

## MAKING DEVICE FOR TORQUE INITIATION WHICH IS APPLIED IN TORQUE WRENCH CALIBRATION

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**Abstract:** The paper describes steps of choosing and making the components of device for torque initiation. All parts of device were modelled in SolidWorks. Cover sheet is done in Sheet Metal modul of Solidworks. Also, procedure of torque wrench calibration is described. Results of calibration and result analysis are given in the table.

**Key words:** torque wrench, calibration, torque initiation

### 1. INTRODUCTION

Torque wrench is a tool which has to be calibrated once a year or twice a year in some cases. That operation requires measuring chain which consist following parts (www.burster.com):

- Sensor
- Calibrator
- Torque initiation device

Sensors and calibrator are made in factory and everybody can have them, but torque initiation device is hard to get from catalogue and simply buy it. Next chapter describes how to make that device in relatively simply way.

### 2. MAKING TORQUE INITIATION DEVICE

Torque, also called moment or moment of force is the tendency of a force to rotate an object about an axis (Brnic, 1993.) In this case, force will be produced by a moving nut, and consequence would be torque in the blocked sensor.

#### 2.1 Housing for spindle and nut

Housing is made of standard square pipes, and spindle with nut is taken from the broken turning machine. Pipes are cut and welded. Nut is machined on the milling machine. The bearing is two-row ball bearing which can tolerate an axial force. When spindle is rotating, nut is moving up and down. On the down side of nut is one side of rod. Other side of rod is connected to the next assembly which transforms translatory motion to torque. All parts are drawn in SolidWorks. Assembly is shown in fig. 1.

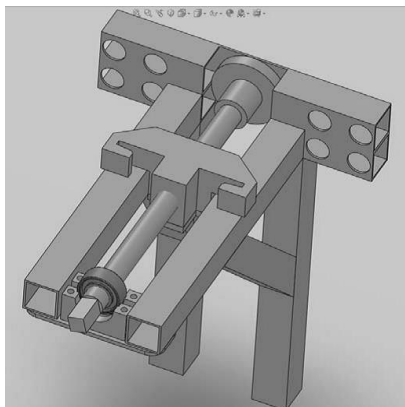


Fig. 1. Housing for spindle and nut

#### 2.2 Steel plate holder

Next assembly consist a strong element which is transforming translatory motion to torque. This part is taken from a car axle and front wheel. Instead of tire, steel plate holder is mounted. Steel plate holder assembly is shown in fig. 2.

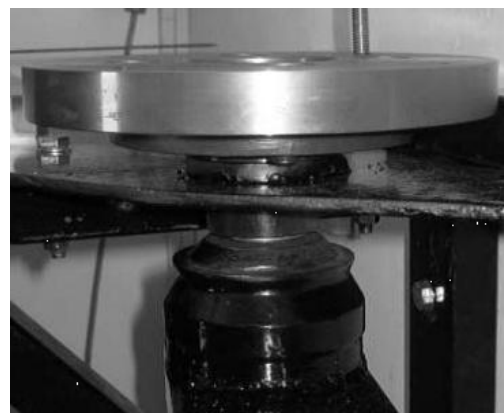


Fig. 2. Steel plate holder assembly

#### 2.3 Aluminum plate

This part holds sensors. Upper side has fit and holes with thread for all Burster torque sensors. Other side has fit for steel plate. Also, this plate can be rotated 90° when it's mounted. This adjustment is needed because rotation angle of mounted sensor, when device is working, is too small. Aluminium plate is shown in fig.3.



Fig. 3. Aluminum plate

#### 2.4 Assembly construction

Construction is made of standard square pipes and mounted on the wall. One side of wrench will be settled in sensor and the other side is on adjustable support. In this moment everything is working and device can be tested. Whole construction is shown in fig. 4.

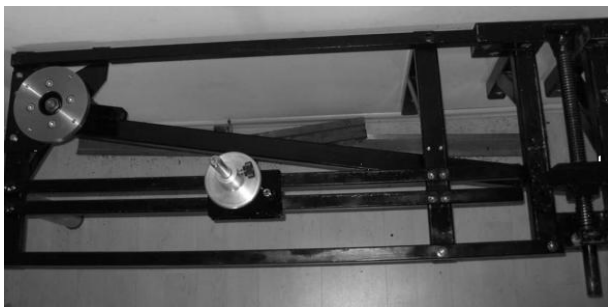


Fig. 4. Assembly construction

### 2.5 Cover sheet

Final job in making this device is drawing cover sheet in SolidWorks – sheet metal forming, send .iges file to ToPs program and make the cover sheet. Finished device for torque initiation connected with a computer is shown in fig. 5.



