



**AEP** transducers [www.aep.it](http://www.aep.it)



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# OPERATIVE MANUAL

# TorqueKAL

Release 4.4

*Application Program*

*For the calibration of torque tools*



## Overview

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The data contained in this manual are just indicative and the manufacturer declines any responsibility for errors or discrepancies with respect to this manual.

## WARNING

The program comes on a USB key in which resides the permanent protection of the program from any claims of piracy. The USB key must always be inserted into the PC.

## System requirement

PC: Pentium III 300 MHz 128 MB RAM  
Windows XP : Service Pack 3 (SP3) + DonNet 3.5  
Windows 2000  
Windows Vista  
Windows 7 – 8 - 10  
Minimum resolution : 1280x720

## Windows: International options

For the proper functioning of the program, you must use (.) as the decimal point regardless of the conventions of the country where this program is used otherwise several settings can cause errors in calculation. Modify or check your decimal separator setting in the Windows Control Panel !



## 1.0 Introduction

The program was designed to perform the calibration of torque tools comparing them to reference tools.

The calibration procedure is performed in accordance with the UNI EN ISO 6789. Evaluation of the uncertainty of calibration is performed according to the requirements of the UNI CEI ENV 13005th.

The calibration is to run five series of torque values for each measurement point calculated at 20%, 60%, 100% of maximum torque of the device in calibration.

After the test, the program calculates, for each point of measurement:

- a) Average readings
- b) The deviation%
- c) the expanded uncertainty%

All certificates are then printed and stored in a database that keeps the historian of calibrations performed.

It is possible to create an archive of devices to quickly recall their characteristic data before calibration.

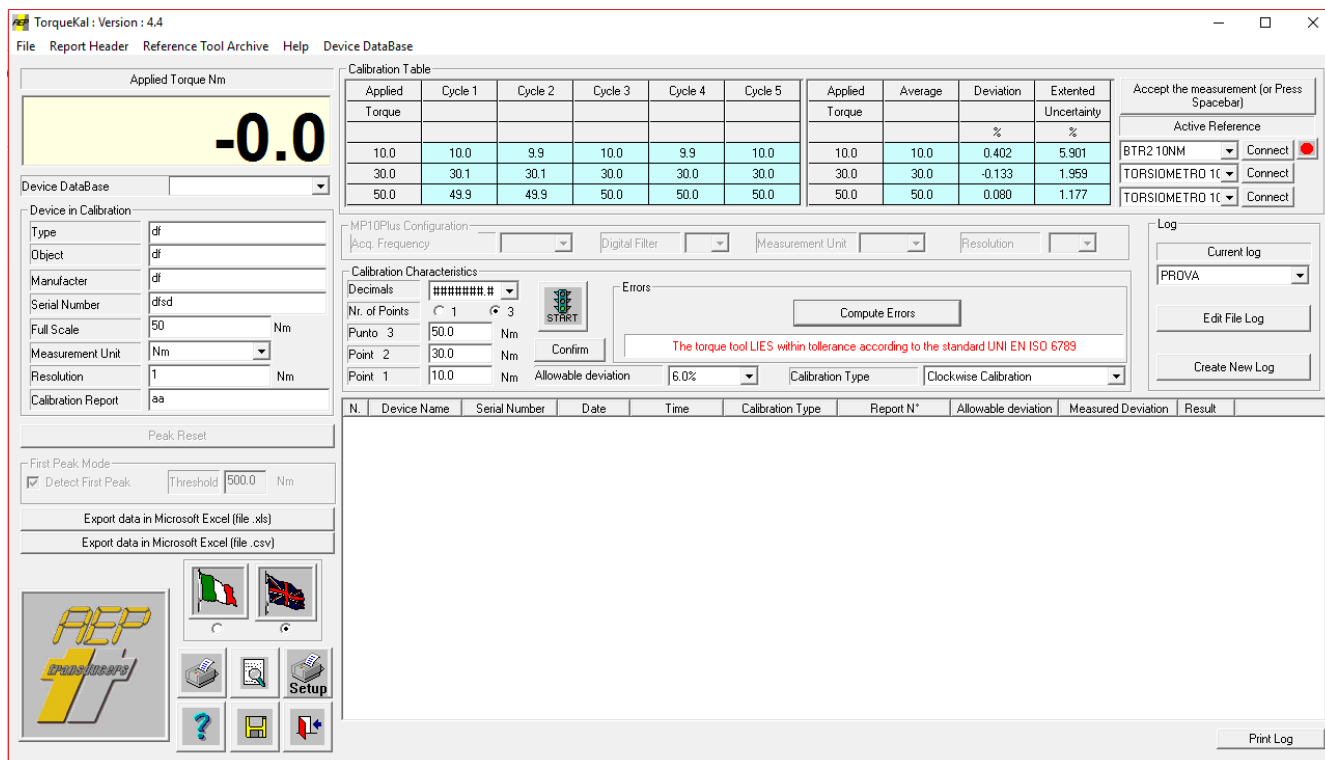
In addition to calibration certificates for each test and it is possible to create log (archives of calibrations ) that allow you to control the statistical data carried out by calculating the quality factors  $c_p$  and  $c_{pk}$ .

