	OK	5/16/2016 12:24:42 PM	0	Pulse Tool preload	Tool check: Pulse Tool Preloaded		Nm	OK	27		3.84	3.84		42.24	

The ***Results Viewer*** *page* shows a group of records (organized in columns) that meet the search criteria set by the customer.
The most important columns are summarized in the following table:

Pset number	For Quick Test (*Delta 1D/6D/7D*), the *Pset number* is automatically set to 0. For *Delta 6D/7D*, the *Pset number* is defined in the *Pset* data.
Status	This is the global status of the test. It is *OK* when the result has been detected according to the thresholds and limits specified, and if the torque does not exceed the maximum transducer overload.
Torque Status	These fields indicate the result for the torque. If the result is within the torque limits (for *Delta 1D*, within the transducer maximum overload, defined into the *Delta Settings* menu), the status is ***OK***. If the *Check Type* in the *Pset* parameters is set to *Angle*, the torque status is marked as *OK* regardless the torque is inside or outside the torque limits specified in the *Pset*. If the torque goes over the maximum transducer overload the result is marked as ***HIGH***.
Angle Status	These fields indicate the result for the angle. If the result is within the angle limits the status is ***OK***. If the *Check Type* in the *Pset* parameters is set to *Torque*, the angle status is marked as *OK* regardless the angle is inside or outside the angle limits specified in the Pset. This is not applicable for ***Delta 1D***.
Result number	Progressive number automatically assigned by the *Delta* to every tightening result. ***Min value: 1*** ***Max value: 5000 (1000 for Delta 1D)*** When 5000 results are stored in the Delta memory, the new results overwrite the oldest starting from result number ***1***.
Strategy	Type of test executed.
Torque peak	For *Delta 7D*, (for *Residual Torque/Angle* and *Residual Torque/Angle Automatic* strategies) it indicates the maximum torque reached during the test.
Torque result and ***Angle results***	Torque and angle values measured by the *Delta*.
Date / Time	Fields indicating the date and time of the tightening operation. Date and time are taken from the date and time set on the *Delta*.
Batch status	If the batch size is set to zero, the *Batch status* is always OK. If the batch size is set to one or more, the *Batch status* is OK when all the tightening operations in the batch are OK.
Unit of Measurement	Unit of measurement.
Result detailed	This field can be very helpful. It explains the reason for a *Not OK* test.

If results belong to the ***Pulse Tool Preload*** strategy, the following fields are shown:

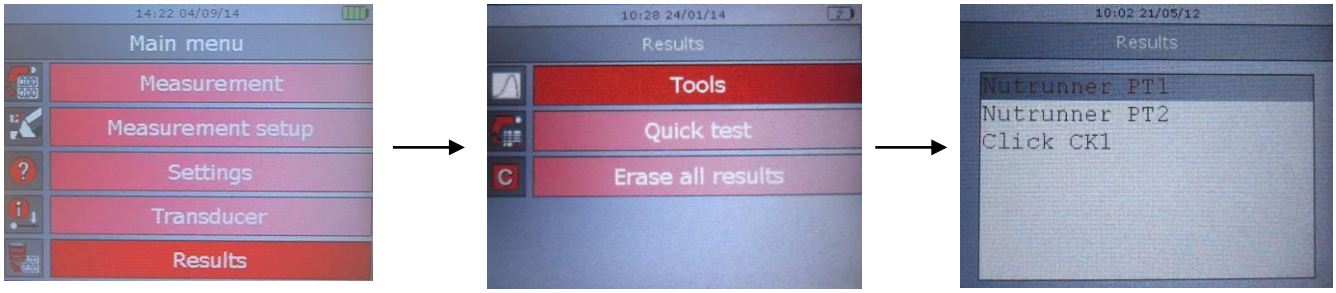
Load result	Load result measured by Delta
K	The K value used to convert the load result into a torque one

In case of *"Tool check: Free Angle" strategy*, the columns related to the torque values are not defined (in the Excel file, the related cells are grey colored).

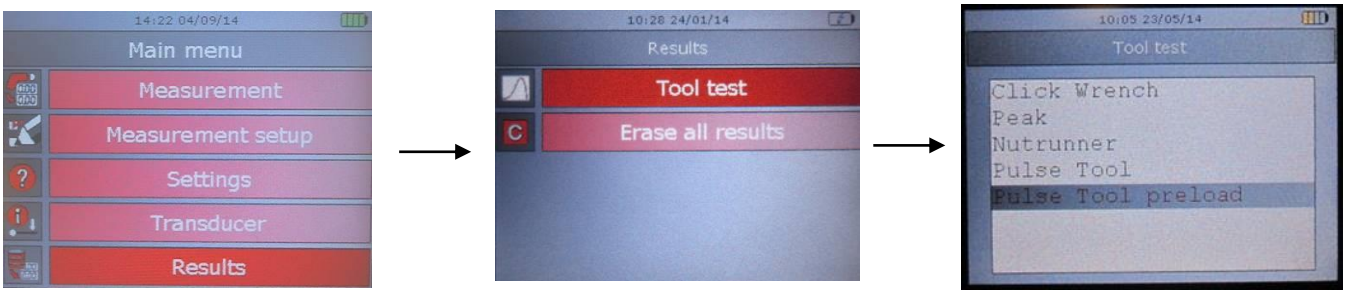
The *Results* can be also viewed from the *Delta* main menu.
Select the ***Results*** menu and then the item to view (select ***Erase all results*** to delete all the results stored in the Delta memory):

Delta 7D

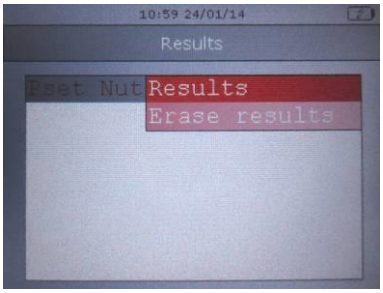
Delta 6D



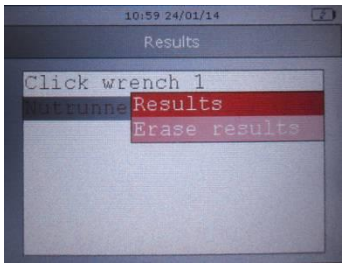
Delta 1D



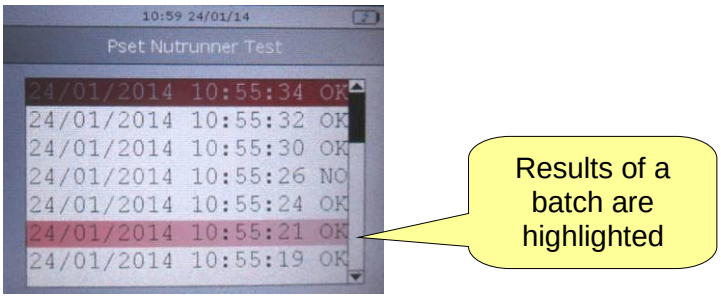
Once the item is selected, click on the ***ENTER*** button on the keyboard and select ***Results*** (select ***Erase results*** to delete the results associated with the *Pset* selected). Press ***Valid*** to continue:



For *Tools* only, an additional menu is shown to select the *Tool*, before selecting the *Pset* associated. Select ***Results*** (select ***Erase results*** to delete the results associated with the *Tool* selected).
Press ***Valid*** to continue:



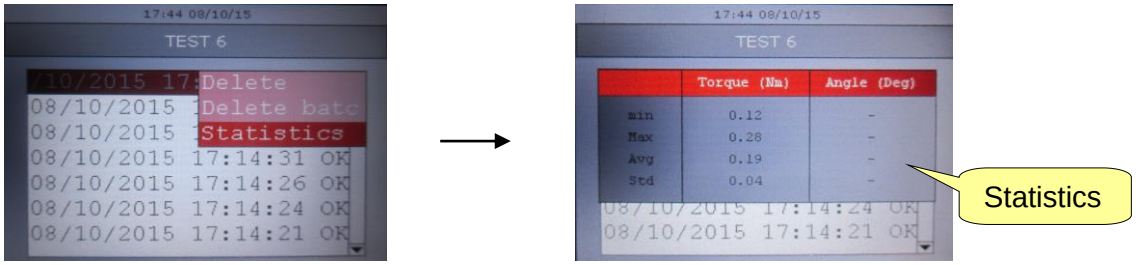
The results associated to the *Pset* selected are shown:



The above *Result* screen shows the test date, the test result status (*OK* or *Not OK*), the torque value, and angle value (if included in the test strategy).

NOTE: If a *Pset* modifies name, identification number or test strategy, the *Results* performed before the change are not shown any longer in this screen (in any case, it is possible to view them in the ***Results Viewer*** area of the DeltaQC Software).

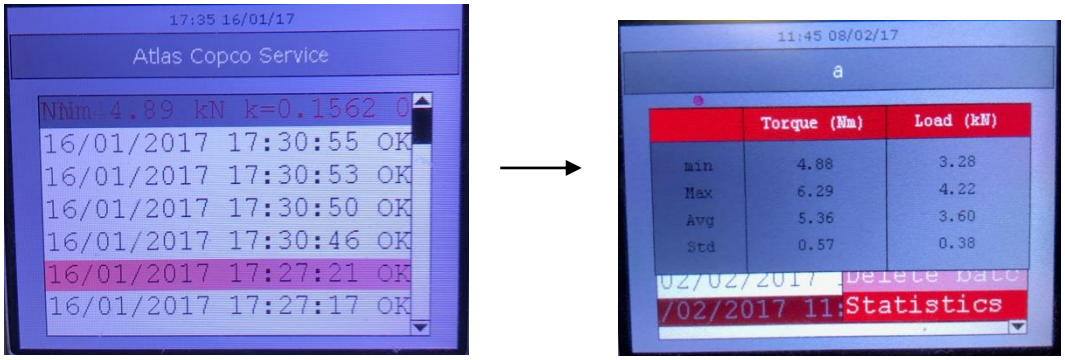
The results of batches are selected; select a result of a batch and press ***ENTER*** on it.
Select ***Statistics*** and press ***VALID***:



Each result, or an entire batch, can be deleted by selecting ***Delete*** (or ***Delete batch***) in the first screen above and pressing ***VALID*** to confirm.

NOTE: The results can be deleted also from the DeltaQC ***Controller*** → ***Memory*** menu (refer to the paragraph "*Memory*" for further details).

