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For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 6789-2

Assembly tools for screws and nuts — Hand torque tools — Part 2: Requirements for calibration and determination of measurement uncertainty

*Outils de manoeuvre pour vis et écrous — Outils
dynamométriques à commande manuelle —*

*Partie 2: Exigences d'étalonnage et détermination de l'incertitude
de mesure*

ICS: 25.140.30

ISO/TC 29/SC 10

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2025-09-15

This document is circulated as received from the committee secretariat.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 29, *Small tools*, Subcommittee SC 10, *Assembly tools for screws and nuts, pliers and nippers*.

The new edition of ISO 6789-2, together with revisions of ISO 6789-1 and the addition of ISO 6789-3, cancel and replace ISO 6789-1:2017 and ISO 6789-2:2017 which have been technically revised with changes as follows. ISO 6789-1:2017 has been divided into two parts. The requirements for design and quality control during manufacture as well as the manufacturer's Declaration of Conformance are now solely aimed at manufacturers and remain in ISO 6789-1. The minimum requirements for conformance checking of tools during use are moved to the new ISO 6789-3.

Minimum requirements for calibration are still found in this standard ISO 6789-2

A list of all parts in the ISO 6789 series can be found on the ISO website.

Introduction

This revision has incorporated user feedback on the following general topics.

Clarifying for users of the standard which parts they should purchase to carry out their work related to hand torque tools. (See below)

Achieving a significant reduction in the number of uncertainty measurements required to provide a calibration certificate

Separating the declaration of conformance issued by a manufacturer from the performance report issued by a test house or internal quality control function.

The calibration or verification of angle measurements found in a growing number of torque tools

The addition of tools that can be either indicating or setting according to the customer need.

The three parts of ISO 6789 that result from this revision can be summarised as follows:

ISO 6789-1 continues to provide designers and manufacturers with relevant minimum requirements for the development and documentation of hand torque tools. The manufacturer may choose the level of documentation supplied with the tool according to the typical needs of the manufacturer's customers. This could be a certificate of calibration according to ISO 6789-2 or a verification report according to ISO 6789-3

ISO 6789-2 provides manufacturers and calibration laboratories with requirements for both torque and angle calibrations of hand torque tools together with streamlined methods for the calculation of uncertainties. Additionally, minimum requirements for the calibration of torque measurement devices as an alternative when national standards are not available, are described in ISO 6789-2, Annex C

ISO 6789-3 provides basic requirements for verifying and reporting whether the torque tool complies with the torque performance requirements of ISO 6789-1. It has been created as a separate standard to make it more accessible to users who are not torque tool manufacturers. The verification defined in ISO 6789-3 does not have as much detailed information, so does not provide the same degree of confidence in the performance of the torque tool, as a calibration certificate defined in ISO 6789-2.

The following scenarios may be of help in assisting users of the ISO 6789 series to identify the appropriate part(s) applicable to their activities:

Customer requires a torque tool with an accredited calibration certificate in order to meet legislative or commercial requirements. Solution is to purchase a torque tool and submit it to an accredited calibration laboratory for a Certificate of Calibration. (Note: Some torque tool manufacturers may offer such a service.) The calibration should be according to ISO 6789-2. The torque tool will be supplied with a Manufacturer's Declaration of Conformance that the tool complies with the design requirements of ISO 6789-1

Customer requires a calibration certificate in order to understand the technical performance of the torque tool. Solution is to purchase a torque tool that is supplied with a Certificate of Calibration. If such a product is not readily available, then a torque tool with a Performance Verification Report according to ISO 6789-3 can be purchased and submitted to a calibration laboratory for calibration according to ISO 6789-2. The torque tool will be supplied with a manufacturer's Declaration of Conformance that the tool complies with the design requirements of ISO 6789-1

Customer does not have any legislative, commercial or technical constraints but would still like some confirmation that the torque tool will perform with the level of accuracy required. Solution is to purchase a torque tool that has a Manufacturer's Declaration of Conformance confirming that the tool has been designed and tested during development in accordance with ISO 6789-1 and is provided with a Performance Verification Report that shows the accuracy level of that specific tool. The lack of the above constraints should not deter the customer from obtaining the increased information and legal protection that comes with a Calibration Certificate compared with a Performance Verification Report.