The program maintains a database of AEP standard instruments, such BTR,DTR,BTRB,DTRB and MP10 connected to the PC via USB or RS232 serial communication to ensure the acquisition of the measure of torque.

For each standard instrument is necessary to introduce all the identification data, certificates ACCREDIA or equivalent reference for the different uncertainties and broken down the various points of torque.

The program automatically handles reference tools with expired certificate warning the operator when he try to use it.

## 2.0 Functional Keys Description



In the main menu you can manage the following operational functions :

**File-> Open Certificate:** This button opens the dialog box to select and open a certificate from those previously saved.

**File-> New Certificate:** This button clear on the screen all data of a previous calibration.

**Report Header:** This button opens the page where you enter the header data of the certificate, choice the logo and insert report footer notes.

**Reference Tools Archive:** This button opens the page where you enter the data and the uncertainties of the standard instrument. To properly use this program is necessary to fill all the required fields in this page.

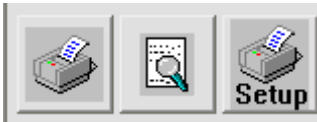
**Device DataBase :** This allows the creation of an archive of devices under test. In this way, if they are repeated over time calibration of a device you can call all its outstanding.

**Help:** you can see this manual and the page that provides information about the program

On the main page some other function keys are active



**Language selection:** This button allows you to select the active language for the video and the report



**Print Certificate:** Here you have the 3 usual print, print preview and setup printer options



**Save Report:** allows you to save the calibration performed in a file. By default the saved data will be stored in the folder 'Certificati' inside the installation folder of the program. The name of the file created will be that of the certificate with the extension 'txt'. If a log is selected the test will be automatically appended to the log and the statistical values will be updated



**Help :** with this key you can see this manual

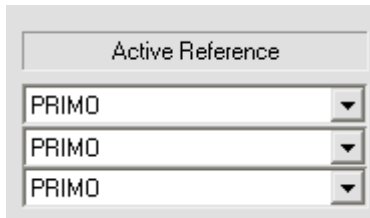


**Quit :** You exit the program. If you have an active calibration the Quit button is disabled

## Note

When you open a report save in archive some fields will be disabled.  
To restore the normal configuration please select the **File->New Certificate**

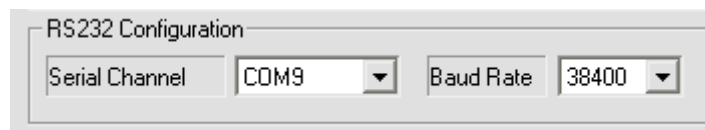
### 3.0 Serial Communication



Active Reference	
PRIMO	▼
PRIMO	▼
PRIMO	▼

For each applied torque in calibration, you can specify a reference instrument to use. The reference instrument used should be connected to the computer via the USB or RS232 serial line provided.

In order to establish a valid communication between PC and reference instrument is necessary to define the baud rate and serial communication port in the window shown below. In case of instrument with USB port it is not necessary to set the Baud Rate. Any valid value can be set.