If results belong to the ***Pulse Tool Preload*** strategy, both torque and load values are shown:



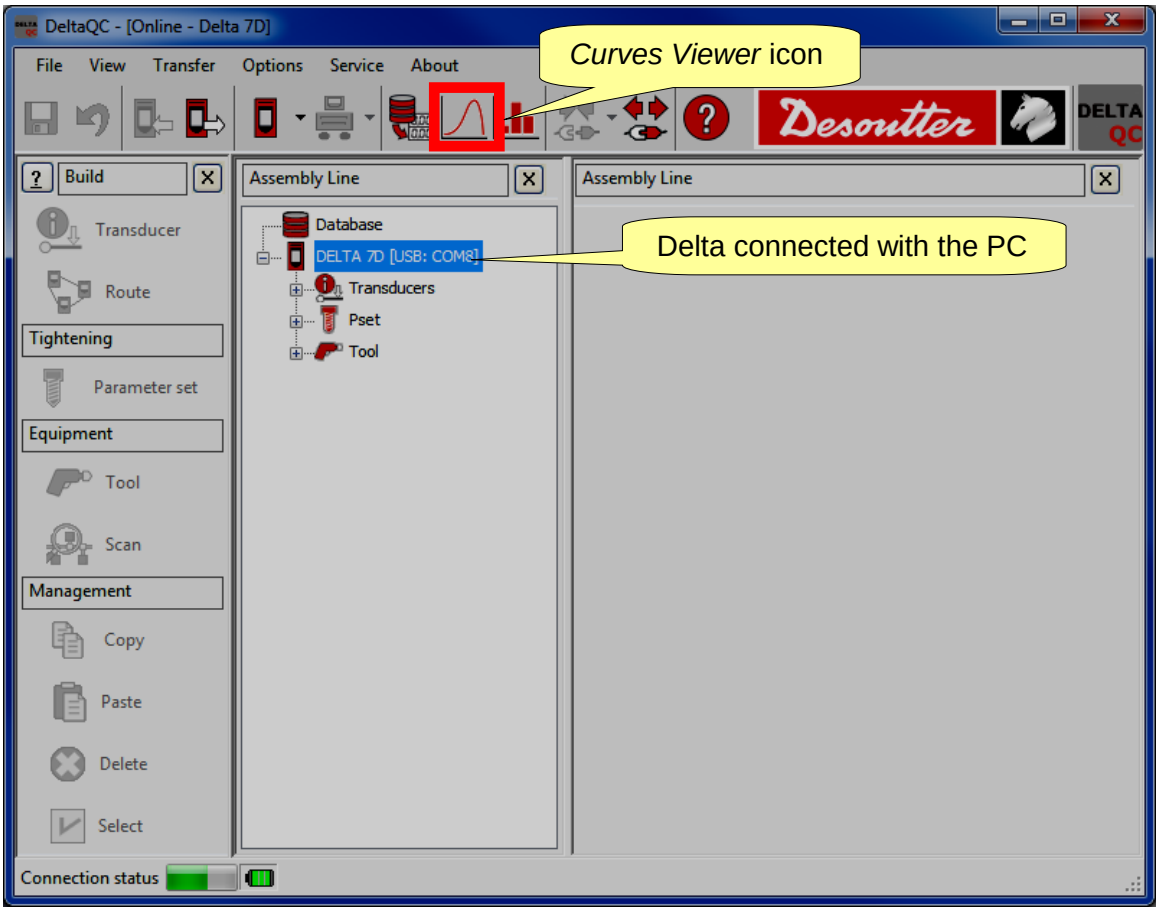
In the same way, both torque and load values are shown into Batch Results screen.

23 CURVES VIEWER

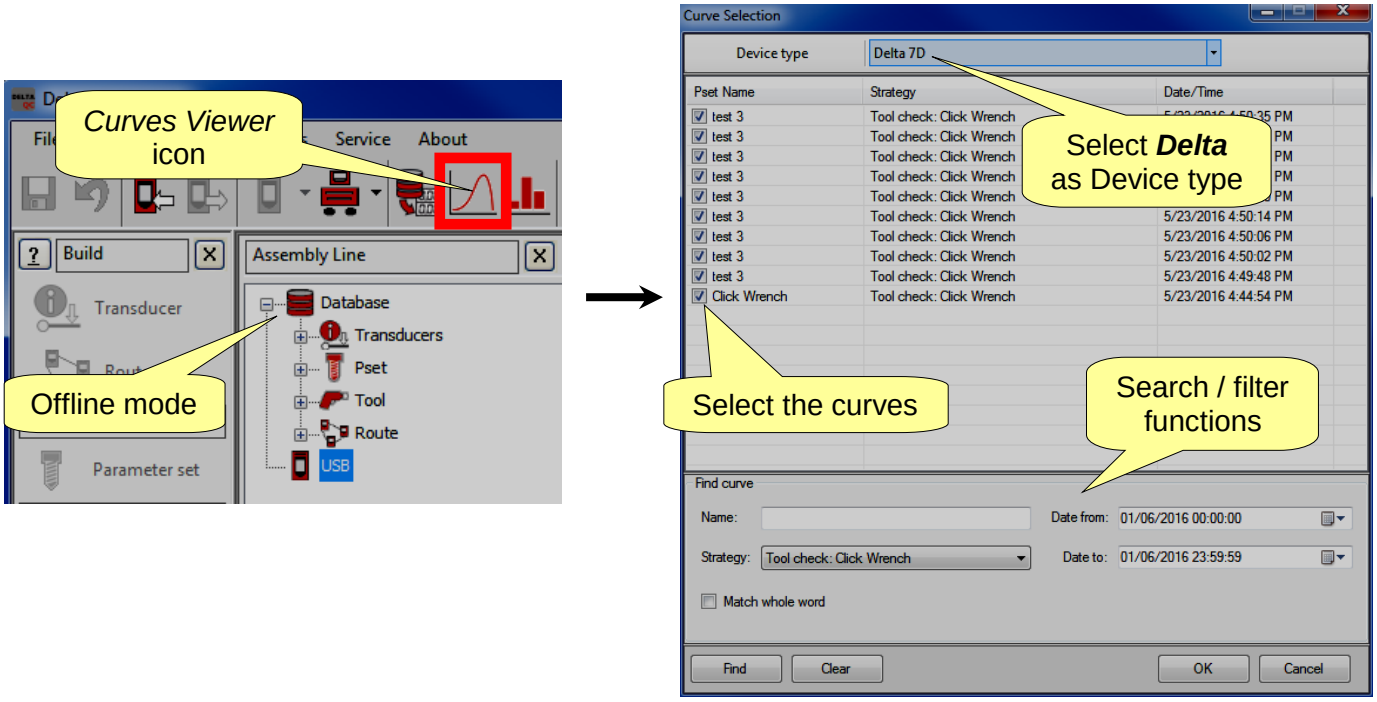
Click on the ***Curves viewer*** icon to retrieve the curve from the *Delta* or from the database.

The *Delta* can store up to ***10 curves*** (*the maximum time length allowed per each curve is equal to 30 seconds*); when the memory is full, the new curves overwrite the oldest ones stored.

To view the curves stored on the *Delta*, connect the instrument to the DeltaQC and select the *Curves Viewer* icon (refer to the screen below):

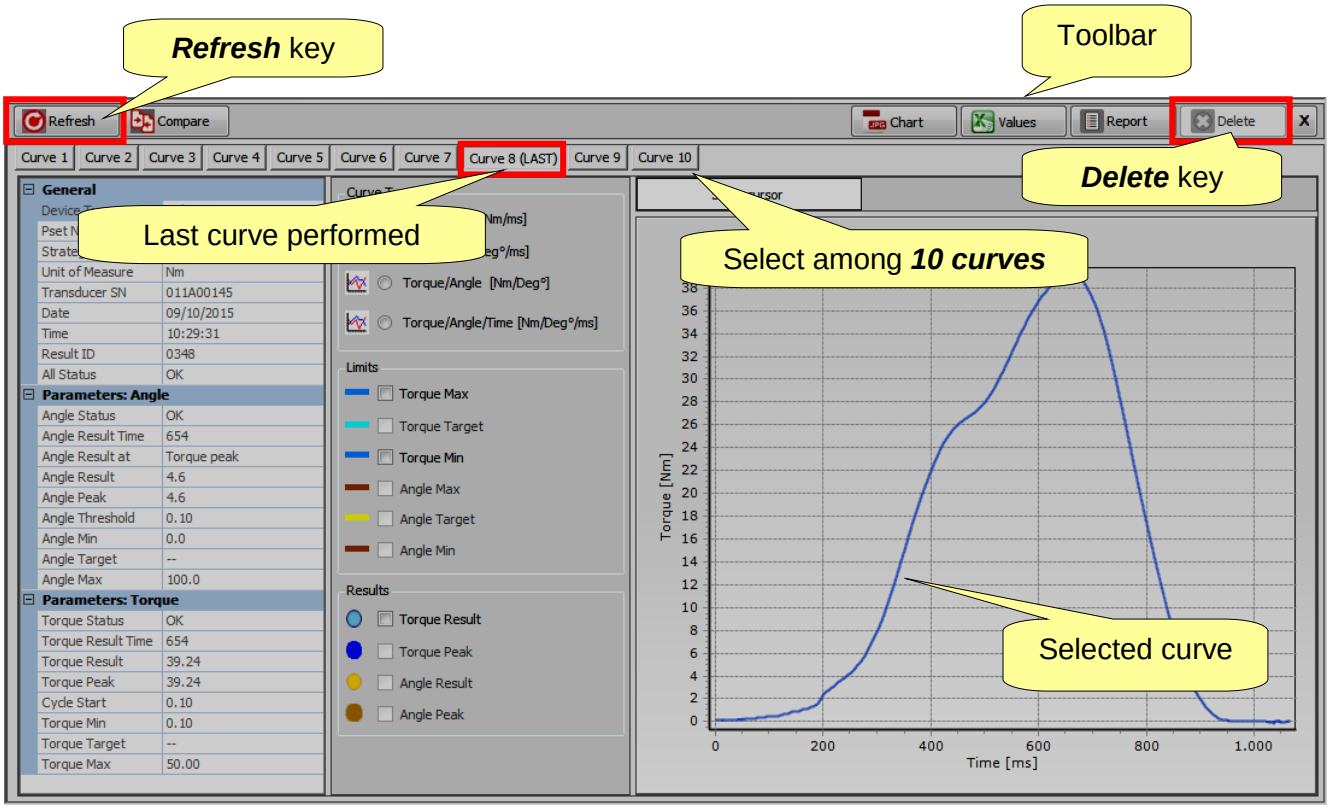


Working in offline mode it is possible to display the curves downloaded from the Delta and stored in the database (refer to the paragraph "*Transfer online data to the database*").
An additional window is shown, to select up to ***10 curves:***



