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Calibration Instrument for Torque Wrenches

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Verification Regulation of Calibration Instrument for Torque Wrenches

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Replacing JJG 797-1992

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Introduction

This regulation was formulated according to Germany and Japan's current verification method of calibration instrument for torque wrenches DKDR-3-8 and MIF 019, this Regulation replaces JJG 797-1992 "Calibration instrument for torque wrenches." The main technical changes are that it adds verification method of standard torque wrenches; VERIFY 0.3-grade and 0.5-grade calibration instrument for torque wrenches, ADD indication value reproducibility under same arm length and indication value reproducibility under different arm length; ADD indication value reproducibility under different arm length for 1.0-grade calibration instrument for torque wrenches, and it cancels verification method for standard torque instrument.

Verification Regulation of Calibration Instrument for Torque Wrenches

1 Scope

This Regulation applies to the initial verification, subsequent verification and usage inspection of electronic, mechanical and hydraulic calibration instrument for torque wrenches (hereinafter referred to as torque instrument).

2 Terminologies

2.1 Standard torque wrench

The torque wrench which has high accuracy and is used to conduct quantity-value transfer for calibration instrument for torque wrenches.

2.2 Average arm length

The average length of torque wrench's arm, within a certain range.

2.3 Minimum arm length

The minimum length of torque wrench's arm, within a certain range.

3 General introduction

Torque instruments are the instruments used to verify (calibrate) various types of manual torque wrenches. Torque instruments can be generally divided into mechanical, hydraulic and electronic types (it usually uses strain torque sensor) according to the working principle. It mainly includes two kinds according to the structure: one is the calibration instrument for torque wrench with a loading structure, another one is the calibration instrument for torque wrench without a loading structure.

Mechanical and hydraulic torque instruments coaxially concatenate the wrench of torque wrench to be verified AND the torsion elastomer of torque instrument. When imposing torque directly or indirectly on the tail section of torque wrench,

specifications and user's requirements.

5.3.2 Torque sensor and indication instrument shall support the use of each other. Generally, they shall not be replaced randomly. If they need to be replaced, the re-verification is needed.

5.4 Indication instrument

5.4.1 Analogue instrument

5.4.1.1 Scale and mark of each indication dial shall be clear, explicit and easy to read. The zero and maximum value of each scale shall be explicitly marked.

5.4.1.2 It shall have reset mechanism to indicate zero and holding mechanism of torque's indication value.

5.4.1.3 The engraved lines on the dial shall be uniform, the width of pointer shall be approximately equal to the width of engraved lines. The resolution shall be determined according to the RATIO of the width of pointer AND the spacing (scale spacing) between the centers of 2 adjacent engraved lines. The recommended ratio is 1/2, 1/5 and 1/10. When the scale spacing is not less than 1.25mm, 1/10 dial scale value may be estimated and read.

5.4.1.4 During the process of imposing torque, the pointer shall be smooth, and have no abnormal phenomenon such as impact and stagnation. Active pointer and passive pointer shall be coincide with the engraved lines of the dial, and be parallel to the surface of dial.

5.4.1.5 The friction of active pointer shall be able to make passive pointer stay in any position. When conducting verification with or without passive pointer, its relative error of indication value shall not exceed the relative error of indication value as specified by the corresponding accuracy grade. When the torque of fixed-value type torque wrench is suddenly removed, the amount of change of active pointer shall not be greater than 1/5 of the relative error of maximum torque indication value of the corresponding accuracy grade.

5.4.2 Digital instrument

5.4.2.1 The connection between torque sensor and indication device shall be

reliable. And it shall have certain ability to resist to electromagnetic interference.

5.4.2.2 Each operation switch, button, knob and jack shall have words or symbols marked on it, and the operation shall be flexible and reliable.

5.4.2.3 The indication of figures shall be clear and accurate. And it shall have functions of continuation, peak holding and zero-adjustment.

5.4.2.4 The minimum figure increment shall be 1×10^n, 2×10^n or 5×10^n, in which *n* is a positive integer, a negative integer or zero. Each grade shall includes zero and maximum value of its scale range. And it shall indicate the declining symbols of less-than zero position (for example, displayed by the symbol "+" or "-").

5.4.2.5 For those with function of digital signal output, the output data shall be consistent with the indication value.

5.4.2.6 When torque instrument is without loading, if the indication value change is not greater than 1 increment, then the resolution is 1 increment of the last significant figure displayed; if the indication value change is greater than one increment, then the resolution is the half of range of the indication value change.

6 Measurement instrument control

Measurement instrument control includes: the initial verification, subsequent verification and inspection when in use.

6.1 Verification condition

6.1.1 Environmental condition

According to the specification of torque instrument grade, verification of 0.3 grade and 0.5 grade shall be at room temperature of (20 + 5) ºC, verification of 1.0 grade and 2.0 grade shall be at room temperature of (20 + 10) ºC, and under the condition of a relative humidity not greater than 80%. During the process of verification, the variation of room temperature shall not exceed 2 ºC.

torque instrument, of which the preheating time is not specified by the manufacturer, is generally pre-heated for 30 min to 1h. SELECT each range successively and ADJUST zero-point. Visually INSPECT the change of zero, the maximum zero drift within 30min shall meet the requirements of Table 1.