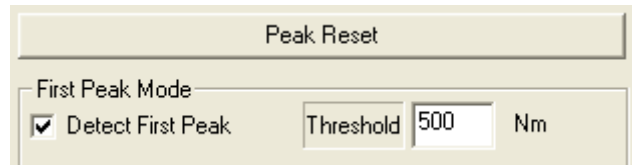
RS232 Configuration			
Serial Channel	COM9	Baud Rate	38400

If your PC does not have a serial port, you can require an RS232C USB adapters.

### 3.1 MP10Plus Indicator

The indicator MP10Plus allows communication of data extremely fast so it is not necessary to set the peak on the indicator the same way as the management of the measures is performed directly at the level of TorqueKal.

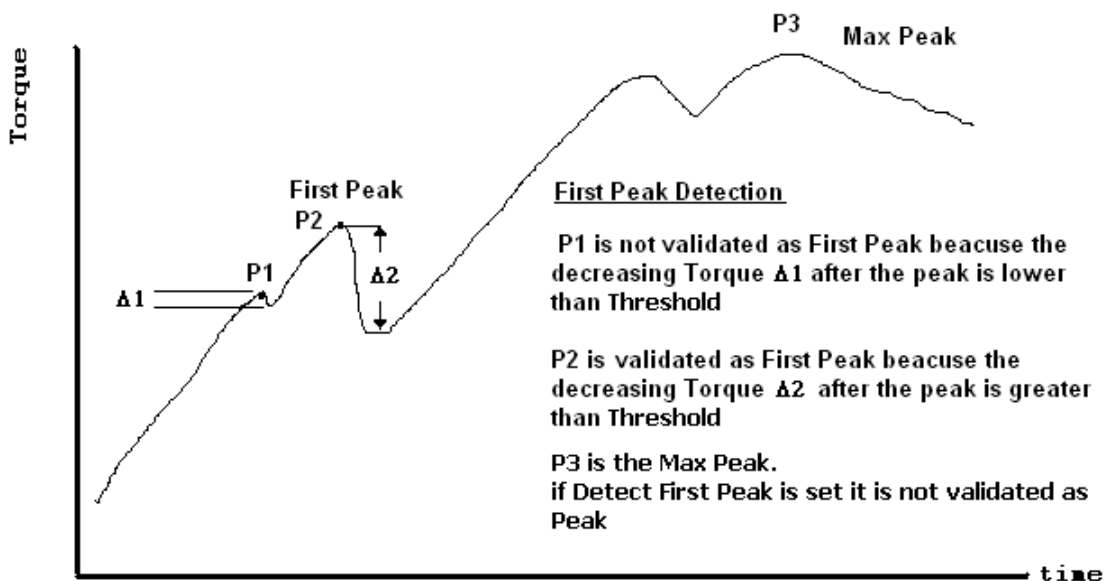
When selected MP10Plus as indicator the window to the side will appear where you can select to enable detection of the first peak and a threshold.



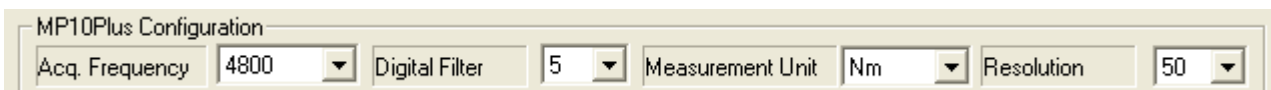
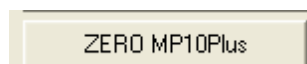
The meaning of the parameter threshold is described in the figure below.

It serves to distinguish the actual first peak from any points of uncertainty that may occur during the measurement. In the figure below the point P1 is not valid as the first peak because of the decrease in the next torque was not greater than the established threshold.

If is not enabled the detection of the first peak it will be adopted the maximum load recorded during the measurement. The peak is automatically reset when you accept the measure. To repeat a measurement, press the Reset Peak button.



With the indicator MP10Plus is further enabled the window below to dynamically change the working parameters of the indicator and perform the **ZERO** function.



## 4.0 Device In Calibration

If it has been created a Device DataBase it is enough to select the device from the data base

Device DataBase TORSIOMETER 100NM

In the window dedicated to the device in Calibration you are supposed to introduced all the specifications of the device being calibrated.

These information will be stored and then reported on the certificate.