23.1 View One Curve

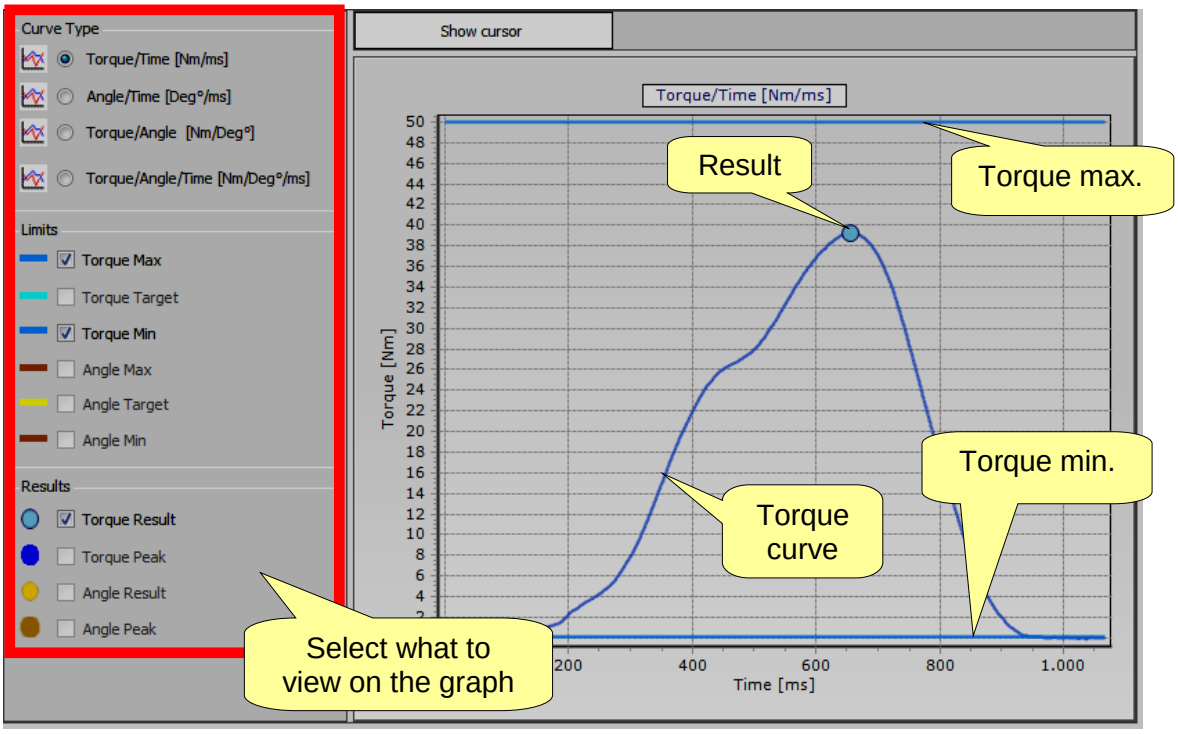
Select the curve to display by clicking on the bar placed at the top of the following screen:



When the Delta is connected with the DeltaQC Software (***online*** mode), the last curve performed can be recognized due to the "***(LAST)***" placed close to the *curve number*.
The ***Refresh*** key (placed on the left upper corner of the above screen) refreshes the window in case a new curve is available.

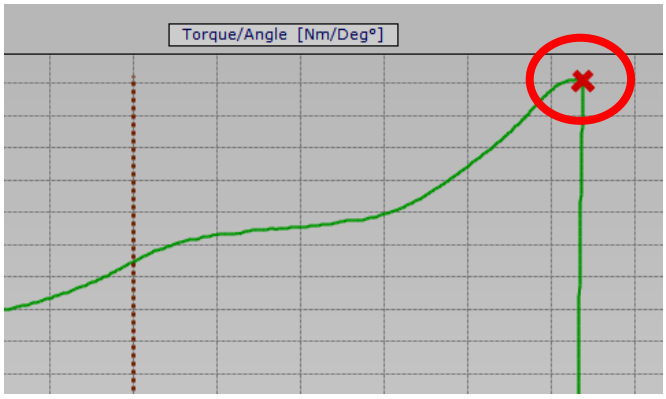
When the Delta is not connected with the DeltaQC Software (***offline*** mode), the ***Delete*** key (placed on the right upper corner of the above screen) is available

In the ***Curve Type***, ***Limits*** and ***Results*** areas it is possible to select what to display on the graph:

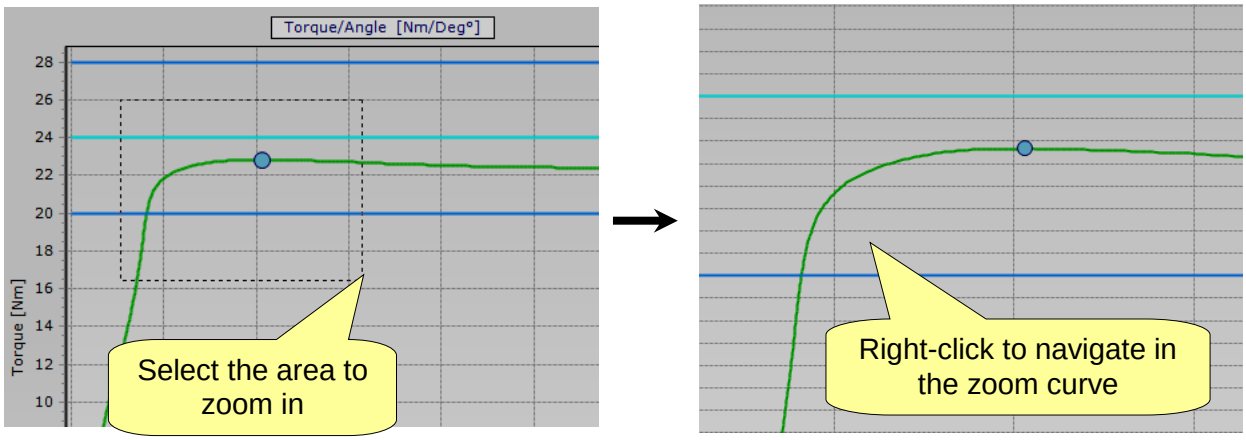


NOTE: The ***Torque peak*** option (placed in ***Results*** area) is available only for *Residual Torque/Angle* and *Residual Torque/Angle Automatic* strategies.

It is possible to select the *Torque curve*, *Angle curve*, *Torque/Angle curve* or both *Torque* and *Angle curve* on the same graph.
If limits and results are enabled, they are shown in the graph.
The ***Result*** indicates (on the curve) the point where the result is taken. If the result is *Not OK*, it will be marked with a red X (refer to the example below):

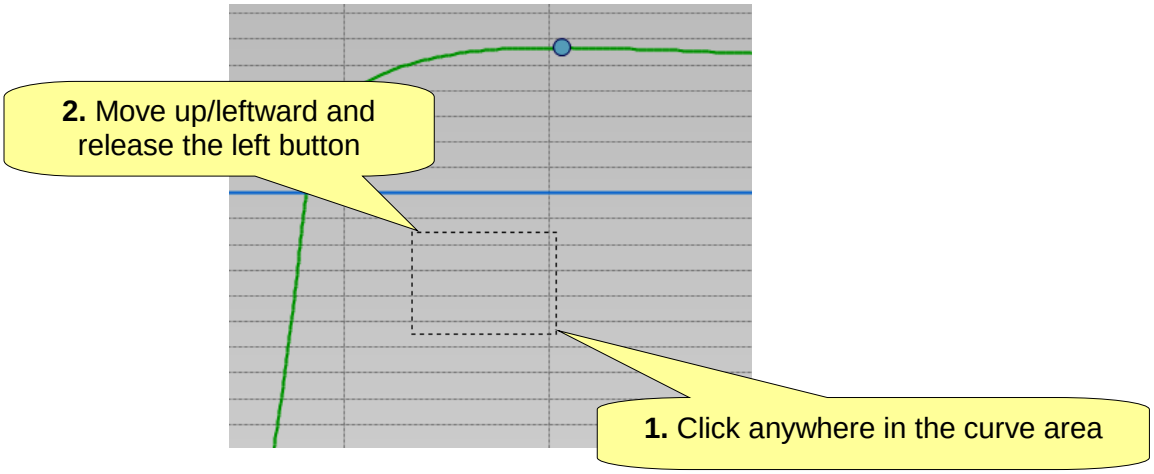


To zoom in on a section of the curve, simply select the desired area with the mouse:

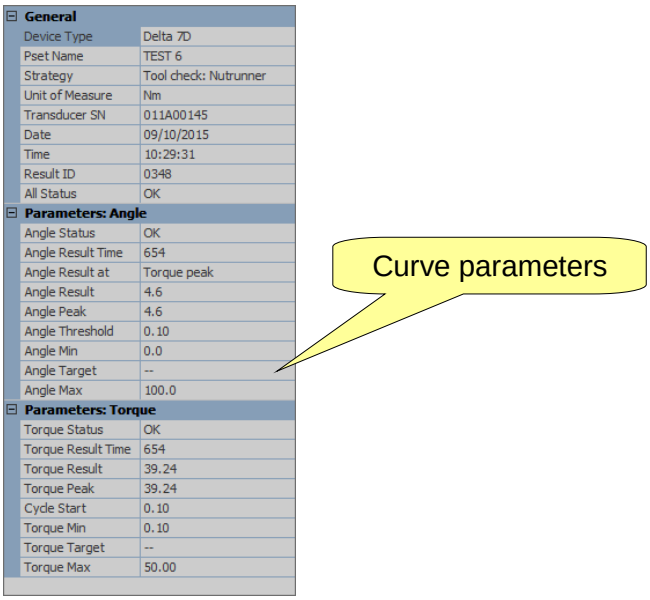


While zoom in, to navigate the graph right-click the curve and move the mouse pointer on the graph.