Assembly tools for screws and nuts — Hand torque tools —

Part 2: Requirements for calibration and determination of measurement uncertainty

1 Scope

This document specifies the method for the calibration of hand torque tools and describes the method of calculation of measurement uncertainties for the calibration.

It also specifies the minimum requirements for a certificate of calibration to this standard for hand torque tools.

The [Annex C](#) of this document specifies the minimum requirements for the calibration of the torque measurement device where the relative measurement uncertainty interval, W'_{md} , is not already provided by a traceable calibration certificate.

This document applies to hand torque tools which are classified as indicating torque tools (Type I) and setting torque tools (Type II).

NOTE Hand torque tools covered by this document are those identified in ISO 1703:2018 by reference numbers 7 1 00 01 0 to 7 1 00 14 0 inclusive. Torque limiting hand torque tools do not yet have reference numbers and will not do so until the next revision of ISO 1703

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 6789-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

calibration

operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

Note 1 to entry: A calibration may be expressed by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases, it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

Note 2 to entry: Calibration should not be confused with adjustment of a measuring system, often mistakenly called “self-calibration”, nor with verification of calibration.

Note 3 to entry: Often, the first step alone in the above definition is perceived as being calibration.

[SOURCE: ISO/IEC Guide 99:2007, 2.3.9]

3.1.2

calibration system

combination of a measurement device and the loading system for application of torque or angle that acts as the measurement standard for the hand torque tool

Note 1 to entry: A calibration system can also be used as a measurement system as defined in ISO 6789-1.

3.1.3

calibration laboratory

facility that has internal systems of quality control including controls over environment, operators and processes and which can demonstrate traceability of the reference measurement standard to national or international standards

3.1.4

accredited calibration laboratory

laboratory with formal recognition by an accrediting organization that the laboratory is competent to carry out specific activities which lead to the calibration of systems in accordance with documented requirements of the accrediting organization

3.1.5

measurement device

working measurement standard provided by an electronic torque transducer or angle encoder and display

3.1.6

measurement error

measured quantity value minus a reference quantity value

[SOURCE: ISO/IEC Guide 99:2007, 2.16, modified — Notes 1 and 2 to entry have been omitted.]

3.1.7

reference measurement standard

measurement standard designated for the calibration of other measurement standards for quantities of a given kind in a given organization or at a given location

[SOURCE: ISO Guide 99:2007, 5.6]

3.1.8

reproducibility

condition of measurement, out of a set of conditions that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects

[SOURCE: ISO Guide 99:2007, 2.24]

3.1.9**Type A evaluation (of uncertainty)**

method of evaluation of uncertainty by the statistical analysis of series of observations

Note 1 to entry: These data are taken directly from the measurements obtained during calibration of each torque tool and cannot be prepared in advance.

[SOURCE: ISO/IEC Guide 98-3:2008, 2.3.2, modified — Note 1 to entry has been added.]

3.1.10**Type B evaluation (of uncertainty)**

method of evaluation of uncertainty by means other than the statistical analysis of series of observations

[SOURCE: ISO/IEC Guide 98-3:2008, 2.3.3]

3.2 Symbols, designations and units

The designations used in this document are indicated in [Table 1](#).