Device in Calibration	
Type	DK50
Object	ChiaveDinamometrica
Manufacturer	Mabo
Serial Number	AD50-115674
Full Scale	50
Measurement Unit	Nm
Resolution	02 Nm
Calibration Report	CT02-228756

**Type:** Set here the model of the device in calibration (Es. DK50)

**Object:** field of general use to indicate the type of device.

**Manufacturer:** Set here the maker of the device

**Serial Number:** Set here the Serial Number of the device

**Full Scale :** indicate the full scale torque of the device being calibrated (eg "25" Nm). For counterclockwise calibration, you have to specify a negative value

**Measurement Unit :** specify the measurement unit of the device in calibration.

If you don't find the torque unit you have to use follow the following instruction

1. Quit from TorqueKal
2. Edit using a Windows Text Editor (Notepad) the file Unit.dat located in the installation folder. For each torque unit are forecasted 2 rows. The first is for the unit itself and the second is for the conversion factor respect 1 Nm. Insert the required information for the new torque unit save and quit.
3. Run TorqueKal and check that the new Torque unit is present in the list.

**Resolution:** Set here the best resolution of the device being calibrated. Be careful because this value is used to calculate the uncertainty of the calibration device .

**Calibration Report :** Set here the number of the certificate. This information will be printed on the calibration certificate.



## 5.0 Reference Instruments Archive

**Modify Reference Tool** ✕

Symbolic Name:

**Indicator**

Type	Object	Manufacturer	Serial Number
<input type="text" value="BTR2"/>	<input type="text" value="TORSIOMETRO"/>	<input type="text" value="AEP"/>	<input type="text" value="xxxx"/>

**Torsionmeter**

Type	Object	Manufacturer	Serial Number
<input type="text" value="BTR2"/>	<input type="text" value="TORSIOMETRO"/>	<input type="text" value="AEP"/>	<input type="text" value="xxx"/>
Max Torque	Measurement Unit	Certificate	expiry date
<input type="text" value="10"/>	<input type="text" value="Nm"/>	<input type="text" value="xxxxxx"/>	<input type="text" value="27/09/18"/>

**Serial Port Configuration**

Serial Channel:  Baud Rate:

Clockwise Uncertainty		CounterClock\Wise Uncertainty	
Applied	Extented Uncertainty	Applied	Extented Uncertainty
Nm	%	Nm	%
1.00	0.100	-1.00	0.100
2.00	0.100	-2.00	0.100
5.00	0.100	-5.00	0.100
10.00	0.100	-10.00	0.100

On this page are stored all data on the reference instruments that can be used during the calibration.

For the proper functioning you should fill all the required fields

These can be easily recovered by a ACCREDIA calibration certificate or equivalent document.

The fields are separated for both indicator and torque:

For the indicator is necessary to include:



**Type:** Select the indicator model (ex "BTR").

**Object:** Generic field to specify the kind of the indicator.

**Manufacturer:** Set here the manufacturer of the indicator

**Serial Number:** Set here the Serial Number of the indicator.

For the torque as well as enter data above is necessary to define:

**Max Torque:** Max Torque of the instrument

**Measurement Unit :** es Nm

**Certificate Number:** Indicate the number of the SIT certificate or equivalent document

**Expiry Date:** Set the date of expiry of the certificate of the standard instrument. the program will warn the operator of the expiry of the certificate when it is used

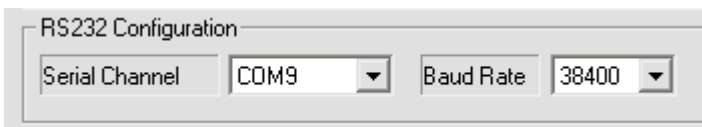
**ClockWise Uncertainty:** in this table, the operator must introduce in the left column the calibration points on the certificate SIT in Nm, and in the right column, the uncertainty associated with each point of torque in a clockwise direction.

The table can accept up to 8 different pairs of points but the operator if necessary can set a lower number of points depending on the certificate in his possession

**CounterClockWise Uncertainty:** in this table, the operator must introduce in the left column the calibration points on the certificate SIT in Nm, and in the right column, the uncertainty associated with each point of torque in a counterclockwise direction.

The CounterClockWise calibration **must** be inserted as negative values.

