Take Pride – Torque Norbar

Getting the Best Out of Your Torque Tester – Part One

Types of tester

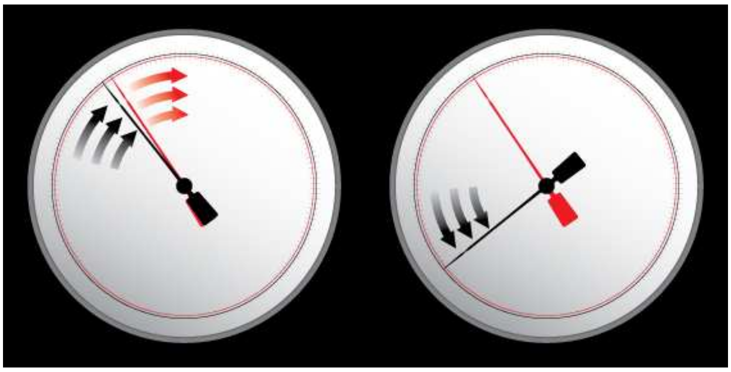
As discussed in the previous article, there are different types of torque tester: mechanical, hydraulic and electronic.

Accuracy

Mechanical and hydraulic testers generally use a needle on a dial to show the torque value. They share three common problems:

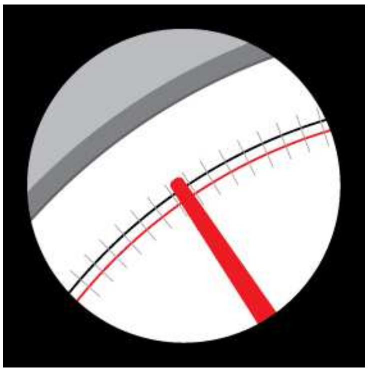
Firstly it is difficult to see where the needle has reached its peak. This is why many testers have slave pointers that are pushed round to the peak reading. Unfortunately the slave pointer can slow down the main needle and show a lower reading than was really achieved.

Secondly the action of a setting type torque wrench or screwdriver is very fast. The damping of the hydraulic or mechanical system may prevent the needle from reaching the true reading and again a lower reading will be shown.



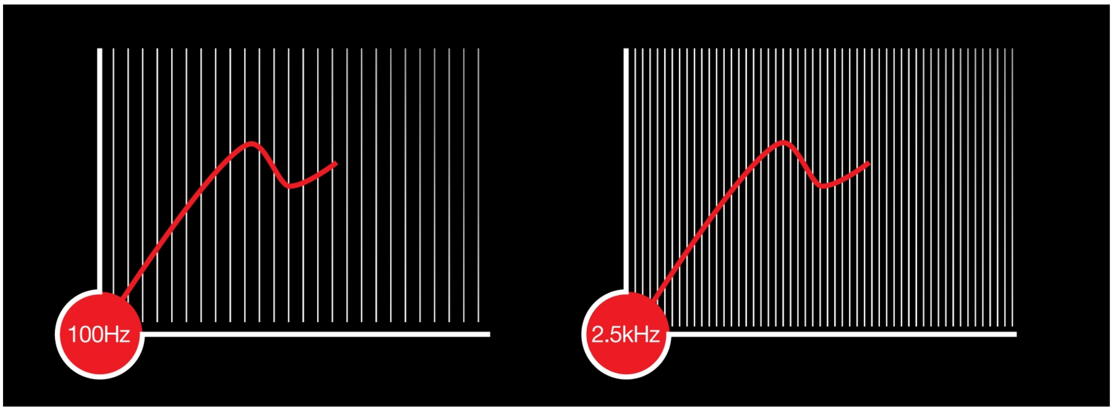
Slave pointers can assist the use of mechanical torque testers but can also introduce errors.

Finally the resolution of a dial is dependent on the size of the dial and the thickness of the needle and the markings. In practice it is hard to read more than ¼ of the gap between marks and this may limit the resolution of reading.