To zoom out to the whole curve, press the left button on the mouse, move the cursor up/leftward, and release the left button:

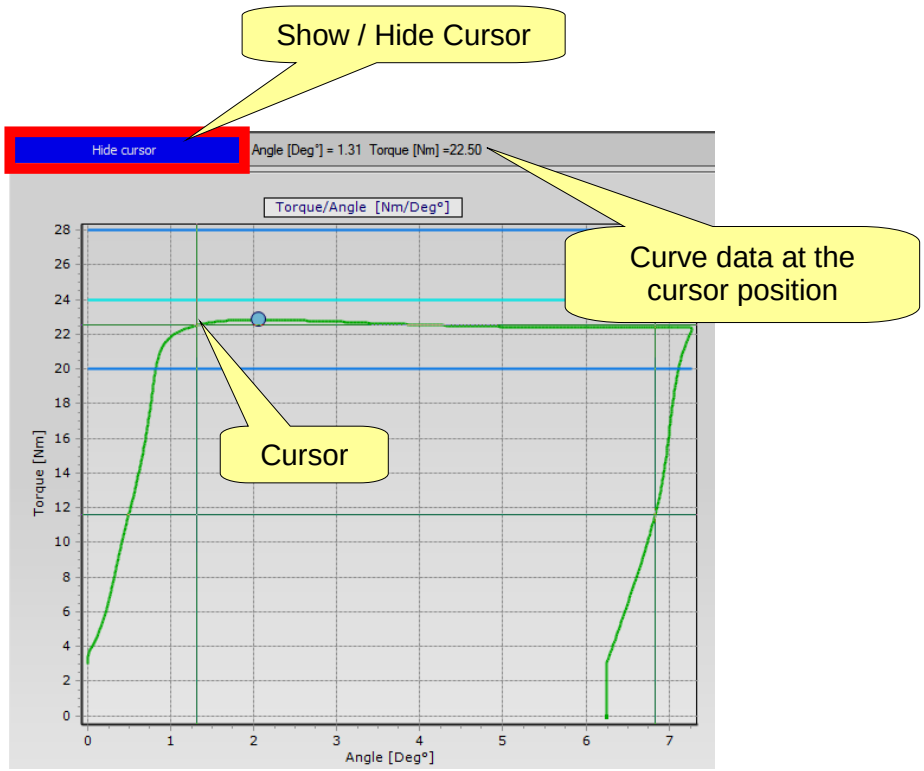


The curve parameters are shown on the left side:



General	
Device Type	Delta 7D
Pset Name	TEST 6
Strategy	Tool check: Nutrunner
Unit of Measure	Nm
Transducer SN	011A00145
Date	09/10/2015
Time	10:29:31
Result ID	0348
All Status	OK
Parameters: Angle	
Angle Status	OK
Angle Result Time	654
Angle Result at	Torque peak
Angle Result	4.6
Angle Peak	4.6
Angle Threshold	0.10
Angle Min	0.0
Angle Target	--
Angle Max	100.0
Parameters: Torque	
Torque Status	OK
Torque Result Time	654
Torque Result	39.24
Torque Peak	39.24
Cycle Start	0.10
Torque Min	0.10
Torque Target	--
Torque Max	50.00

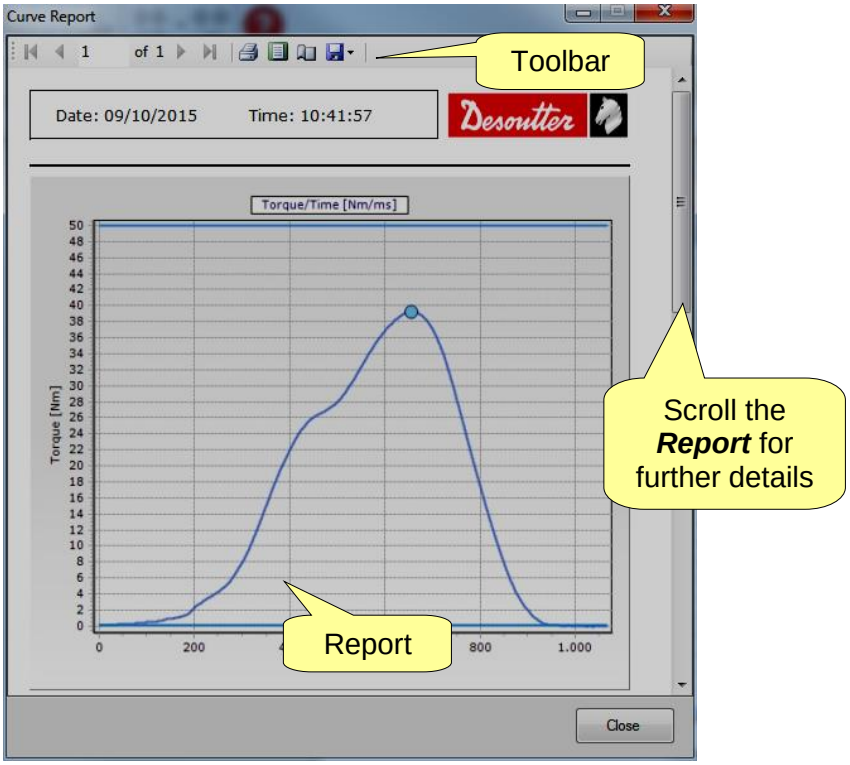
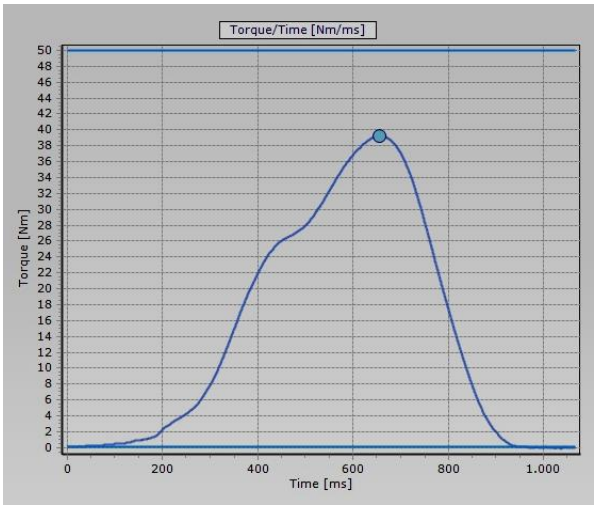
To evaluate the curve in details, click ***Show cursor*** in order to activate the cursor on the graph:



NOTE: In case of *"Tool check: Free Angle" strategy*, only ***Angle/Time curve type*** is available. The torque parameters are not available.

23.2 Export a Curve

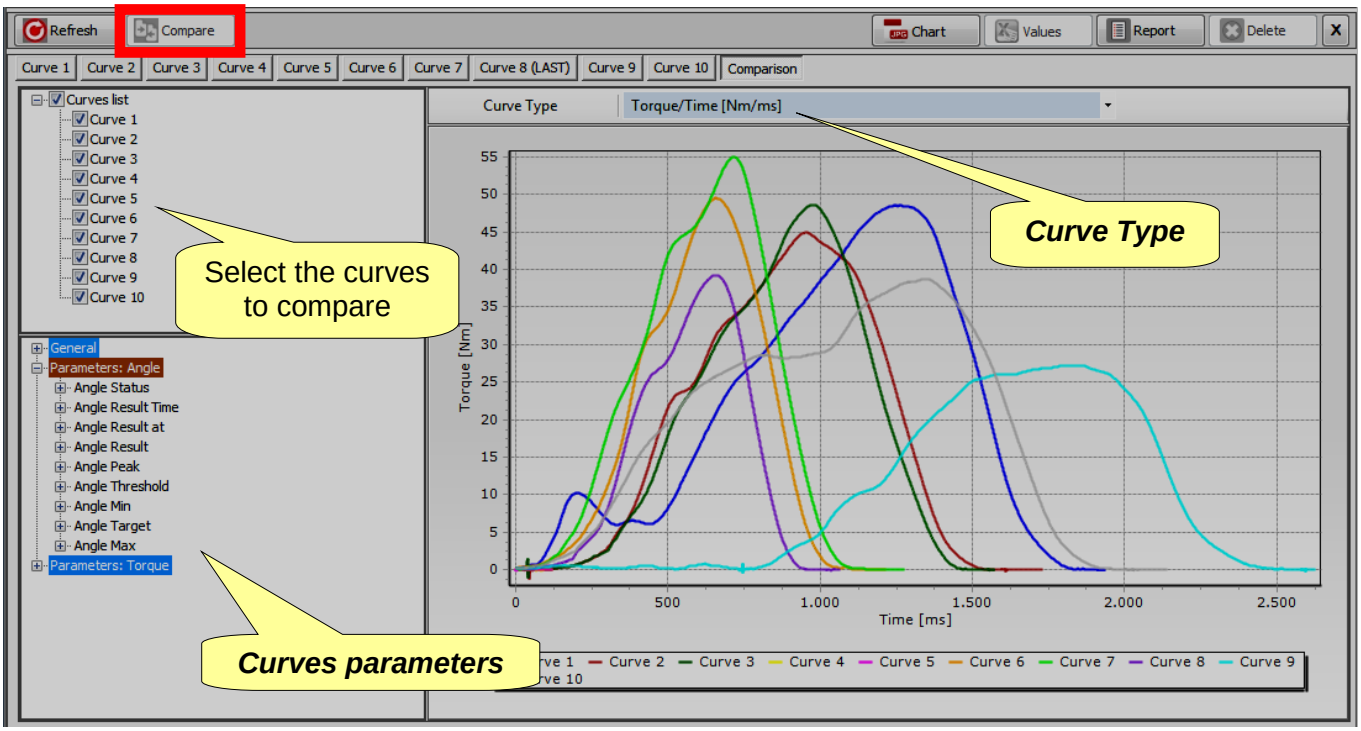
Some useful keys are available in the toolbar:

Values	This key exports curve values in an Excel file.
Report	This key creates a *Report*:  The ***Report*** can be printer or exported into Excel / PDF by means of the icons placed in the report toolbar.
Chart	This key creates a .jpg file of the curve: 

23.3 Curves Comparison

This feature overlaps the curves for a comparison of the tightening operations.

Click on ***Compare*** icon to open the "*comparison screen*":



Select the curves to be compared on the left side of the above screen (refer to the ***Curves list***).