The table can accept up to 8 different pairs of points but the operator if necessary can set a lower number of points depending on the certificate in his possession



RS232 Configuration

Serial Channel	COM9	Baud Rate	38400
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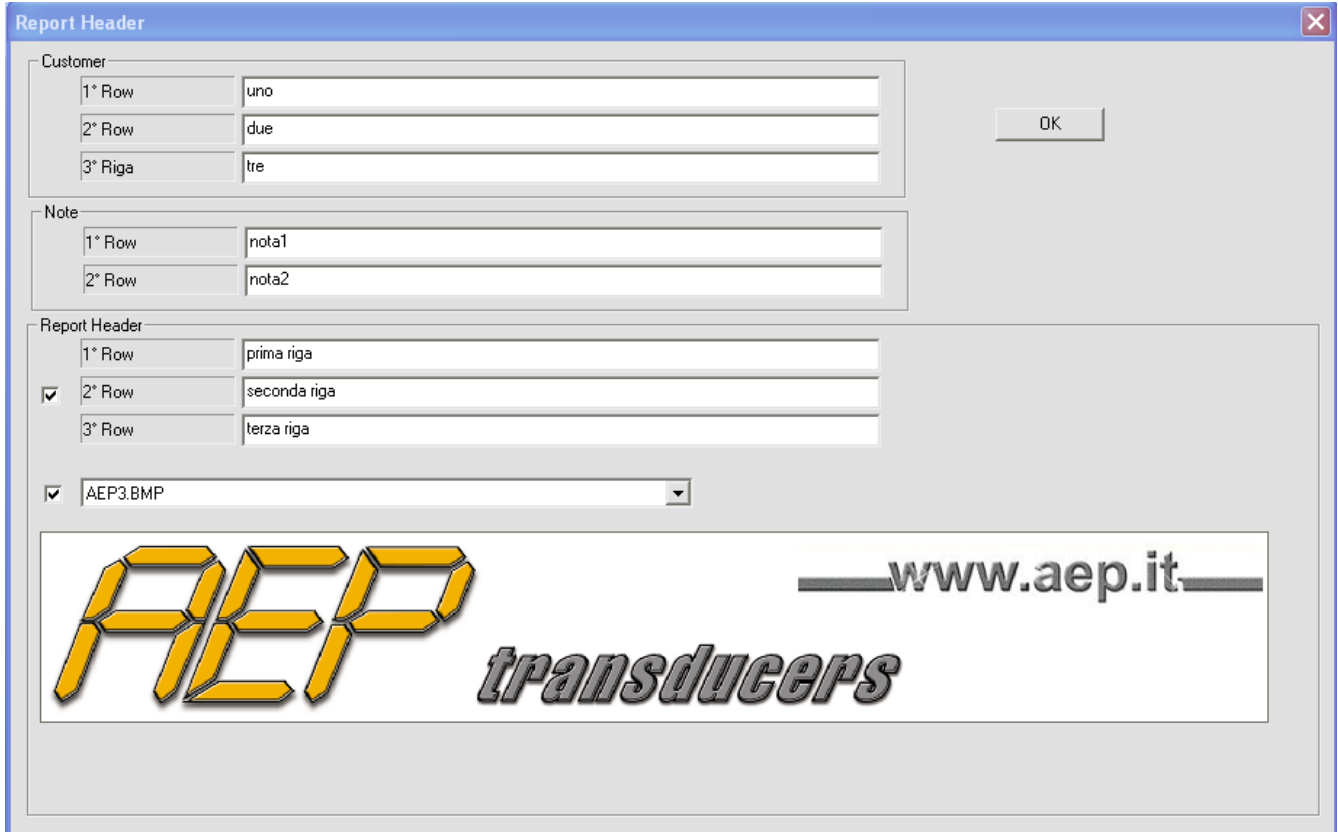
In order to establish a valid communication between PC and reference instrument is necessary to define the baud rate and serial

communication port in the window shown below. In case of instrument with USB port it is not necessary to set the Baud Rate. Any valid value can be set.

**WARNING:**

The introduction of incorrect data affect the calculation of the uncertainty on the machines being calibrated.

## 6.0 Report Header



On this page you can enter some data of interest on the certificate.