It can be difficult to determine the exact reading from mechanical gauges

Just because a tester is electronic, it does not mean that it is accurate enough for your needs. The two key specifications that matter are the sampling rate and the resolution. The graph below shows the importance of sampling rate. If the tester is not looking often enough at the torque generated by the torque wrench or screwdriver, it may miss the exact moment that the torque reaches its peak level. This means that the tester will not always report the same reading, even when the wrench repeats at the same peak torque. The tester sample rate needs to be at least 2,000 times a second, or 2 KHz in order to give consistent readings.



With a low sampling rate, the tester may miss the exact moment of peak torque.

The second specification is the resolution of the device which is determined by the number of digits on the display and the number of counts in the Analogue to Digital Converter. Taking the resolution first, consider the following example:

A display has 4 digits and a maximum capacity of 100 N.m. The display can move from 99.9 to 100.0 to 100.1 in resolution steps of 0.1 N.m. The resolution as a percentage of reading is 0.1 in 100 or 0.1%.

Now consider the effect at 10 N.m. The display moves from 9.9 to 10.0 to 10.1 in resolution steps of 0.1 N.m. The resolution as a percentage of reading is now 1%.

The resolution is also affected by the number of counts on the A-D converter. Let us assume that the device is designed to work clockwise and anticlockwise and allows for overload in each direction so the display probably reads from -125.0 to +125.0 which is 2500 steps.

A 10 bit A-D converter has 2^{10} counts or 2x2x2x2x2x2x2x2x2x2 = 1024 counts. You can see that it does not have enough counts for each of the 2500 steps. The tester will then have to count up in 1024 steps of about 0.25 N.m.

At 100 N.m the resolution is now quite high at 0.25% and at 10 N.m the resolution has jumped to 2.5%!

Make sure that the resolution of your tester is better than 0.5%.

Calibration traceability

The first part of traceability is related to the chain from the tester back to the international standards for mass and length held by national laboratories around the world. This is important because we want the value of 100 N.m in England to be the same as 100 N.m in the USA or in China. There are two ways of establishing this unbroken link.

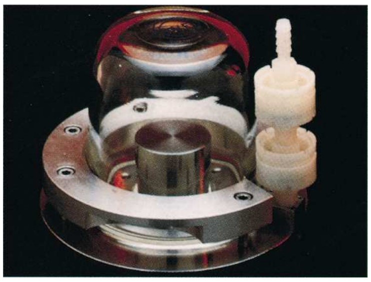


Photo courtesy of the National Physics Laboratory.

It should be possible by finding the serial number of the calibrating device and then the serial number of the device that in turn was used for that calibration. Eventually you arrive at the serial number of the international standard.

The above way is very time consuming. Also it is not enough just to know that the calibrating device has traceability. You must have confidence that the calibration was performed in such a way that there is a good relationship between the calibrating device and the device being calibrated. This is the reason for accreditation of laboratories. An accredited laboratory will have been audited to prove that the uncertainty of measurement is low enough to maintain this good relationship.

Accredited laboratories do not need to record all of the serial numbers on their calibration certificates because they have been audited to check that there is traceability back to international standards.

Calibration Uncertainty

We never know the exact torque value of our torque tester. The definition of calibration explains that we are comparing the value of our tester with the calibrating device. There will always be some uncertainty about the measurement and this can be calculated to a certain level of confidence. Normally we calculate to a confidence level of 95%.

The uncertainty is calculated first for the calibrating device and then for the overall calibration, including the amount of uncertainty that is caused by your tester. An accredited laboratory should take into account all of the things that make the measurement uncertain, including the effect of the operator. It is important to know the size of the uncertainty of your tester as you will not be able to test your torque wrench or screwdriver more accurately than the tester allows. A good accredited calibration laboratory will give you the information that you need to understand this uncertainty.

In “Getting the Best Out of Your Torque Tester – Part Two” we will cover the following areas:

- Matching the calibration device capacity to your torque wrenches
- Different modes and settings
- Warm up and zeroing
- Adjustment of the wrench
- Load point and angle of the wrench