Table 1 — Symbols, designations and units

Symbol	Designation	Unit
a_s	Calculated relative measurement error of the torque tool for the calibration torque	%
$\bar{a}_s$	Mean value of the relative measurement error at each calibration torque	%
b_e	Stated measurement error of the measurement device	N·m
b_{ep}	Stated relative measurement error of the measurement device	%
b_{int}	Variation due to geometric effects of the interface between the output drive of the torque tool and the calibration system	N·m
b_l	Variation due to the variation of the force loading point	N·m
b_{od}	Variation due to geometric effects of the output drive of the torque tool	N·m
b_{re}	Variation due to the repeatability of the torque tool	N·m
b_{rep}	Variation due to the reproducibility of the torque tool (Type I and Type II Classes A, D and G only)	N·m
θ_a	Indicated value of angle on torque tool	°
θ_r	Indicated value of angle on reference device	°
a_θ	Relative angle measurement error at each calibration point	%
k	Coverage factor applied to the relative measurement uncertainty to achieve a confidence level of approximately 95 %	—
r	Resolution of the display (Type I and Type II Classes A, D and G only)	N·m
T_{max}	Maximum limit value of the measurement range of the torque tool declared by the manufacturer	N·m
T_{min}	Minimum limit value of the measurement range of the torque tool declared by the manufacturer	N·m
w	Relative standard measurement uncertainty of the torque tool at the calibration torque	%
w_a	Relative standard angle measurement uncertainty of the torque tool at the calibration torque	
w_{ben}	Component of w due to the bending of the tool structure under torque while measuring angle	
w_{int}	Component of w due to geometric effects of the interface between the output drive of the torque tool and the calibration system	%
w_l	Component of w due to the length variation of the force loading point from the centre of tool rotation	%
w_{od}	Component of w due to geometric effects of the output drive of the torque tool	%
w_r	Relative standard measurement uncertainty due to resolution of the display of the torque tool (Type I and Type II Classes A, D and G only)	%
NOTE While N·m is the unit commonly used, the output signal can be detected in various units, e.g. voltage.		

Table 1 (continued)

Symbol	Designation	Unit
w_{ss}	Component of w due to the variation in angle measurement when rotating as slow speed	%
w_{st}	Component of w due to the variation in stability of angle measurement when stationary	%
w_{re}	Component of w due to repeatability of the torque tool	%
$w_{re,a}$	Component of w due to angle repeatability of the torque tool	%
w_{rep}	Component of w due to reproducibility of the torque tool (Type I and Type II Classes A, D and G only)	%
W	Relative expanded measurement uncertainty of the torque tool at the calibration torque	%
W'	Relative measurement angle uncertainty interval of the torque tool at the calibration torque	%
Wa	Relative expanded measurement angle uncertainty of the torque tool at the calibration torque	%
W'_a	Relative measurement uncertainty interval of the torque tool at the calibration torque	%

NOTE While N·m is the unit commonly used, the output signal can be detected in various units, e.g. voltage.

Table 2 — Type, Class and Description of Hand Torque Tools

Class	Type	Description
I	A	Wrench, torsion or flexion bar
I	B	Wrench, rigid housing, with scale or dial or display
I	C	Wrench, rigid housing and electronic measurement
I	D	Screwdriver, with scale or dial or display
I	E	Screwdriver, with electronic measurement
II	A	Wrench, adjustable, graduated or with display;
II	B	Wrench, fixed adjustment
II	C	Wrench, adjustable, non-graduated
II	D	Screwdriver, adjustable, graduated or with display
II	E	Screwdriver, fixed adjustment
II	F	Screwdriver, adjustable, non-graduated
II	G	Wrench, flexion bar, adjustable, graduated
II	H	Wrench, torque limiting, adjustable, graduated
II	J	Wrench, torque limiting, fixed adjustment
II	K	Wrench, torque limiting, adjustable, non-graduated

4 General requirements for torque calibration and angle calibration

4.1 Calibration by the manufacturer of the torque tool

ISO 6789-1 allows the manufacturer to choose the format of documentation provided with a new torque tool in addition to the Manufacturer's Declaration of Conformance. The needs of users should be considered in choosing to offer either a Certificate of Calibration, according to ISO 6789-2, or a Verification Report according to ISO 6789-3. Where the torque tool also is capable of measuring angle, the angle performance shall be included in the documentation.

If a Certificate of Calibration is chosen, the calibration may be performed as part of the production process or in a separate calibration laboratory. The calibration shall comply with the requirements of this standard.