**Report Header** It is possible to define the header of the certificate

- with a custom logo,
- with up to 3 lines of free text
- both.

By clicking on the appropriate selections on the side of the choices you can enable / disable the header and / or logo.

You can choose from more than a logo.

Through the selection window you can choose the most appropriate logo file for the certificate to be printed.

To create new files of logos just copy in the folder 'Loghi' (inside the installation folder) the BMP file with the desired image. Each time you change your choice you can see the preview of the image

**Customer:** You can enter up to 3 lines of free text to indicate the details of your customer

**Note:** You can enter up to 2 lines of free text to show general information. (eg expiry of the certificate, the operator name, etc. ..). This text is inserted in the footer of the certificate.

## 7.0 Calibration Procedure

The calibration is semi-automatic because the program sets and suggests the execution sequence, but the operator must perform properly the sequence so that the program successfully scanned data and calculates the average, the expanded measurement uncertainty Deviation.

Calibration Table										Accept the measurement (or Press Spacebar)
Applied	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Applied	Average	Deviation	Extended	
Torque						Torque			Uncertainty	
Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	%	%	Active Reference
10.00	10.03	10.03	10.23	10.02	10.56	10.00	10.17	-1.710	4.618	DTR
30.00	29.99	31.30	30.50	30.45	31.21	30.00	30.69	-2.248	3.614	DTR
50.00	50.06	51.02	50.45	50.21	49.80	50.00	50.31	-0.612	1.846	DTR

Calibration Characteristics				Errors		Log
Decimals	#####.##	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="Compute Errors"/>		<input type="button" value="Current log"/>
N. Misure	1 3					<input type="button" value="Edit File Log"/>
Point 3	50.00 Nm	<input type="button" value="Confirm"/>	<input type="text" value="The torque tool LIES within tolerance according to the standard UNI EN ISO 6789"/>		<input type="button" value="Create New Log"/>	
Point 2	30.00 Nm	Allowable deviation: 2.5%		Calibration Type: Clockwise Calibration		
Point 1	10.00 Nm					

The number of measurement series of each torque value is 5

For each calibration device can run both clockwise and counterclockwise calibration. The number of measurement points (1 or 3), the allowable deviation and the position of the decimal point must be identical in the two settings, while can be different the measuring points.

If you need to set different values in the allowable deviation or a different number of measurement points you should create 2 certificates for calibration in a clockwise direction and one for the adjustment counter-clockwise.

Programming "**Calibration Characteristics** " :

**Allowable Deviation:** Set the maximum Deviation of each measurement allowable from the reference value (eg "4.0%" minimum 2.0% max 6.0%), this deviation must be considered  $\pm$  compared to the reference.

**Type of measure:** set "Clockwise Calibration" if the calibration is performed with positive torque, set "Counterclockwise Calibration " if the calibration is performed with negative torque.

**Decimals :** define the number of significant figures with which to show the torque

The program automatically prepares three measurement points to 20%, 60%, 100% of maximum torque device in calibration. It is possible to modify these values selecting the desired values in the relevant fields. It is possible to select 1 or 3 measurement points. In



case of 1 measurements point the default value is set to 100% of the maximum torque device in calibration.

For each torque point must be defined the reference indicator that will be used in the appropriate selection windows

To achieve calibration, follow these steps

Activate the instrument Peak mode to the reference instrument (not necessary if the MP10Plus indicator is used)

It is necessary to generate five loads for each point of measurement to verify the repeatability of the tool being calibrated

Press the **Start** button to begin calibration.

If accepted the Start button changes to Stop

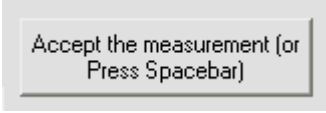
It is highlighted in red box the first measure to be carried

With your instrument, the torque value will also appear in the box active acquisition, which will appear in red.

Generate the first point of torque proposed by the program in the "applied load" (eg "10 Nm"), press the button Zero on the standard instrument to send the measure to the program. Press the "Accept the measure" button to place the measure received in the table.

In this way the PC is stored the value of standard instrument refers to "10 Nm" generated by the device being calibrated.

Pressing the spacebar or the button 'Accept the Measure', the measure is confirmed and the program prepares for the new measure.