Zero drift is calculated according to the formula (1):

$$Z_d = \frac{M_{0\,max}}{M_n} \times 100\% \quad (1)$$

In the formula:

$M_{0\,max}$ — The maximum torque value of deviation from zero within 30min;

M_n — The maximum torque value of the range.

6.2.3.4 Loading and unloading shall be slow and steady, it shall not have shock and overload (hereinafter the same).

6.2.3.5 When using standard torque wrench, INSTALL standard wrench on torque instrument under verification in the state of torque instrument wrench verification. ADJUST the force point at the position of average arm length. PRE-LOAD at least three times of rated load to torque instrument, in the prescribed method. Holding time of each rated load shall be 30s~1min. After completely removing of each preloading, WAIT at least 30s to return to zero. INSPECT the situation of return-zero of indication device. It may readjust zero according to the needs.

6.2.3.6 Primary load of verification generally is 20% of rated load. Verification points shall be evenly distributed as possible, generally not less than 5 points.

6.2.3.7 VERIFY point by point according to the ascending order of load. After each grade of load is added to the full, MAINTAIN for certain time (usually 30s), RECORD the reading value until the rated load. According to the requirements of submitting organization, the torque instrument which needs return-trip verification shall be verified point by point according to the descending order of load until it returns to zero load. READ the reading value of zero after

maintaining for at least 30s. If necessary, the zero point of indication device can be re-adjusted.

Note: For mechanical and hydraulic torque instrument, when reading the value on the analog indication device, it needs to use a flexible small stick to knock the center of dial indicator's surface gently, if the indication value remains the same before and after knocking, there is no need of knocking.

6.2.3.8 0.3 grade and 0.5 grade need to be conducted the steps of 6.2.3.7 three times continuously (if it needs return-trip verification, it only needs to conduct return-trip value verification at the first time of loading). 1.0 grade needs to be conducted the steps of 6.2.3.7 twice continuously (if it needs return-trip verification, it only needs to conduct return-trip value verification at the first time of loading).

6.2.3.9 After 0.3-grade and 0.5-grade need re-installation [Translator: the original text of this sentence is ambiguous], if the square bar is adjustable then adjusting the square bar's position, then REPEAT the loading according to the steps of 6.2.3.7.

6.2.3.10 For 0.3-grade and 0.5-grade torque instrument, after completing the steps of 6.2.3.9; for 1.0-grade torque instrument, after completing the steps of 6.2.3.7 and 6.2.3.8, then ADJUST the force point of standard wrench to the position of minimum arm length. Then repeatedly CONDUCT the steps of 6.2.3.7 (not including return-trip).

6.2.3.11 For 2.0-grade torque instrument, it needs to be conducted the steps of 6.2.3.7 three times continuously (there is no need to conduct return-trip verification).

According to the grading requirements, the verification steps are shown in Appendix C.

The recommended average arm length and minimum arm length are shown in Appendix D.

6.2.3.12 When using verification leverage and force value weight to verify, the

method shall refer to 6.2.3.5, 6.2.3.6, 6.2.3.7, 6.2.3.8 and 6.2.3.9. There is no need to conduct the steps of 6.2.3.10. For 2.0 grade, REFER to 6.2.3.11.

6.2.3.13 For clockwise and counterclockwise torque instrument, in principle it shall be treated as 2 independent torque instruments of clockwise and counterclockwise. When the loading direction is changed, it shall be preloaded at least three times with rated load at the new direction.

6.2.4 Calculation method of relevant technical indicators of torque instrument

6.2.4.1 Average value $\overline{X}$

The average value of each verification point shall be calculated according to the formula (2), it is deemed as the average value of measurement result obtained in process measurement.

$$\overline{X}=\frac{1}{n}\sum_{j=1}^{n}(I_j-I_{j,0}) \tag{2}$$

In the formula:

j — Number of chosen series;

n — Times of process measurement in average arm length;

I_j — In the process, the readings of indicator at each verification point of installation number j;

$I_{j,0}$ — At the installation number j, the indicator's zero reading before loading.

6.2.4.2 Repeatability b' and reproducibility b, b_1

Repeatability b' in average arm length, is calculated according to the formula (3):

$$b'=|X_1-X_2|/\overline{X}\times 100\% \tag{3}$$

In the formula:

X_1, X_2 — The first measurement result and the second measurement result at the position of average arm length.

Reproducibility b in average arm length, is calculated according to the formula

D.2 Reference arm length

Reference arm length of torque wrench is shown in Table D.1.

Table D.1 Reference arm length

Torque value (M_{nom}) Nm	Minimum arm length (l_{min}) mm	Average arm length (l_{mid}) mm
4~20	100	200
20~50	200	400
50~150	300	500
150~400	400	700
400~1000	600	1000
1000~2000	1000	1500

D.3 Reference documents

DKD-R-3-8 Static Calibration of Torque Wrench Calibration Devices

JMIF019 The Guideline for Calibration Laboratories of Torque Testing Machines and/or Torque Wrench Tester. Japan Measuring Instruments Federation , 2007

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