4.2 Calibration during use

If the user utilizes procedures for the control of test devices, torque tools shall be included in these procedures. The interval between calibrations shall be chosen based on the factors of operation such as

required maximum permissible measurement error, frequency of use, typical load during operation as well as ambient conditions during operation and storage conditions. The interval shall be adapted according to the procedures specified for the control of test devices and by evaluating the results gained during successive calibrations.

If the user does not utilize a control procedure, a period of 12 months, or 5 000 cycles, whichever occurs first, may be taken as default values for the interval between calibrations. The interval starts with the first use of the torque tool.

Shorter interval between calibrations may be used if required by the user, their customer or by legislation.

The torque tool shall be calibrated when it has been subjected to an overload greater than 125 % of the maximum capacity of the tool, after repair, or after any improper handling which might influence the torque tool performance and the fulfilment of the quality conformance requirements.

4.3 Ambient conditions

The measurement procedure shall be carried out at an ambient temperature held constant to within ± 1 K. This temperature shall be between 18 °C and 28 °C at a maximum relative humidity of 90 % and shall be documented.

Prior to measurement, the measurement device and the torque tool shall be allowed to acclimatise to the ambient temperature and humidity.

4.4 Calibration system

The calibration system shall be chosen to be suitable for the measurement of the specified range of the torque tool and will comply with the requirements of this clause.

Torque and angle measurement devices shall have a valid calibration certificate traceable to a national standard or to a calibration laboratory meeting the requirements of ISO/IEC 17025. The torque calibration shall be performed to a recognised national or regional standard for the calibration of torque measurement devices, or, in the absence of such a standard, according to [Annex C](#) of this standard.

If the user does not utilize a control procedure, a period of 24 months shall be the maximum interval between calibrations. The measurement device shall be re-calibrated if it was exposed to an overload larger than 20 % of T_E , after a repair has been carried out or after an improper use which can influence the measurement uncertainty.

At each target value of torque, the relative uncertainty interval, W'_{mdT} , of the respective measurement device shall not exceed 1/4 of the expected maximum relative uncertainty interval of the torque tool, W'_T .

At each target value of angle, the absolute angle uncertainty interval, W'_{mdA} , of the respective measurement device should not exceed 1/4 of the expected maximum absolute uncertainty interval of the torque tool, W'_A .

Note The achievable angle measurement uncertainty will depend upon the angle measurement method chosen. See [Clause 7](#)

The uncertainty intervals of the measurement device and the torque tool shall be stated in the calibration certificate.

5 Torque calibration - specific requirements

5.1 Torque measurement - application

The torque shall be applied by means of one of the following methods.

- a) The torque tool is caused to rotate about the torque measurement device axis by the following:
 1. for torque wrenches, a force or two forces with equal value and opposite direction for T-handles, applied to the handle of the tool at a constant radial distance;
 2. for torque screwdrivers, a torque applied to the handle of the tool or two forces with equal value and opposite direction for T-handles.
- b) The torque measurement device rotates on its measuring axis while a reaction force is applied to the handle of the torque tool.

5.1.1 Orientation of torque tools to be calibrated

Torque wrenches to be measured shall be positioned in one of the orientations shown in [Figure 1a](#), [1b](#), [1c](#). The orientation shall be documented by reference to the tool position and the measurement axis within the Calibration Certificate.

Torque screwdrivers to be measured shall be positioned in line with the measurement axis of the torque measurement device in either the horizontal or vertical axis shown in [Figure 1d](#) and [1e](#).

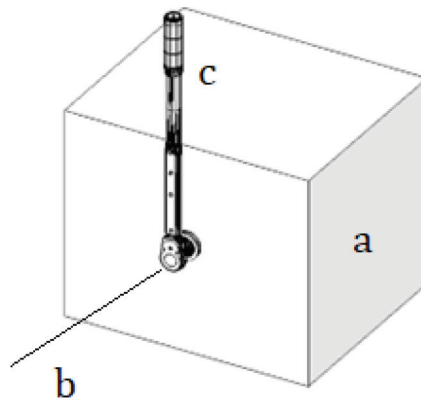


Figure 1a — Testing of a tool in a vertical position with horizontal measuring axis