Accept the measurement (or  
Press Spacebar)

It is possible at any time to resume a point already made by simply clicking inside the window on the measure

If the measure is not satisfactory, do not accept it , and repeat the measure.

At the end of the sequence of tests, the program will automatically calculate the average, the extended deviation uncertainty of the device in calibration.

You can stop the test at any time by pressing the Stop button and then start again the procedure by pressing **Start**.

At the end of the test you can manually edit each measure by clicking within the window in question and entering the new value. You can then recalculate all the values by pressing the dedicated button.

You can similarly create completely in manual calibration by filling all fields of the table manually.



## 8.0 Errors and Uncertainty calculation

**Average ( $e_m$ ):** It is compute for each point:

$$e_m = ((\text{Sum of reading points}) / (n^\circ \text{ of series}))$$

**Deviation % ( $\Delta\%$ ):** It is computed for each point as the relative percentage deviation between the Average point and the nominal value. è calcolato per ogni punto di misura tra la media delle letture ed il valore nominale di coppia:

$$\Delta\% = ((\text{Average} - \text{Nominal Value}) / \text{Nominal value}) * 100$$

**Incertezza Estesa % (U):** it is computed for each measurement point keep in count the reading error %( $u\%$ ):

$$U\% = (\text{SQR}((U_{res})^2 + (U_{rep})^2 + (U_{std})^2)) * k$$

where:

$U_{res}$  = Uncertainty due to the relative resolution

$U_{rep}$  = Uncertainty due to the repeatability

$U_{std}$  = Uncertainty due to the reference instrument

k=2 is adopted



## 9.0 Report example

The report always refers to a single setting in clockwise or counterclockwise depending on what is displayed on the screen.



### Report N° : CT02-228756

Customer Date : 02/12/2009  
**UBO** Time : 16:32:01  
 due  
 due

#### Reference Devices

##### PRIMO

**Indicator**  
 Type DTRB  
 Object Indicator  
 Serial Number 123456  
 Manufacturer AEP

**Torsiometer**  
 Type CSTY  
 Object Torsiometer  
 Serial Number 76890  
 Manufacturer AEP  
 Max Torque 100 Nm  
 Report N° 000-0002-11

#### Device in Calibration

Type DK50 Manufacturer Mabco  
 Object Chiave Dinamometrica Max Torque 50 Nm  
 Serial Number AD60-115674 Resolution 02 Nm

#### Torque Measurement

Applied Torque Nm	Cycle 1 Nm	Cycle 2 Nm	Cycle 3 Nm	Cycle 4 Nm	Cycle 5 Nm
10.00	9.90	9.80	9.90	10.00	9.90
30.00	30.00	29.80	29.90	30.00	29.90
50.00	49.80	50.00	50.00	50.00	49.90

Applied Torque Nm	Average Nm	Deviation %	Extended Uncertainty %	Active Reference
10.00	9.90	1.010	11.751	PRIMO
30.00	29.92	0.267	3.901	PRIMO
50.00	49.92	0.160	2.339	PRIMO

Note  
 nota1  
 nota2

Signature \_\_\_\_\_

## 10. Log

A Log is a record of calibration results that are collected in order to perform statistical analysis. A record is created for each calibration saved as shown in the figure below and automatically update the statistics.