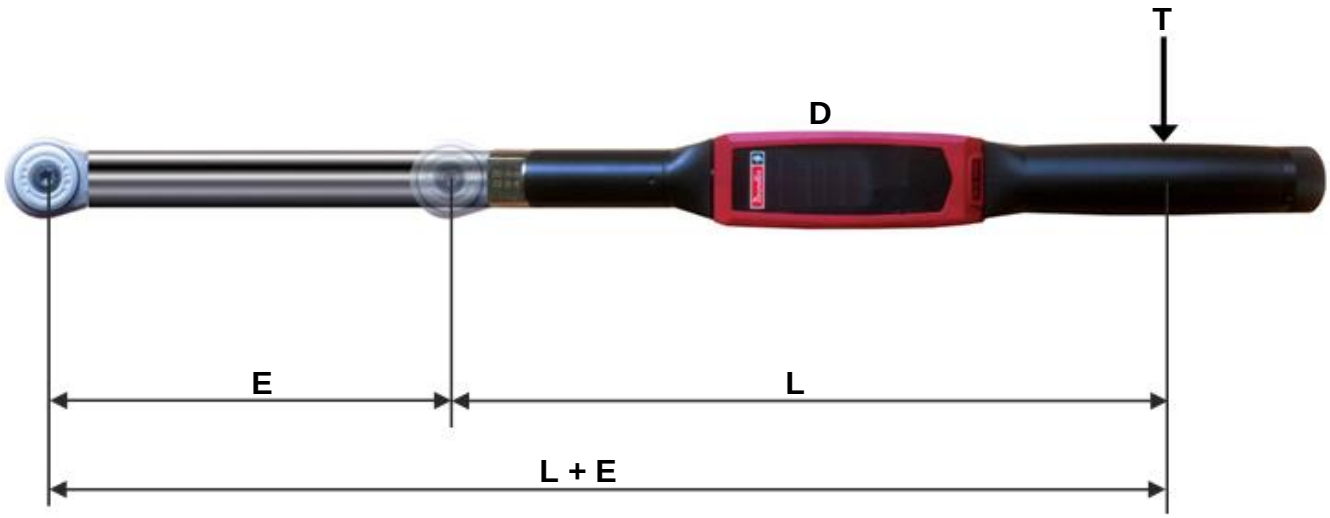
Select the type of graph (*Torque/Time*, *Angle/Time*, or *Torque/Angle*) by means of the ***Curve Type*** drop-down menu.

All the parameters and results of the curves can be displayed in the ***Curves parameters*** section. Click on the + or – icons to expand or collapse the nodes.

24 CALCULATING CORRECTION COEFFICIENTS FOR EXTENSIONS

In both the *Production and Quality strategies*, when the joint design or space limitations preclude use of standard sockets or tools, it may be necessary to use special extension spanners to fit the application.
In these cases the Q-AUDIT measure must be adequately compensated because the factory calibration is made for the standard arm (L) and the extension arm (E) either increases or decreases (according to the case) the measured torque. The angle measure is also affected by the extensions, due to their specific bending/torsion when torque is applied. For DRT5, the angle correction coefficient can be used to compensate torsion of an axial extension (in this case torque correction coefficient is 1).

24.1 Torque Correction Coefficient



T	=	*applied torque*
D	=	*displayed torque*
L	=	*standard arm (from mid point of the hanlde to the center point of end fitting tool)*
E	=	*extension arm*
L + E	=	*total arm*

From the relation between the displayed and applied torque $\boldsymbol{T = \frac{D \times (L + E)}{L}}$, the following formula gives the torque correction coefficient:

Torque correction coefficient = $\boldsymbol{\frac{L + E}{L}}$

It can be used also to align the torque measurement when a torque multiplier is used; in that case, the torque correction coefficient is equal to the torque ratio of the multiplier.

24.2 Angle Correction Coefficient

When an extension is used, the angle correction coefficient allows linear compensation of extension torsion due to the torque applied. The value (expressed in degrees) is the angle measured when a torque equal to the transducer capacity is applied to a vice.

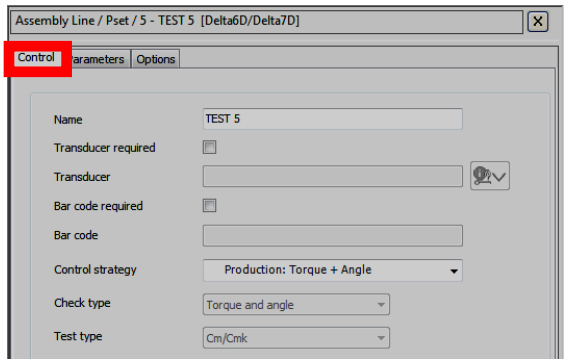
To calculate the proper angle correction coefficient, the torque correction coefficient must be set to 1 and specified in the *Pset* used for calculating the angle correction coefficient.

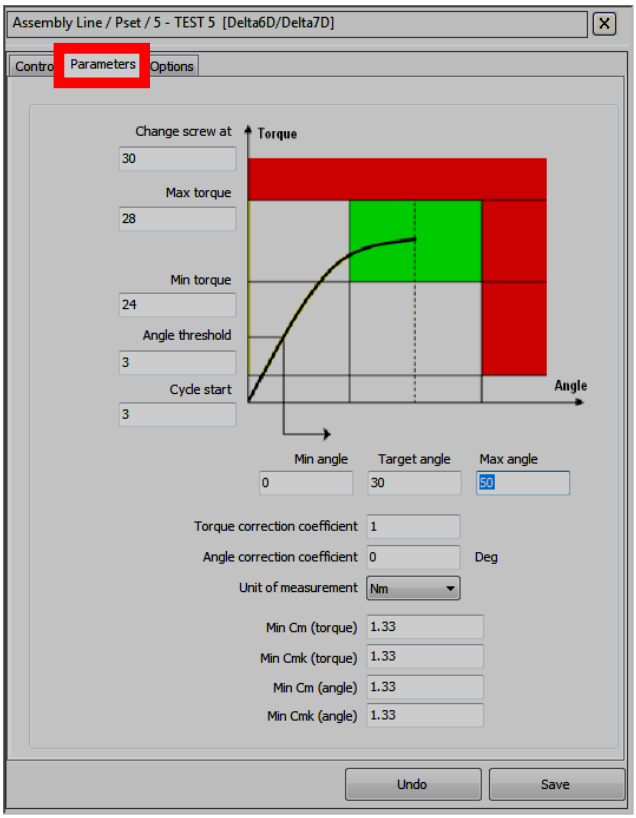
Thus, follow the procedure below:

1. Create a Pset with the following parameters:

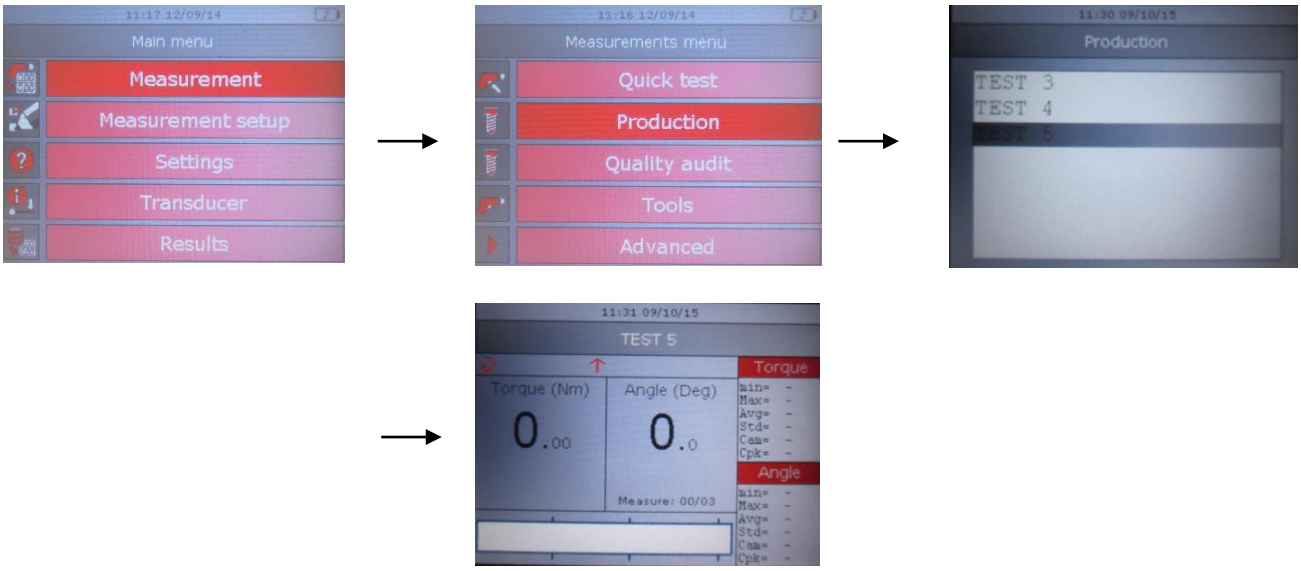
- *Control strategy*: ***Torque & Angle***
- *Torque correction coefficient*: ***1***
- *Target torque*: 80***% of the Q-AUDIT capacity***
- *Cycle start* and *Angle threshold*: ***10% of the Q-AUDIT capacity***
- *Minimum angle*: ***0***
- *Target angle*: ***15***
- *Maximum angle*: ***30***
- *Check already tightening angle*: ***Disabled***

For instance, it could be a proper Pset for a Q-AUDIT with 30 Nm capacity:

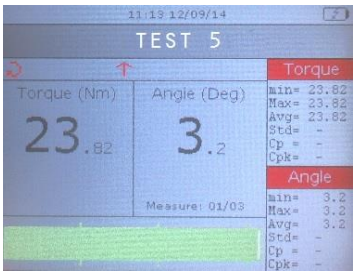




2. Execute the Pset:



3. Apply the target torque specified in the Pset, operating the Q-AUDIT on a vise:



WARNING: Since for this test the *Torque Correction Coefficient* is set to 1, the torque applied to the vise is higher than the torque shown on the display. The vice must support the maximum torque of the Pset multiplied by the *Torque Correction Coefficient* calculated above.

4. The angle displayed is the bending of the extension applied to the torque shown on the display. Therefore, the *Angle Correction Coefficient* is equal to the following formula:

$$\textit{Angle correction coefficient} = \frac{\textit{angle measured}}{\textit{torque measured} - \textit{angle threshold}} \times \textit{Capacity}$$

The *Capacity* is the *Up. Limit* shown in the transducer information (refer to the screen below):

In the example of the figure above, the *Angle Correction Coefficient* is: ***(3.2 / (23.82 - 3)) x 33.0 = 5.07***.