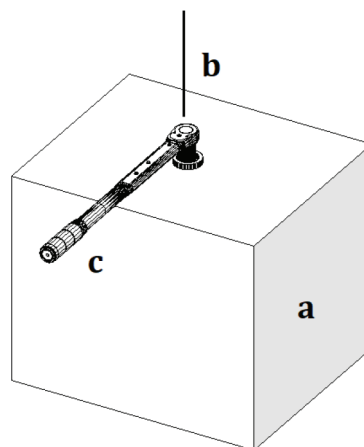


Figure 1b — Testing of a tool in a horizontal position with vertical measuring axis

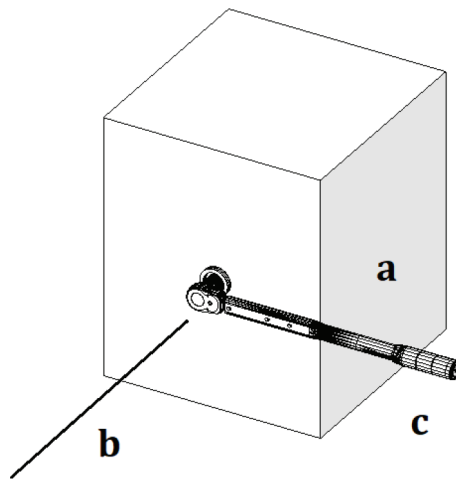


Figure 1c — Testing of a tool in a horizontal position with horizontal measuring axis

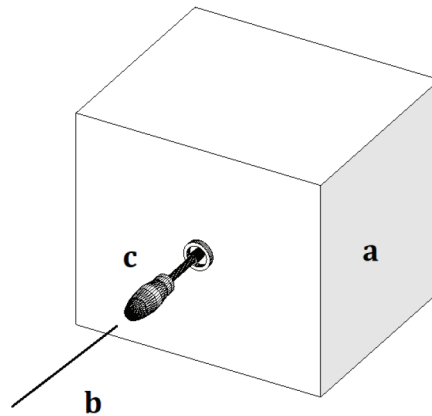
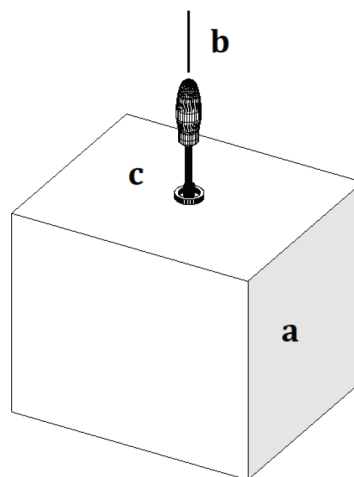


Figure 1d — Testing of a torque screwdriver in a horizontal position with horizontal measuring axis



- a Torque measurement device.
- b Axis of rotation.
- c Orientation of torque tool.

Figure 1e — Testing of a torque screwdriver in a vertical position with vertical measuring axis

5.1.2 Loading methods for torque tools to be calibrated

The torque tool may be loaded, or the reaction force provided, either by machine or by hand. The calculation of the uncertainty associated with the calibration will consider the loading method.

Whilst highly skilled operators can perform reasonably consistent loading of torque tools, they are still subject to fatigue and other distractions that are not present in machine loading. Less skilled operators will show a higher variation in loading and observation of target values, especially for Type I torque tools.

The effect of operator variability shall be evaluated by users of this standard who wish to calibrate torque tools by hand. Requirements are detailed in [5.4.2.9](#).

The connection between the loading system, whether by machine or by hand, and the torque tool, shall permit self-alignment of the tool so that parasitic forces and moments are minimized.

For torque wrenches the operating force, F , shall be applied to the centre of the hand hold position of the grip or of the marked load point and shall be at 90° to the axis of the tool within $\pm 5^\circ$ angular deviation.

For torque screwdrivers the axis of the tool shall be held parallel within $\pm 5^\circ$ of the axis of the measurement device.