N.	Device Name	Serial Number	Date	Time	Calibration Type	Report N°	Allowable deviation	Result
10	Torsiometer 100Nm	AD50-115674	02/03/2013	16:16:27	Clockwise Calibration	CT02-228756	2.5%	OK
11	Torsiometer 100Nm	AD50-115674	03/03/2013	17:09:35	Clockwise Calibration	CT02-228756	2.5%	OK
12	Torsiometer 100Nm	AD50-115674	04/03/2013	09:08:55	Clockwise Calibration	CT02-228756	2.5%	OK
13	Torsiometer 100Nm	AD50-115674	05/03/2013	08:33:34	Clockwise Calibration	CT02-228756	2.5%	OK
14	Torsiometer 100Nm	AD50-115674	06/03/2013	10:56:22	Clockwise Calibration	CT02-228756	2.5%	OK
15	Torsiometer 100Nm	AD50-115674	07/03/2013	10:24:11	Clockwise Calibration	CT02-228756	2.5%	OK
16	Torsiometer 100Nm	AD50-115674	08/03/2013	11:22:25	Clockwise Calibration	CT02-228756	2.5%	OK
17	Torsiometer 100Nm	AD50-115674	09/03/2013	17:17:56	Clockwise Calibration	CT02-228756	2.5%	OK
18	Torsiometer 100Nm	AD50-115674	10/03/2013	13:09:29	Clockwise Calibration	CT02-228756	2.5%	OK
19	Torsiometer 100Nm	AD50-115674	11/03/2013	16:33:45	Clockwise Calibration	CT02-228756	2.5%	OK
20	Torsiometer 100Nm	AD50-115674	12/03/2013	16:12:11	Clockwise Calibration	CT02-228756	2.5%	OK
21	Torsiometer 100Nm	AD50-115674	13/03/2013	16:34:00	Clockwise Calibration	CT02-228756	2.5%	OK
22	Torsiometer 100Nm	AD50-115674	14/03/2013	10:23:56	Clockwise Calibration	CT02-228756	2.5%	OK
23	Torsiometer 100Nm	AD50-115674	15/03/2013	10:11:22	Clockwise Calibration	CT02-228756	2.5%	OK
24	Torsiometer 100Nm	AD50-115674	16/03/2013	11:00:13	Clockwise Calibration	CT02-228756	2.5%	OK
25	Torsiometer 100Nm	AD50-115674	17/03/2013	11:06:18	Clockwise Calibration	CT02-228756	2.5%	OK
26	Torsiometer 100Nm	AD50-115674	18/03/2013	09:11:19	Clockwise Calibration	CT02-228756	2.5%	OK
27	Torsiometer 100Nm	AD50-115674	19/03/2013	08:34:22	Clockwise Calibration	CT02-228756	2.5%	OK
28	Torsiometer 100Nm	AD50-115674	20/03/2013	09:21:44	Clockwise Calibration	CT02-228756	2.5%	OK
29	Torsiometer 100Nm	AD50-115674	21/03/2013	11:11:56	Clockwise Calibration	CT02-228756	2.5%	OK
30	Torsiometer 100Nm	AD50-115674	22/03/2013	15:33:04	Clockwise Calibration	CT02-228756	2.5%	OK

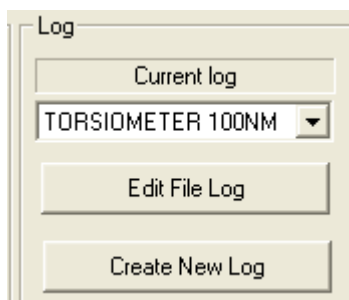
Number of Test: 30    Test in Range: 30    Test Out Of Range: 0    cpk: 0.745    cp: 0.814

Are calculated:

- Number of calibration inside the log
- Number of calibration in tolerance
- Number of calibration out of tolerance
- Cp
- Cpk

Remains to the operator the choice of how to create a log

For example attach the log to the entire batch of devices or create a Log for each device, etc. ...



You create a log using **Create New Log** where you will be asked simply to name the new log.

Automatically the log created becomes the current one.

Log files are files with the extension .csv created in the Logs folder located inside the installation folder of the program.

With **Edit Log File** is possible to make a maintenance of the file to correct or change erroneous data.

Log file are text file in which each field separated by a semicolon .

They can then be imported directly from programs such as Microsoft Excel.





The printing of the log is activated via **the Print Log** button. In the report are kept the size of columns on the screen. For which it is possible to enlarge / tighten the columns to give more space or one or the other field. To disable a column is sufficient to minimize the width of a column.

## Cp e Cpk

Cp and Cpk are indices of quality statistics that are associated with a process of measurement.

The variable is kept under control is the measured deviation of each calibration

The upper (LS) and lower (LI) limits are the permissible deviation selected.

by definition

$$cp = \frac{LS - LI}{6\sigma}$$

$$cpk = \text{Min}\left(\frac{\mu - LI}{3\sigma}, \frac{LS - \mu}{3\sigma}\right)$$

where  $\sigma$  is the standard deviation and  $\mu$  is the average of the deviation measured of the calibration inside the log