



The Checking and Calibration of Torque Wrenches

Introduction

In this article we will look in more detail at the ways of testing the performance of hand held torque wrenches.

Starting with a reminder about the different types of torque wrench, the article will explain the difference between checking and calibration and the stages of calibration including adjustment. The most appropriate type of test equipment for different situations will also be discussed.

Types of Torque Wrench

Click type or "setting" torque wrenches:



These are set before use to the required torque value. There will normally be some form of scale on the tool. When the desired torque is reached the tool responds by means of a click or physical change of geometry. Due to manufacturing tolerances, even if the wrench is used correctly, the actual torque applied by the tool may be different from the value set on the scale.

A torque wrench tester will display this value during checking or calibration. If there is a difference between the set value and the displayed value then the tool may need adjustment.

Some setting tools do not have scales. In this case the desired torque is set by adjusting the mechanism according to manufacturer's instructions until the "click" is reached at the desired value on the torque wrench tester.



"Indicating" or "measuring" torque wrenches:

These use a mechanical dial or electronic display to show the torque value being applied by the operator.

During checking or calibration, torque is applied until the desired value is shown on the torque tool. The operator then stops applying torque and the desired value on the torque tool is compared with the value displayed on the torque wrench tester. Again the tool may then need adjustment.



Torque screwdrivers:

For very small torques, below 5 N.m (0.5 Kgf.m) it is common to use a torque screwdriver rather than a torque wrench. The issues and requirements are very similar and the term wrench is used for this article to mean both wrench and screwdriver. Where a difference exists it is noted.



Checking of Torque Wrenches

Calibration intervals set by national and international standards are either one year or 5000 cycles, whichever comes first. This may be too long for safety critical operations and more frequent calibration may be necessary. Proper calibration is time consuming and needs to be done in a controlled environment by qualified technicians. Some torque tool manufacturers have therefore now introduced torque checking devices designed to be used by operators at their place of work. This provides a quick and easy way to see if the torque wrench is in good working condition or if it needs to be quarantined for proper calibration. Torque checking devices do not have such a high accuracy and do not normally have a loading mechanism as they are designed to be used by the operator in their normal technique.



Calibration of Torque Wrenches

This will follow a set procedure. The four most common standards are ISO6789, JJG 707, ANSI/ASME B107/14 and GGG 686D.

Throughout the world the ISO 6789 has the largest use. ANSI/ASME B107/14 is popular in the USA. GGG686 is an American military standard which is being overtaken by B107/14. The JJG 707 standard is used in China.

All have similar requirements and in this article we will use ISO 6789 for illustration. There are eight key points to consider.

1. The calibration must be carried out in controlled temperature and humidity conditions. Records must be kept of the temperature during the calibration.
2. The torque measuring instrument is called a calibration device in the standard. This device must have an uncertainty of measurement no greater than $\pm 1\%$ of reading. The standard explains more precisely what this means but the idea is that the calibration device needs to be more accurate than the wrench otherwise the calibration result would be meaningless.
3. The torque wrench must be operated in either a horizontal plane, or positioned vertically and operated in a vertical plane. Setting the wrench horizontal and pushing down is not acceptable for calibration. This is because the weight of the wrench can affect the reading. Screwdrivers can be calibrated in the vertical or horizontal plane.
4. The torque wrench must be exercised (operated) before taking readings. (Once for indicating tools and five times for setting tools.) This is to allow re-lubrication of moving surfaces and settling of components into their working position.
5. The load applied to the torque wrench must be at the centre of the handle, or at some other load point marked by the manufacturer. This is not relevant for screwdrivers.



6. The rate of torque increase must be controlled. This is because the rate of application can affect the torque result. The standard requires control of the rate of torque increase rather than the angular speed of rotation.
7. The readings must be taken at certain points in the range of the torque wrench and there must be five readings at each point. For “setting” wrenches the target point must always be approached from lower on the scale. If the scale is wound too far (above the target point) it must be taken backwards and wound up to the target point again. The technician must look at 90° to the scale when setting to avoid parallax errors.



8. Some torque wrenches have mechanisms that operate in two directions. Others allow the operator to push the square drive through the ratchet for torque in the opposite direction. This means that the mechanism is only operating in one direction. The single direction mechanism is easier to calibrate.

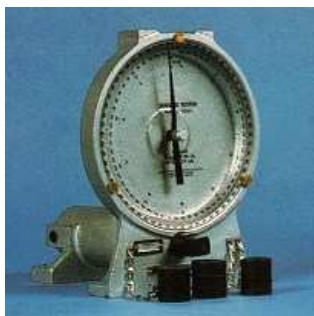


Where a torque wrench has a mechanism that can operate in two directions, it must be exercised after changing direction before taking readings.

These points are a summary of the standards available. The appropriate standard should be purchased and followed when performing a calibration.

Calibration Device

Torque wrench testers can be mechanical, hydraulic or electronic in operation.



Mechanical



Hydraulic



Electronic

The modern electronic torque measuring instruments are designed to monitor the increase of torque applied by the tool and they can recognise when setting tools have reached the “click” or the change in geometry. Mechanical and hydraulic devices are not able to do this and will not be as accurate in their recognition of the “click” point.

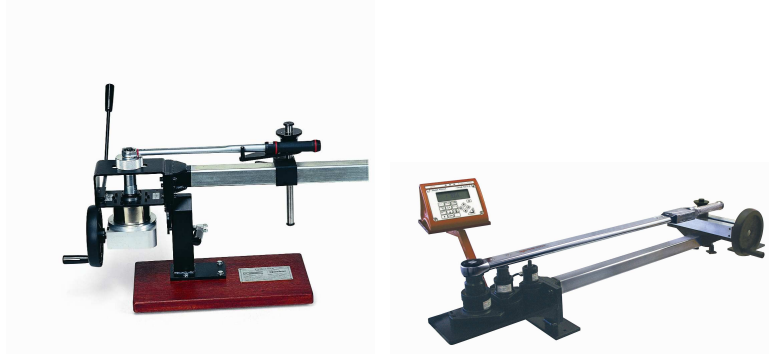
Electronic devices have different modes for “setting” wrenches and “indicating” wrenches. These are often referred to as “first peak” and “peak” readings respectively.

The range of the device is limited. Standards controlling the calibration of these testers limit the useable range to 2% to 100% in the best case and 10% to 100% is more normal. It will be necessary to have several testers to check or calibrate a wide range of torque wrenches.

Loaders should allow calibration in the horizontal plane, or with the wrench held vertically.



For calibration it is useful to have a loader that allows control of the rate of torque increase. Generally loaders where the torque wrench is held stationary and the square drive is rotated are slower and will comply with the standards better than testers where the handle is pushed sideways while the square remains stationary.



Computer controlled loaders are available to exactly control the rate of torque application but these are much more expensive.

Summary

It is very important that manual torque wrenches are calibrated regularly. This article has given an introduction to the subject. Please consult the torque tool manufacturer for more complete information.