NOTE: After storing the *Angle Correction Coefficient*, in order to verify the correct operation of the angle coefficient, it is NOT possible to use the demo mode, since it does not foresee the correction coefficients. Therefore, for a verification test, a Pset must be used.

24.3 Correction Formulas

During the tightening, the torque and angle measured by the transducers are corrected to obtain the real torque and angle values that are displayed on the Delta and used in the tightening curves and results.
The *correction formulas* are as follows:

$$\textit{Torque displayed} = \textit{torque measured} \times \textit{torque correction coefficient}$$

$$\textit{Angle displayed} = \textit{angle measured} - \textit{angle coefficient} \times \frac{\textit{torque displayed} - \textit{angle threshold}}{\textit{transducer capacity} \times \textit{torque correction coefficient}}$$

25 SCHEDULED MAINTENANCE

25.1 Cleaning

Keep the Delta clean.

After use, remove any curves of oil, grease and dust from the Delta, especially from the display, the keyboard, and the connectors.

Avoid using harsh detergents to clean the Delta.

25.2 Battery Pack Maintenance

Keep batteries in good working order.
Avoid fully discharging the battery. During normal use, recharge the battery when it is low.
For long-term storage (as in the case of spare batteries), cells should be kept within a range of a 30% ± 15% charge.

Follow the following important rules:

- Store the battery in a dry place not exceeding 30° C
- Recharge the battery for one hour every six months

After long-term storage, fully recharge the battery before use.

26 TROUBLESHOOTING GUIDE

Hereunder is a quick *Troubleshooting Guide* for the Delta.

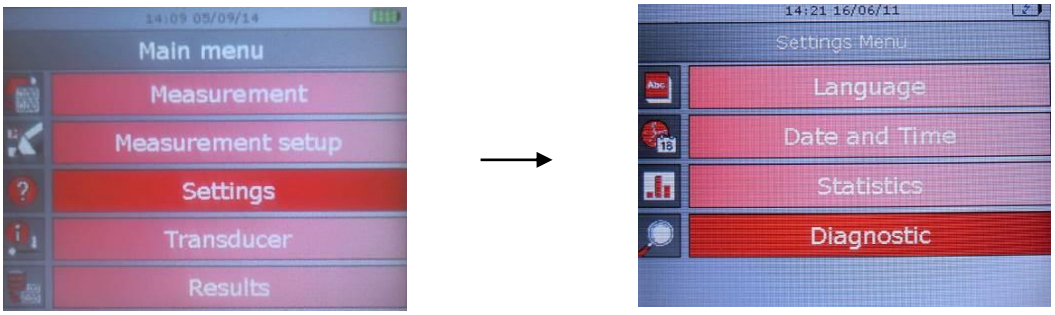
If a problem is shown, before taking any action (replacing parts or contacting customer support), be sure to check that the Delta is being used properly; improper operation can cause defeats even if the system is in good working order.
In case of issues, the log file can provide information about the problem (refer to the paragraph "*Delta LOG file*" for further details).

Symptom	Possible cause	Solution
Cannot enter the test menu	- Transducer not connected	- Connect a valid transducer to the Delta. Ensure that the cable is also the correct one
Cannot connect the DeltaQC to the Delta	- Wrong connection type	- When clicking on the Connect icon, ensure that the USB or Network is selected. Click on the arrow on the right side of the icon to select the connection method
Test result is always *Not OK* when testing a tool, or the click-point of a wrench is never detected	- Ensure to use proper setup	- Check and eventually modify the test setup parameters (the thresholds are the most critical parameters)
"Min Load Error" appears on the Delta display when starting a test	- Pset and transducer data not matching	- Check both the transducer and the Pset data; they must be compatible to start a test
"Capacity error" appears on the Delta display when starting a test	- The transducer has capacity not adequate for the test	- Use a transducer with higher capacity
"No Pset available" appears on the Delta display when selecting a tool	- Tool has not Pset associated	- Associate at least one Pset to the tool
"No more Psets available" appears on the Delta display when starting a test	- Tool has been deleted	- Exit the test menu, and create a tool with at least a linked Pset
"No tool" appears on the Delta display when accessing the *Tools* menu	- Tool not defined	- Create at least a tool with a Pset associated to start a test
"Transducer not suitable" is shown on the Delta display	- Incompatible transducer used for the test (for example, a static transducer used for a test with angle measurement)	- Connect a compatible transducer for the test

26.1 Delta Diagnostic

The diagnostic menu can be used to perform a check of the Delta hardware.

Select ***Diagnostic*** from the ***Settings*** menu to start the diagnostic procedure:



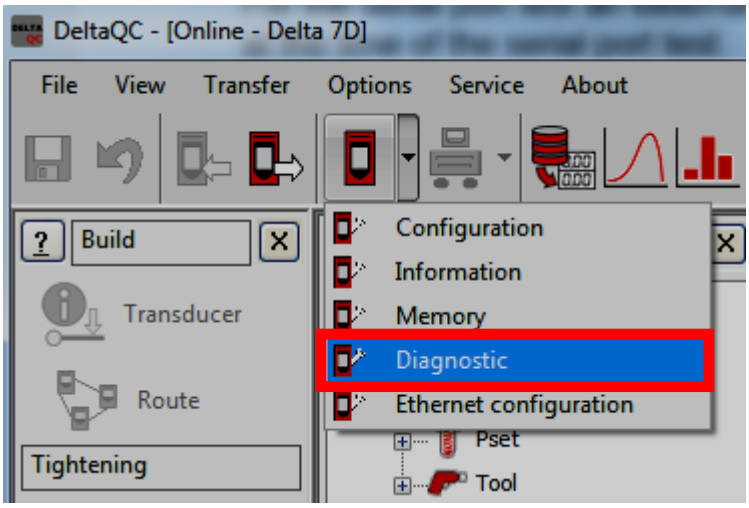
The diagnostic procedure leads the user to check all the Delta hardware.

The diagnostic procedure is interactive: simply follow the instructions given on the Delta display to complete it; if a component gives a *Not OK* result during the test, it should be repaired or replaced.

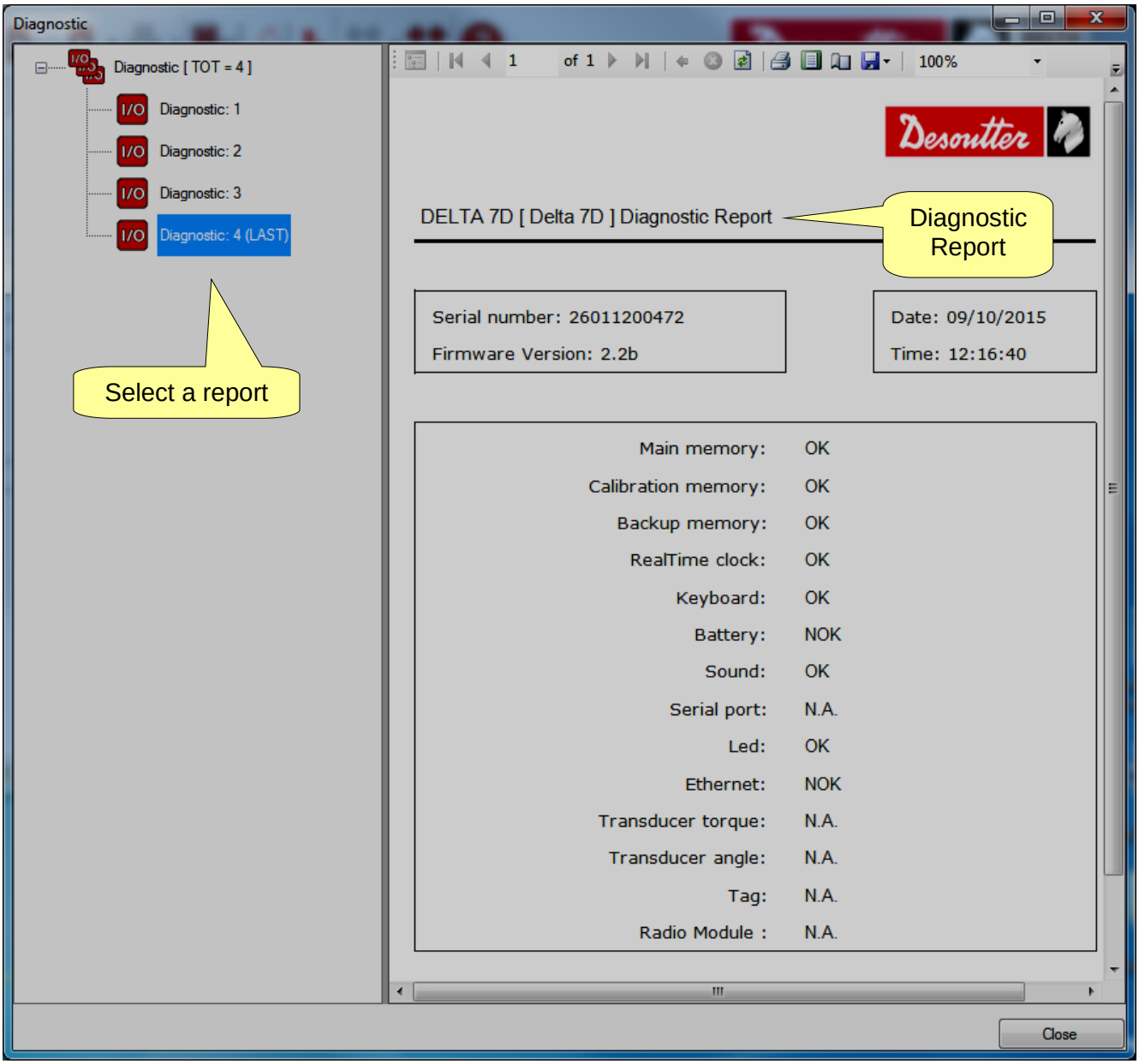
To perform network test, the Delta must be connected with the network (without the need of specific settings).
For the serial port test an external barcode must be connected and a barcode string must be scanned at the time of the serial port test.

NOTE: If the test on some buttons of the Delta keyboard gives *Not OK* result, all the following tests requiring the operator to use that button to confirm the test result will not be performed, and will be marked as *N.A.* (Not Applicable).