Tools with flexible head shall be loaded with the tool handle perpendicular to the axis of the output drive.

Where the output drive is not permanently attached, the dimensions of the drive that affect the radial distance shall be recorded.

During measurement, analogue scales or dials shall be read in a perpendicular direction in order to minimize parallax errors.

Type I torque tools shall be loaded with an increasing torque until the target torque value is indicated on the torque tool. Slave pointers (memory indicators) shall not be used when taking the readings. Alternatively, a Type I torque tool may be loaded with an increasing torque until the target torque value is indicated on the torque measurement device. The calibration certificate shall indicate which method was used.

Every effort shall be made to stop loading a Type I torque tool at the target torque value. If the target is under or over-achieved by less than 2 % or reading, the reading on both the torque tool and the torque measurement device shall be recorded and the error of interpolation calculated, together with its associated uncertainty according to [Formula \(12\)](#). Alternatively, the largest net error (need to clarify) shall be presented as an additional element of uncertainty.

Type II torque tools shall be loaded with a slowly and steadily increasing torque until attainment of the target torque is signalled by the torque tool.

The rate of torque increase shall be as defined in [Table 2](#).

Table 2 — Minimum time period for application of torque values

Applied torque value	<1 N·m	<10 N·m	≥10 N·m <100 N·m	≥100 N·m <1 000 N·m	≥1 000 N·m
Type I Class A, B, C, D, E Type II Class A, B, C, G Minimum time to increase the torque from 80 % of target value to target value	>0,5 s <2 s	0,5 s	1 s	1,5 s	2 s
Type II Class D, E, F Minimum time to increase the torque from 80 % of target value to target value	>0,5 s <2 s	0,5 s	1 s	1,5 s	2 s
Type II, Classes H, J, K Minimum time to increase the torque from 80 % of target value to target value	>0,5 s <2 s	0,5 s	1 s	1,5 s	2 s

5.2 Torque measurement – loading sequence

5.2.1 General

Where the torque measurement device has not been continuously operating during the previous hour, it shall be conditioned by three preloadings to the maximum torque of the torque tool in the measurement direction. After the three preloadings, all load on the torque tool and the torque measurement system shall be removed. Then after a waiting period of at least 5 seconds, the pointer or electronic display of the torque measurement device shall be set to zero where such a facility exists.

Loadings should not be repeated, ignored or discarded. Each observed measurement should be recorded.

Torque tools with electronic measurement shall not be turned off during the whole measurement sequence.

Minimum ($T_{\min}$) and maximum ($T_{\max}$) torque values shall be taken from the marked values on the tool, or in the absence of such markings, from the manufacturer's specifications.

If the torque tool operates in two directions, steps 1-5 of the measurement sequence detailed in [Table 3](#) shall be carried out separately for each direction

Type II torque tools shall be set to each target value starting from a lower value. If the target value is exceeded during setting, then the tool setting shall be returned to the lower value and adjusted once more to the target value. The time intervals between any two subsequent loadings shall be of the same or similar duration.

Type I and Type II torque tools with scale or display shall first be measured at the lowest specified torque value of the measurement range, then at approximately 60 % and finally at 100 % of the torque tool's maximum value. Tools with no scale or display shall be calibrated at the set value. Customers may specify the range or single torque value to be used in the calibration, which then should be marked on the tool. Optional additional calibration points may be inserted between $T_{\min}$ and $T_{\max}$.

Tools with a scale or display shall be loaded five times at each torque value. Tools with no scale or display shall be calibrated 10 times at the set value. For Type II Class B, C, E, F, J and K, the necessary number of loadings to complete one full rotation of the output drive should be completed.

5.2.2 Preloading sequence

The torque tool shall be preloaded three times at its pre-set or its maximum specified torque value without recording. For torque screwdrivers, a full rotation of the tool should be completed to exercise each trigger mechanism. There shall be no further preloading during the calibration sequence. Unless these preloads are required by [5.2.1](#), they do not need to be performed on the torque measurement device. Type I tool pointers