Fig. 5. Device for torque initiation

## 3. TORQUE WRENCH CALIBRATION

A period of validity of a calibration certificate is 12 months as a maximum. This period should be reduced when the tool is frequently used. The release point of click type wrench must be determined at intervals of 20%, 60% and 100% of the maximal nominal torque (ISO/CD 6789). For each measurement we take 5 measurements, if any one of them (even a single one) is out of the tolerance band of  $\pm 4\%$  the wrench is considered out of tolerance (www.boch.net). Experience shows that points have an asymptotic distribution, with the first value higher than following points.

This is mainly due to an adaptation of the spring in the guide and an hysteresis effect on the first clicks. This phenomenon is typical with almost all torque tools even if the tool has been, as requested by the ISO 6789 standard, operated for at least 5 times at full scale a few seconds before the start of the calibration procedure at 20% of full scale torque value. Fig. 6. shows calibration of torque wrench.



Fig. 6. Calibration procedure

For this reason ISO 6789 requests to use at least 5 times the torque tool at the maximum nominal value just before starting the calibration procedure, so that first clicks can be considered outliers and would not affect the automatic calibration procedure (www.boch.net).

Environmental factors as temperature and air humidity are NOT taken into account, given their minimal influence on measurement results. All electrical equipment must have been switched on at least 15 minutes before starting the calibration procedure.

The expanded uncertainty is given by  $U$ , where  $U_{MG}$  is the measurement uncertainty of the measuring instrument and  $U_{TN}$  is the measurement uncertainty of the reference torque wrench.

$$U = \sqrt{(U_{MG})^2 + (U_{TN})^2} \quad (1)$$

In table 1 are given results of calibration and result analysis. Measurement at 30 Nm is shown in fig. 7.

Nominal value (Nm)	Measured value (Nm)	Mistake		Uncertainty of measurement (%)
		(Nm)	(%)	
10	10,09	-0,09	-0,9	2,1
30	29,81	0,19	0,6	2,9
50	49,77	0,23	0,5	1,6

Tab. 1. Measuring results of 50 Nm torque wrench

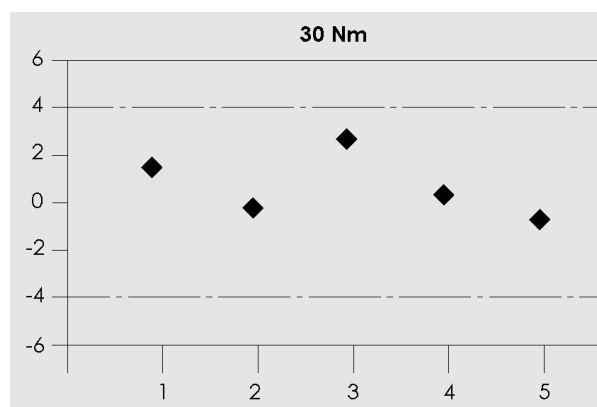


Fig. 7. 30 Nm measurement

## 4. CONCLUSION

Device for torque initiation during calibration process worked well. Measurements are done at intervals of 20%, 60% and 100% of the maximal nominal torque, which are: 10 Nm, 30 Nm and 50 Nm. Maximum uncertainty of measurement was 2,9% on the 2<sup>nd</sup> measurement of 30 Nm.

Calibrated wrench didn't go out of the 4% tolerance limit in any of taken measurements.

## 5. REFERENCES

- Brnić, J.; *Mehanika i elementi konstrukcija*, Školska knjiga Zagreb, 1993
- \*\*\*ISO/CD 6789 ; *Assembly tools for screws and nuts – Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure*
- \*\*\* www.burster.com, Accessed on: 2010-09-06
- \*\*\* www.boch.net, Accessed on: 2010-08-01
- \*\*\* www.dzm.hr, Accessed on: 2010-09-06