The last ten diagnostic reports are saved in the Delta memory and can be retrieved by the DeltaQC software. Connect the Delta to the DeltaQC software and select the ***Controller*** → ***Diagnostic*** menu:



The following screen is shown:



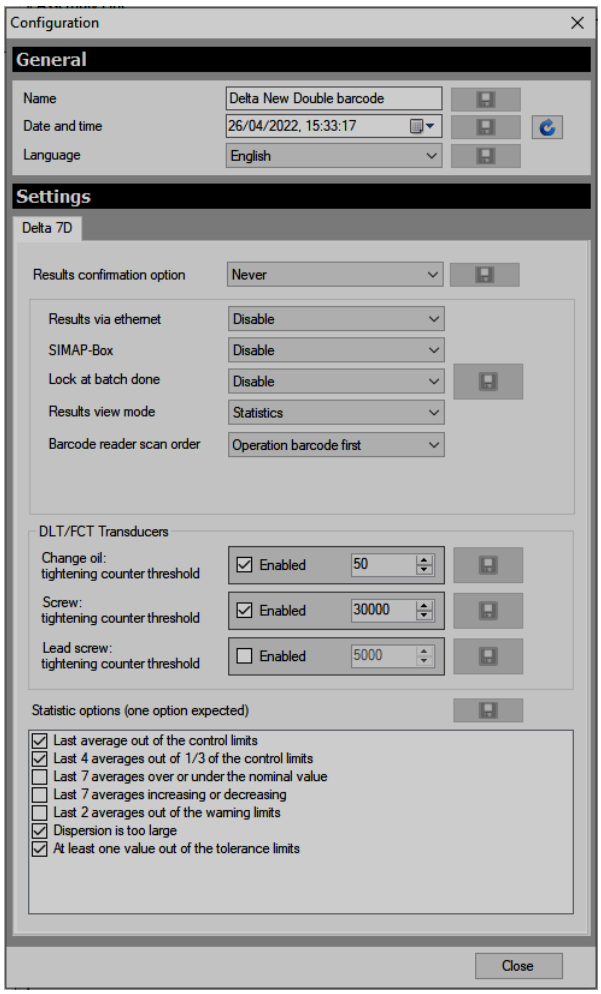
Each report is marked (in the left column) either in green if all of the test are *OK* (or not applicable or in red if at least one test gives a *Not OK* result.

The last report is marked as ***LAST***.

The toolbar in the upper area of the *Diagnostic Report* provides functions to print the report or export it to Excel or PDF file.

27 DELTA FACTORY SETTINGS

The following table details the Delta factory configuration:



GENERAL

Name	→	This field is left blank as factory settings
Date and time	→	Current date and time
Language	→	*English*

SETTINGS

Result confirmation option	→	*Never (not applicable for **Delta 1D** model)*
Results via Ethernet	→	*Disable (not applicable for **Delta 1D** model)*
SIMAP-Box	→	*Disable*

Lock at batch done	→	*Disable (not applicable for **Delta 1D** model)*
Results view mode	→	*Statistics*
Barcode reader scan order	→	*Operation barcode first*
Change oil: tightening counter threshold	→	*Enabled – 60000 (applicable only for **FCT** transducer)*
Screw: tightening counter threshold	→	*Enabled – 30000 (applicable only for **FCT** transducer)*
Lead screw: tightening counter threshold	→	*Disabled – 5000 (applicable only for **DLT** transducer)*
Statistic options	→	All rules enabled *(not applicable for **Delta 1D** model)*

28 ABBREVIATIONS

Abbreviation	Description	Abbreviation	Description
A	Ampere	LED	Light-Emitting Diode
AC	Alternating current	Max	Maximum
ART	Analog rotary transducer	Min	Minimum
Avg	Average	ms	millisecond
CCW	Counter clockwise	n	Numbers (of values)
CW	Clockwise	N.A.	Not Applicable
dBm	Decibel referred to milliwatt	Nm	Newton meter
DC	Direct current	Nr.	Number
DRT	Digital rotary transducer	OK	Approved (test)
DST	Digital static transducer	NOK	Not approved (test)
DSTxs	Digital static transducer for very low torques	PC	Personal Computer
DWT	Digital wrench transducer	Std	Standard deviation
EMC	Electromagnetic Compatibility	SW	Software
EMI	Electromagnetic Interference	USB	Universal Serial Bus
ESC	Exit	V	Volt
Hz	Hertz (measurement unit of frequency)	VIN	Vehicle Identification Number
ID	Identification	WEEE	Waste Electrical and Electronic Equipment
IP	Internet Protocol		

(1) DECLARATION OF CONFORMITY
(Fr) DECLARATION DE CONFORMITE

(2) **We:**
(Fr) Nous

Ets Georges Renault
38 rue Bobby Sands
44818 Saint Herblain - FR

(3) Technical file available from EU headquarter.
(Fr) Dossier technique disponible auprès du siège social

Pascal Roussy, R&D Manager
Ets Georges Renault
38 rue Bobby Sands – BP 10273
44818 Saint Herblain - France

(4) **Declare that the product(s):**
(Fr) déclarons que les produits

Delta
Delta

(5) **Machine type(s):**
(Fr) type(s)

Model *(Modèle)*	**Part Number** *(Référence)*	**Serial Number** *(N° série)*
ANY	***ANY***	***ANY***

(6) Origin of the product: Italy
(Fr) Origine du produit

(7) **Is in conformity with the requirements of the council Directives on the approximation of the laws of the Member States relating:**
(Fr) est (sont) en conformité avec les exigences de la Directive du conseil, concernant les législations des états membres relatives:

(8) **To "Risk of Hazardous Substances (ROHS)" 2011/65/EC (21/07/2011)**
(Fr) aux "Risque de substances dangereuses (ROHS)" 2011/65/EC (21/07/2011)

(9) **To "Electromagnetic Compatibility" 2004/108/EC (15/12/2004)**
(Fr) aux "Compatibilité électro-magnétique" 2004/108/EC (15/12/2004)

(11) **Applicable harmonised standard(s):**
(Fr) Norme(s) harmonisée(s) applicable(s):

EN 61010-1:2010	→	*Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General Requirements*
EN 61326-1:2013	→	*Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements*

(12) **NAME and POSITION of issuer:**
(Fr) NOM et FONCTION de l'émetteur:

Pascal ROUSSY
(R&D Manager)

(13) **Place & date: Saint Herblain 01/31/2018**
(Fr) Place et dat

(1) DECLARATION OF CONFORMITY

(Fr) DECLARATION DE CONFORMITE

DEUTSCH (GERMAN) (1) **EG-KONFORMITÄTSERKLÄRUNG** - (2) Wir, **DESOUTTER** – (3) Technische Datei beim EU - (4) erklärenhiermit, daß das (die) Produkt(e) : - (5) Typ(en): - (6) Produktherkunft - (7) den Anforderungen der EG-Richtlinie zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten - (8) für **"(ROHS)" 2011/65/EG** (21/07/11) - (9) für **"Elektromagnetische Störfreiheit" 2004/108/EG** (15/12/04) - (10) N/A - (11) geltende harmonisierte Norme(n) - (12) NAME und EIGENSCHAFT des Ausstellers: - (13) Datum:

NEDERLANDS (DUTCH) (1) **E.G.-VERKLARING VAN OVEREENSTEMMING** - (2) De firma : **DESOUTTER** - (3) Technisch bestand verkrijgbaar - (4) verklaart hierbij dat het (de) produkt(en): - (5) type: - (6) Herkomst van het product - (7) in overeenstemming is (zijn) met de vereisten van de richtlijn van de Raad inzake de onderlinge aanpassing van de wetgevingen van de lidstaten betreffende: - (8) **"(ROHS)" 2011/65/CEE"** (21/07/11) - (9) **"elektromagnetische compatibiliteit" 2004/108/EG** (15/12/04) - (10) N/A - (11) geldige geharmoniseerde norm(en) - (12) NAAM en FUNCTIE van de opsteller: - (13) Datum:

SVENSKA (SWEDISH) (1) **EG-DEKLARATION OM ÖVERENSSTÄMMELSE** - (2) Vi **DESOUTTER** - (3) Teknisk fil tillgänglig från - (4) Förklarar att maskinen: - (5) Maskintyp: - (6) Produktens ursprung - (7) För vilken denna deklaration gäller, överensstämmer med kraven i Ministerradets direktiv om harmonisering av medlemsstaternas lagar rörande - (8) **"(ROHS)" 2011/65/EEG** (21/07/11) - (9) **"elektromagnetisk kompatibilitet" 2004/108/EEG** (15/12/04) - (10) N/A - (11) Harmoniserade standarder som tillämpats: - (12) Utfärdarens namn och befattning: - (13) Datum:

NORSK (NORWEGIAN) (1) **EF ERKLÆRING OM OVERENSSTEMMELSE** - (2) Vi **DESOUTTER** - (3) Teknisk dokument tilgjengelig - (4) Erklærer at produktet/produktene: - (5) av type: - (6) Produktets opprinnelse - (7) er i overensstemmelse med de krav som finnes i Ministerrådets direktiver om tilnærming av Medlemsstatenes lover vedrørende: - (8) **"(ROHS)" 2011/65/EF** (21/07/11) - (9) **"elektromagnetisk kompatibilitet" 2004/108/EF** (15/12/04) - (10) N/A - (11) Harmoniserende standarder som er anvendt: - (12) Utsteders navn og stilling: - (13) Dato:

DANSK (DANISH) (1) **EF OVERENSSTEMMELSESERKLÆRING** - (2) Vi **DESOUTTER** - (3) Teknisk dokument kan fås på - (4) erklærer at produktet(erne): - (5) type: - (6) Produktets oprindelse - (7) er i overensstemmelse med kravene i Rådets Direktiv vedr. Tilnærmelse mellem medlemslandenes love for - (8) **"(ROHS)" 2011/65/EF** (21/07/11) - (9) **"elektromagnetisk kompatibilitet" 2004/108/EF** (15/12/04) - (10) N/A - (11) Gældende harmoniserede standarder: - (12) Udsteder, navn og stilling: - (13) Dato:

SUOMI (FINNISH) (1) **ILMOITUS YHDENMUKAISUUDESTA EY** - (2) Me **Toiminimi DESOUTTER** - (3) Tekniset tiedot saa EU:n - (4) vakuutamme, että tuote / tuotteet: - (5) tyyppi(-pit): - (6) Tekniset tiedot saa EU:n - (7) on / ovat yhdenmukainen(-sia) neuvoston jäsenmaiden lainsäädäntöä koskevien direktiivin vaatimusten kanssa, jotka koskevat: - (8) **"(ROHS)" 2011/65/EY** (21/07/11) - (9) **"elektromagneettista yhteensopivuutta" 2004/108/EY** (15/12/04) - (10) N/A - (11) yhdenmukaistettu(-tut) soveltuva(t) standardi(t): - (12) ilmoituksen antajan NIMI ja ASEMA: – (13) Päiväys:

ESPAÑOL (SPANISH) (1) **DECLARACION DE CONFORMIDAD CE** - (2) Nosotros **DESOUTTER** - (3) Archivo técnico disponible en - (4) declaramos que el producto: - (5) tipo de máquina: - (6) Origen del producto - (7) es conforme a los requisitos de la Directiva del Consejo sobre la aproximación de las leyes de los Estados Miembros con relación - (8) a la **"(ROHS)" 2011/65/CE** (21/07/11) - (9) a la **"compatibilidad electromecánica" 2004/108/CE** (15/12/04) - (10) N/A - (11) normas armonizadas aplicadas: - (12) Nombre y cargo del expedidor: - (13) Fecha:

PORTUGUÊS (PORTUGUESE) (1) **DECLARAÇÃO DE CONFORMIDADE CE** - (2) Nós **DESOUTTER** - (3) Ficheiro técnico disponível na - (4) declaramos que o produto: - (5) tipo de máquina: - (6) Origem do produto - (7) está em conformidade com os requisitos da Directiva do Conselho, referente às legislações dos Estados-membros relacionados com: - (8) **"(ROHS)" 2011/65/CE** (21/07/11) - (9) **"compatibilidade electromagnética" 2004/108/CE** (15/12/04) - (10) N/A - (11) Normas harmonizadas aplicáveis: - (12) Nome e cargo do emissor: - (13) Data:

ITALIANO (ITALIAN) (1) **DICHIARAZIONE DI CONFORMITÀ CE** - (2) La Società : **DESOUTTER** - (3) File tecnico disponibile dal - (4) dichiara che il(i) prodotto(i): - (5) tipo: - (6) Origine del prodotto - (7) è (sono) in conformità con le esigenze previste dalla Direttiva del Consiglio, sulle legislazioni degli Stati membri relative: - (8) alle **"restrizioni dell'uso di sostanze pericolose (ROHS)" 2011/65/CE** (21/07/11) - (9) alla **"compatibilità elettromagnetica" 2004/108/CE** (15/12/04) - (10) N/A - (11) norma(e) armonizzata(e) applicabile(i): - (12) NOME e FUNZIONE del dichiarante: - (13) Data:

ΕΛΛΗΝΙΚΑ (GREEK) (1) _**ΗΛ ΣΗ ΠΙΣΤΟΤΗΤΑΣ ΕΚ** – (2) Η εταιρεία : **DESOUTTER** – (3) Τεχνικός φάκελος διαθέσιμος - (4) δηλώνει υπεύθυνα ότι το(τα) προϊόν(-ντα): – (5) τύπου(-ων): – (6) Προέλευση προϊόντος - (7) είναι σύμφωνο(-α) προς τις απαιτήσεις της Οδηγίας του Συμβουλίου που αφορά την προσέγγιση των νομοθεσιών των κρατών μελών τις οχετικές με: – (8) τα **"(ROHS)" 2011/65/EOK** (21/07/11) – (9) την **"ηλεκτρομαγνητική συμβατότητα" 2004/108/EOK** (15/12/04) – (10) N/A – (11) εφαρμοστέο(-α) εναρμονισμένο(-α) πρότυπο(-α): – (12) ONOMA και ΑΡΜΟ(ΙΟΤΗΤΑ του δηλούντος: – (13) Ημερομηνία:

ČESKY (CZECH) (1) **PROHLÁŠENÍ O SOULADU S PŘEDPISY ES** - (2) My, **firma DESOUTTER** – (3) Technický soubor, dostupný - (4) prohlašujeme, že výrobek (výrobky): – (5) typ přístroje (přístrojů): – (6) Původ výrobku - (7) je v souladu s požadavky směrnic Rady EU o aproximaci práva členských států EU, a to v těchto oblastech: – (8) „**(ROHS)" 2011/65/EC** (21/07/11) – (9) „**Elektromagnetická kompatibilita" 2004/108/EC** (15/12/04) – (10) N/A – (11) *relevantní harmonizované normy*: – (12) Jméno a funkce osoby, která prohlášení vystavila – (13) Datum:

MAGYAR (HUNGARIAN) (1) **CE MEGFELELİSÉGI NYILATKOZAT** - (2) Mi, az: **DESOUTTER** - (3) kijelentjük, hogy a termék(ek) - (4) géptípus(ok): - hogy a termék(ek): - (5) géptípus(ok): - (6) A mőszaki leírás az EU-s - (7) megfelel(nek) a tagországok törvényeiben megfogalmazott, alábbiakban szereplı tanácsi Irányelvek követelményeinek: - (8) **"(ROHS)" 2011/65/EC** (21/07/11) - (9) **"Elektromágneses kompatibilitás" 2004/108/EC** (15/12/04) - (10) N/A - (11) alkalmazható harmonizált szabvány(ok): - (12) Kibocsátó neve és adatai: - (13) Dátum:

(1) DECLARATION OF CONFORMITY
(Fr) DECLARATION DE CONFORMITE

LIETUVIŠKAI (LITHUANIAN) (1) **EB ATITIKTIES DEKLARACIJA** - (2) Mes: **DESOUTTER** - (3) Techninius duomenis galite - (4) pareiškiame, kad gaminys(-iai): - (5) mašinos tipas(-ai): - (6) Produkto kilmė - (7) atitinka Europos Tarybos Direktyvų reikalavimus dėl valstybių narių įstatymų, susijusių: - (8) su **„(ROHS)" 2011/65/EB** (21/07/11) - (9) su **„Elektromagnetiniu suderinamumu" 2004/108/EB** (15/12/04) - (10) N/A - (11) *taikomi harmonizuoti standartai*: - (12) Išdavusio asmens pavardė ir pareigos: - (13) Data:

SLOVENŠČINA (SLOVENIAN) (1) **IZJAVA ES O SKLADNOSTI** - (2) Mi: **DESOUTTER** - (3) Tehnična kartoteka je na voljo - (4) izjavljamo, da je izdelek (oziroma izdelki): - (5) vrsta stroja (oziroma vrste): - (6) Izvor izdelka - (7) v skladu z zahtevami direktiv Sveta Evrope o približevanju zakonodaje držav članic glede: - (8) **"(ROHS)" 2011/65/ES** (21/07/11) - (9) **“Elektromagnetne združljivosti” 2004/108/ES** (15/12/04) - (10) N/A - (11) *veljavnih harmoniziranih standardov*: - (12) Ime in funkcija izdajatelja - (13) Datum:

POLSKI (POLISH) (1) **UE –DEKLARACJA ZGODNOŚCI** - (2) My, firma **DESOUTTER** - (3) Plik techniczny jest dostępny w - (4) oświadczamy, ze produkt (produkty): - (5) urządzenie typu (typów): - (6) Pochodzenie produktu - (7) jest (są) zgodne z wymogami Dyrektywy Rady, odpowiadajacej ustawodawstwu krajów członkowskich i dotyczącej: - (8) **“(ROHS)” 2011/65/UE** (21/07/11) - (9) **“Zgodności elektromagnetycznej” 2004/108/UE** (15/12/04) - (10) N/A - (11) *stosowanych norm, wzajemnie zgodnych:* - (12) Nazwisko i stanowisko wydajacego deklarację: - (13) Data:

SLOVENSKY (SLOVAK) (1) **DEKLARÁCIA ER O SÚHLASE** - (2) My: **DESOUTTER** - (3) Technický súbor k dispozícii z - (4) prehlasujeme, že výrobok (y): - (5) strojový typ(y): - (6) Pôvod produktu alebo výrobku - (7) zodpovedá požiadavkom Smerníc rady, týkajcich sa aproximácie zákonov členských štátov, pre: - (8) **“(ROHS)” 2011/65/EC** (21/07/11) - (9) po **“Elektromagnetickú kompatibilitu” 2004/108/EC** (15/12/04) - (10) N/A - (11) *zodpovedajúce harmonizačné normy*: - (12) Meno a funkcia vystavovateľa dokladu: - (13) Dátum:

LATVISKI (LATVIAN) (1) **EK ATBILSTĪBAS DEKLARĀCIJA** - (2) Mēs, **kompānija DESOUTTER** - (3) Tehniskais fails pieejams ES - (4) deklarējam, ka šis (-ie) izstrādājums (-i): - (5) ierīces tips (-i): - (6) Izstrādājuma izcelsme - (7) atbilst Padomes Direktīvu prasībām par dalībvalstu likumu piemērošanu, kas attiecas uz: - (8) **“(ROHS)” 2011/65/EK** (21/07/11) - (9) **“elektromagnētisko savietojamību” 2004/108/EK** (15/12/04) - (10) N/A - (11) *spēkā esošajam (-iem) saskaĦotajam (-iem) standartam (-iem)*: - (12) Pieteicēja vārds un amats: - (13) Datums:

中文 (CHINESE) (1) **EC 一致性声明** - (2) 我们：**DESOUTTER** - (3) 技术参数资料可以从EU总部获得。 - (4) 声明其产品: - (5) 机器类型: - (6) 产品原产地 - (7) 符合会员国立法会议“ 决定” 的相关要求: - (8) **“(ROHS)” 2011/65/EC** (21/07/11) - (9) “**电磁相容性**” **2004/108/EC** (15/12/04) - (10) N/A - (11) 适用协调标准: - (12) 发行者名称和地点: - (13) 日期:

РУССКИЙ (RUSSIAN) (1) **ДЕКЛАРАЦИЯ СООТВЕТСТВИЯ** - (2) Мы: **DESOUTTER** - (3) Технический файл можно - (4) заявляем, что продукция: - (5) тип оборудования: - (6) Происхождение продукта - (7) соответствует требованиям директивы европейского совета относительно законодательств стран-участниц по: - (8) **“(ROHS)” 2011/65/EC** (21/07/11) - (9) по **“Электромагнитной совместимости” 2004/108/EC** (15/12/04) - (10) N/A - (11) применяемые согласованные нормы: - (12) Фамилия и должность составителя: - (13) Дата: