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EN ISO 6789

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English version

Assembly tools for screws and nuts - Hand torque tools - Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure (ISO 6789:2003)

Outils de manoeuvre pour vis et écrous - Outils dynamométriques à commande manuelle - Exigences et méthodes d'essai pour vérifier la conformité de conception, la conformité de qualité et la procédure de réétalonnage (ISO 6789:2003)

Schraubwerkzeuge - Handbetätigte Drehmoment-Werkzeuge - Anforderungen und Prüfverfahren für die Typprüfung, Annahmeprüfung und das Rekalibrierverfahren (ISO 6789:2003)

This European Standard was approved by CEN on 24 March 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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Foreword

This document (EN ISO 6789:2003) has been prepared by Technical Committee ISO/TC 29 "Small tools" in collaboration with CMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

This document supersedes EN 26789:1994.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 6789:2003 has been approved by CEN as EN ISO 6789:2003 without any modifications.

INTERNATIONAL STANDARD

ISO 6789

Third edition
2003-04-01

Assembly tools for screws and nuts — Hand torque tools — Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure

Outils de manœuvre pour vis et écrous — Outils dynamométriques à commande manuelle — Exigences et méthodes d'essai pour vérifier la conformité de conception, la conformité de qualité et la procédure de réétalonnage

Reference number
ISO 6789:2003(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 6789 was prepared by Technical Committee ISO/TC 29, *Small tools*, Subcommittee SC 10, *Assembly tools for screw and nuts, pliers and nippers*.

This third edition cancels and replaces the second edition (ISO 6789:1992), which has been technically revised, in particular by the addition of a new Clause 3, subclauses 5.1, 5.2 and 5.3, Figure 3 and Figure B.7. Further, Figures 1 and 2 have been revised.

Introduction

The revision of the previous edition of ISO 6789 became necessary, because the requirements of ISO 9001, concerning the procedure of the control of test devices, as well as the introduction of calibration services, unambiguously need guidelines in ISO 6789 for calibration and recalibration of hand torque tools.

Further, information about recalibration has been included in the present new issue.

Assembly tools for screws and nuts — Hand torque tools — Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure

1 Scope

This International Standard specifies the requirements for, and describes the test methods and marking of, hand torque tools used for controlled tightening of bolted connections.

It applies to torque tools in accordance with Clause 4, in particular to indicating and setting torque wrenches in accordance with numbers 258 and 259 of ISO 1703:1983.

2 Normative references

The following referenced documents are indispensable for the application 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.

GUM, *Guide for evaluation of uncertainty in measurement*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
design conformance testing
those requirements to be met during design or modification of hand torque tools (see 5.1)

3.2
quality conformance testing
those requirements to be met during manufacture of hand torque tools (see 5.2)

3.3
calibration
set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards

[VIM:1993, definition 6.11]

NOTE For the specific purposes of this International Standard, the following definition may apply:

set of operations that establish, under specified conditions, the relationship between values indicated or signalled by a torque tool, and the corresponding values indicated by a calibration device

3.4
recalibration
those requirements to be met during calibration of hand torque tools after a defined period of use (see 5.3)

3.5
indicating torque tool (Type I)
tool that indicates by means of a mechanical scale, dial or electronic display, the value of torque exerted by the tool at the output drive

3.6
setting torque tool (Type II)
tool that is pre-set to a certain torque value, so that, when the prescribed value of torque is exerted by the tool at the output drive, a signal is released (e.g. audibly, visibly, perceptibly)

3.6.1
adjustable graduated torque tool (Type II, Class A, Class D and Class G)
tool designed to be adjusted by the user, which has a scale or a display to assist adjustment

3.6.2
adjustable non-graduated torque tool (Type II, Class C and Class F)
tool designed to be adjusted by the user with the aid of a calibration device

3.6.3
torque tool with fixed adjustment (Type II, Class B and Class E)
tool not designed to be adjusted by the user, i.e. having a single setting

3.7
calibration device
device used for the calibration of torque tools

4 Classification

The hand torque tools to which this International Standard applies are classified as follows:

a) Type I: Indicating torque tools (see Annex A)

— Class A: wrench, torsion or flexion bar
— Class B: wrench, rigid housing, with scale or dial or display
— Class C: wrench, rigid housing and electronic measurement
— Class D: screwdriver, with scale or dial or display
— Class E: screwdriver, with electronic measurement

b) Type II: Setting torque tools (see Annex B)

— Class A: wrench, adjustable, graduated or with display
— Class B: wrench, fixed adjustment
— Class C: wrench, adjustable, non-graduated
— Class D: screwdriver, adjustable, graduated or with display
— Class E: screwdriver, fixed adjustment
— Class F: screwdriver, adjustable, non-graduated
— Class G: wrench, flexion bar, adjustable, graduated

5 Requirements

5.1 Design conformance testing

5.1.1 General

The manufacturer shall test samples of wrenches in order to verify they are in conformity with 5.1.2 to 5.1.7.

5.1.2 Assignment of the driving square

The size of the driving square is a function of the maximum torque value of the respective torque tool. The assignment is carried out according to the values given in Table 1.

Table 1 — Assignment of the driving square

Maximum torque value N·m	Driving square nominal size[a] mm
30	6,3
135	10
340	12,5
1 000	20
2 100	25

[a] In accordance with ISO 1174-1.

5.1.3 Specified measuring range

The requirements and test methods in this International Standard cover a specified measuring range from 20 % to 100 % of the maximum torque value of the respective tool.

The scales of torque tools of Type I shall be marked with a zero position.

5.1.4 Scales

The increment between two graduation marks of a scale shall not exceed 5 % of the maximum value.

5.1.5 Tolerances

5.1.5.1 Indicating torque tools (Type I)

Permissible deviation of the torque value indicated by the tool, from the simultaneous indication of the calibration device, shall be as given in Table 2.

Table 2 — Permissible deviation (Type I)

Class[a]	Maximum torque value	
	⩽ 10 N·m	> 10 N·m
A and D	± 6 %	
B, C and E	± 6 %	± 4 %

[a] In the case of torque tools with electronic measurement (Class C and Class E) and display (Class B and Class D), the values of permissible deviation include the error due to the resolution of the display.

5.1.5.2 Setting torque tools (Type II)

Permissible deviation of the torque value set on the scale or display (Classes A, D and G) or the nominal value (Classes B and E) from the torque value indicated by the calibration device shall be as given in Table 3.

Table 3 — Permissible deviation (Type II, Classes A, B, D, E and G)

Class[a]	Maximum torque value	
	⩽ 10 N·m	> 10 N·m
A and B	± 6 %	± 4 %
D, E and G	± 6 %	

[a] In the case of torque tools with display (Class A and Class D), the values of permissible deviation include the error due to the resolution of the display.

Permissible deviation of the torque value set from the torque value indicated by the calibration device shall be as given in Table 4.

Table 4 — Permissible deviation (Type II, Classes C and F)

Class	Maximum torque value	
	⩽ 10 N·m	> 10 N·m
C	± 6 %	± 4 %
F	± 6 %	

For Classes C and F, the torque value set is equal to the arithmetical mean of the 10 test readings obtained in accordance with 6.4.

5.1.6 Overloading test

After setting at 100 % of the maximum torque value, all torque tools to be tested shall be loaded three times in each direction of operation to a torque value of 125 % of the maximum capacity (or nominal capacity for tools of Type II, Classes B and E). This does not apply to limiting torque tools.

After the overloading test, the torque tool shall still be within the tolerances specified in 5.1.5 and shall show no physical damage that can be detrimental to the torque accuracy and safety.

5.1.7 Endurance test

All torque tools to be tested shall be cycled at maximum capacity (or nominal capacity for tools of Type II, Classes B and E) for 5 000 cycles, in each direction of operation, at a rate between 5 cycles/min and 10 cycles/min.

After the endurance test, the torque tool shall still be within the tolerances specified in 5.1.5 and shall show no physical damage that can be detrimental to the torque accuracy and safety.

5.2 Quality conformance testing

All torque tools shall be tested in accordance with 6.3 and shall comply with the requirements in 5.1.5.

5.3 Recalibration

5.3.1 Method

The torque tools shall be tested in accordance with 6.3 and shall comply with the requirements in 5.1.5.

5.3.2 Interval

Torque tools shall be considered as test devices. If the user utilizes procedures for the control of test devices, torque tools shall be included in these procedures. The calibration interval shall be chosen on the basis of the factors of operation such as required accuracy, 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 experience gained during recalibration.

If the user does not utilize a control procedure, a period of use of 12 months, or approximately 5 000 cycles, can be taken as a default value for the recalibration interval. For the first recalibration, the period of validity starts with user's first operation of the torque tool.

In addition to these specifications, factory or legal regulations shall be observed.

The torque tool shall be recalibrated when it has been subjected to an overload greater than the values given in 5.1.6, after repair, or after any improper handling which might influence the errors of measurement.

6 Calibration

6.1 Calibration device

The maximum permissible uncertainty of measurement of the calibration device shall be ± 1 % of the indicated value. Uncertainty of measurement shall be calculated in accordance with the "Guide for evaluation of uncertainty in measurement" (GUM), with a coverage factor $k = 2$.

The calibration device shall be set to zero before calibration is started.

6.2 Calibration temperature

The calibration shall be carried out at a temperature fluctuating by not more than ± 1 °C. This temperature shall be in the range between 18 °C to 28 °C (maximum relative humidity 90 %) and shall be documented.

6.3 Calibration conditions

6.3.1 Prior to calibration, it is to be ensured that:

a) the calibration device is oriented in accordance with Figures 1, 2 or 3;

b) for torque tools of Type I with scale or dial gauge, the direction of reading is vertical to the scale or dial gauge (parallax compensation);

c) for indicating torque tools, Type I: prior to testing in accordance with 6.4, one pre-loading up to the maximum value has been carried out in the operating direction to be tested and after release of load, the pointer or electronic indication has been set to zero. For testing in any other operating direction, this procedure shall be repeated;

d) for setting torque tools, Type II: prior to testing in accordance with 6.4, five releases without measurement have been carried out at the maximum value (nominal capacity of the torque tool) in the operating direction to be tested. For testing in any other operating direction, this procedure shall be repeated;

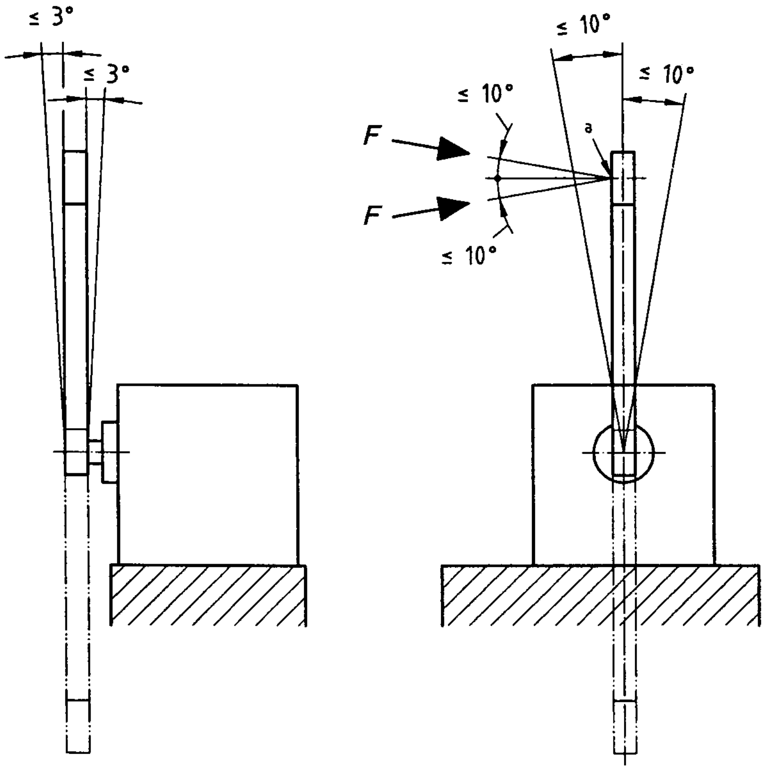
e) the operating force, F, is applied within the limits specified in Figures 1 and 2, in the centre of the hand hold position of the grip or the marked loading point;

f) for the torque screwdriver and T-handle torque wrenches, the operating force, T, is applied within the limits specified in Figure 3.

6.3.2 Type I torque tools shall be loaded on the calibration device with increasing force until the torque tool indicates the respective torque value. Type II setting torque tools shall be loaded on the calibration device with increasing force up to approximately 80 % of the respective target torque value. From 80 % to the final target torque value, the load shall be applied slowly and uniformly during a period of 0,5 s to 4 s.

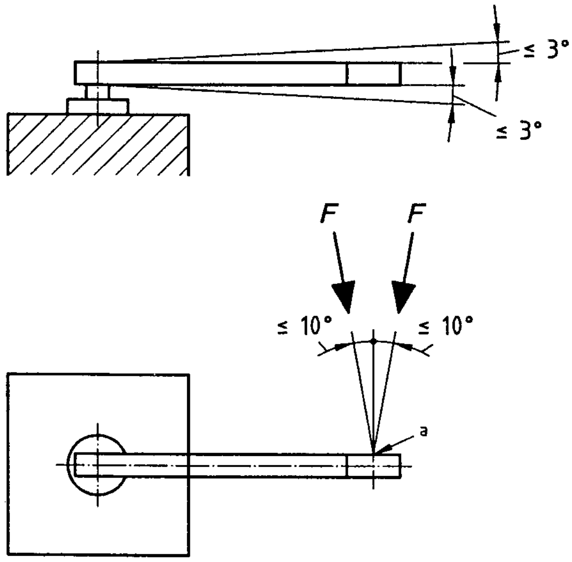
If for Type I torque tools the torque value to be measured has been exceeded, this calibration stage shall be repeated from the zero position.

Type II torque tools, except Class B and Class E, shall be adjusted to the respective test value, starting from a lower value.



a Line contact, marked loading point or centre of the hand hold position of the grip.

Figure 1 — Testing of a wrench in a vertical position



a Line contact, marked loading point or centre of the hand hold position of the grip.

Figure 2 — Testing of a wrench in a horizontal position

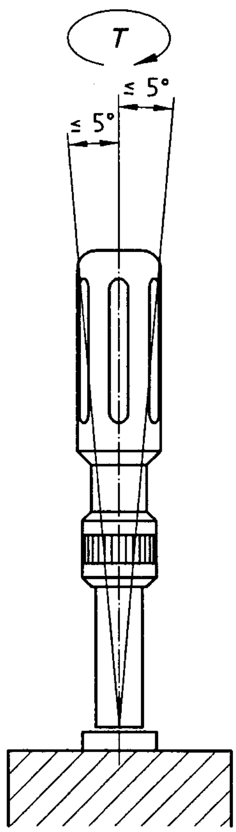


Figure 3 — Testing of a torque screwdriver and T-handle torque wrench in horizontal and vertical positions

6.4 Calibration sequence

The torque tools shall be tested first at 20 % and then at about 60 % and at 100 % of the maximum torque value of the torque tools (or at the nominal/set value for tools of Type II, Classes B and E).

If the scale mark of 20 % of the maximum torque value is not indicated on the torque tool, the permissible deviation shall be determined at the next lower scale mark.

In every operating direction, the number of measurements shall be as follows:

— Type I, all classes — 5 times in a row, for every point of measurement;

— Type II, Classes A, D and G — 5 times in a row, for every point of measurement;

— Type II, Classes B and E — 5 times at the nominal/set value;

— Type II, Classes C and F — 10 times in a row, for every point of measurement.

All readings shall be within the maximum tolerances specified in 5.1.5 and shall be recorded.

The evaluation of the deviation shall be made by the following formula:

$$A_s\ (\%) = \frac{(x_a - x_r)100}{x_r}$$

where

A_s (%) is the calculated deviation of the torque tool;

x_a is the indicated value of the torque tool;

x_r is the reference value (determined by the calibration device).

6.5 Calibration examples

EXAMPLE 1 Calculation of the deviation of indicating and setting torque tools (except Type II, Class C and Class F):

— indicated value of dial, mechanical scale or display (Type I, Classes A, B, C, D and E) or

— set value of mechanical scale or display (Type II, Classes A, D and G) or

— nominal value (Type II, Classes B and E):

$X_a = 100$ N·m

Reference values (determined by the calibration device)

$x_{r1} = 100$ N·m

$x_{r2} = 96$ N·m

$x_{r3} = 103$ N·m

$x_{r4} = 99$ N·m

$x_{r5} = 101$ N·m

Calculated deviations of the torque tools in %

$$A_{s1} = \frac{(100 - 104) \times 100}{104}$$

$$A_{s1} = -3{,}85\ \%$$

$$A_{s2} = \frac{(100 - 96) \times 100}{96}$$

$$A_{s2} = 4{,}17\ \%$$

$$A_{s3} = \frac{(100 - 103) \times 100}{103}$$

$$A_{s3} = -2{,}91\ \%$$

$$A_{s4} = \frac{(100 - 99) \times 100}{99}$$

$$A_{s4} = 1{,}01\ \%$$

$$A_{s5} = \frac{(100 - 101) \times 100}{101}$$

$$A_{s5} = -0{,}99\ \%$$

EXAMPLE 2 Calculation of the deviation of setting torque tools, adjustable, non-graduated (Type II, Class C and Class F):

— Set value relevant to the arithmetical mean of the 10 reference values (determined by the calibration device)

$$x_a = \frac{x_{r1} + x_{r2} + \ldots\ldots x_{r10}}{10}$$

$$x_a = \frac{104 + 96 + 103 + 99 + 101 + 98 + 97 + 101 + 100{,}5 + 102{,}5}{10}$$

$$x_a = 100{,}2\ \text{N·m}$$

Reference values (determined by the calibration device)

$$x_{r1} = 104\ \text{N·m}$$

$$x_{r2} = 96\ \text{N·m}$$

$$x_{r3} = 103\ \text{N·m}$$

$$x_{r4} = 99\ \text{N·m}$$

$$x_{r5} = 101\ \text{N·m}$$

$$x_{r6} = 98\ \text{N·m}$$

$$x_{r7} = 97\ \text{N·m}$$

$$x_{r8} = 101\ \text{N·m}$$

$$x_{r9} = 100{,}5\ \text{N·m}$$

$$x_{r10} = 102{,}5\ \text{N·m}$$

Calculated deviations of the torque tools in %

$$A_{s1} = \frac{(100,2 - 104) \times 100}{104}$$

$$A_{s1} = -3,65\ \%$$

$$A_{s2} = \frac{(100,2 - 96) \times 100}{96}$$

$$A_{s2} = 4,38\ \%$$

$$A_{s3} = \frac{(100,2 - 103) \times 100}{103}$$

$$A_{s3} = -2,72\ \%$$

$$A_{s4} = \frac{(100,2 - 99) \times 100}{99}$$

$$A_{s4} = 1,21\ \%$$

$$A_{s5} = \frac{(100,2 - 101) \times 100}{101}$$

$$A_{s5} = -0,79\ \%$$

$$A_{s6} = \frac{(100,2 - 98) \times 100}{98}$$

$$A_{s6} = 2,24\ \%$$

$$A_{s7} = \frac{(100,2 - 97) \times 100}{97}$$

$$A_{s7} = 3,30\ \%$$

$$A_{s8} = \frac{(100,2 - 101) \times 100}{101}$$

$$A_{s8} = -0,79\ \%$$

$$A_{s9} = \frac{(100,2 - 100,5) \times 100}{100,5}$$

$$A_{s9} = -0,30\ \%$$

$$A_{s10} = \frac{(100,2 - 102,5) \times 100}{102,5}$$

$$A_{S10} = -2,24\ \%$$

7 Marking

Hand torque tools shall be marked, permanently and legibly, at least with the following information:

a) the maximum torque value;

b) the unit of measuring;

c) the direction of operation (for tools capable of operating in one direction only);

d) the name or trademark of the manufacturer (or responsible supplier);

e) where accompanied by a calibration certificate, the torque tool shall have a serial or identification number. If necessary, an identification number shall be assigned by the calibration laboratory.

Annex A
(normative)

Indicating torque tools: Type I

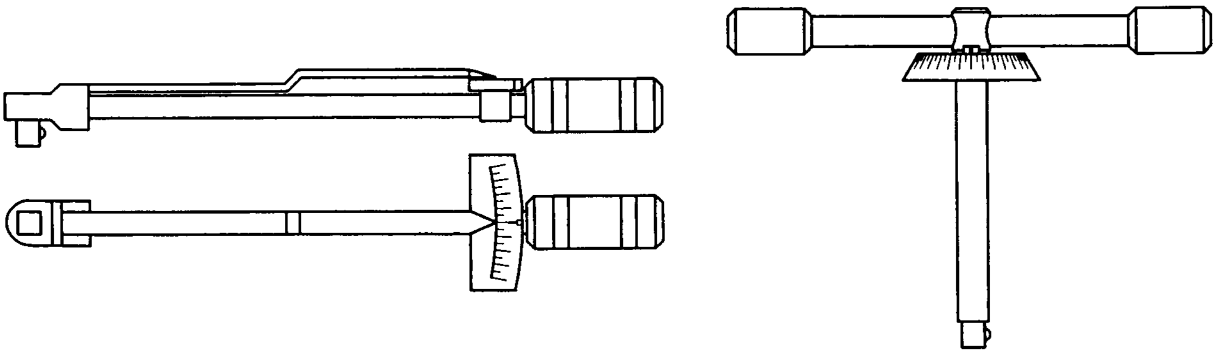


Figure A.1 — Class A: wrench, torsion or flexion bar

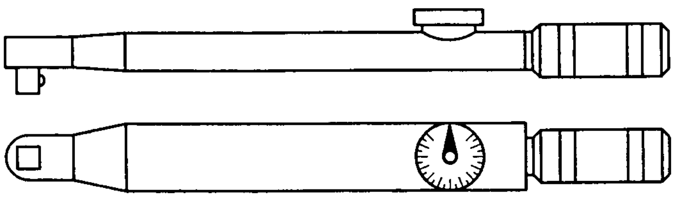


Figure A.2 — Class B: wrench, rigid housing, with scale or dial or display

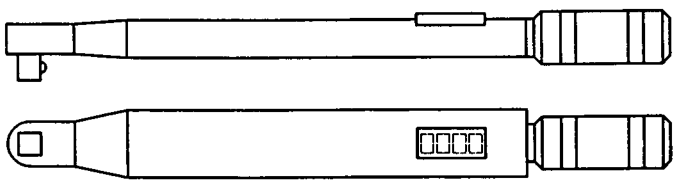


Figure A.3 — Class C: wrench, rigid housing and electronic measurement

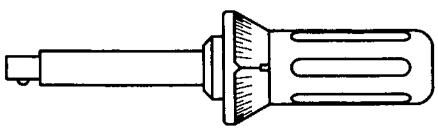


Figure A.4 — Class D: screwdriver, with scale or dial or display

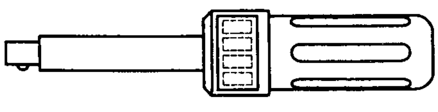


Figure A.5 — Class E: screwdriver, with electronic measurement

Annex B
(normative)

Setting torque tools: Type II

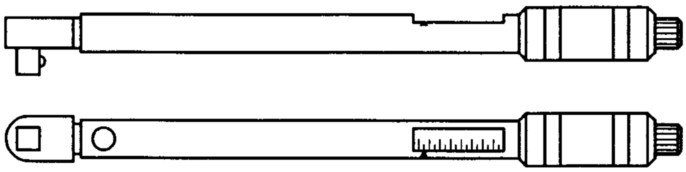


Figure B.1 — Class A: wrench, adjustable, graduated or with display

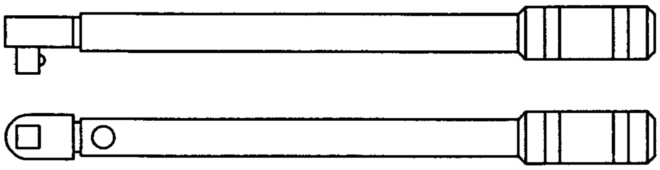


Figure B.2 — Class B: wrench, fixed adjustment

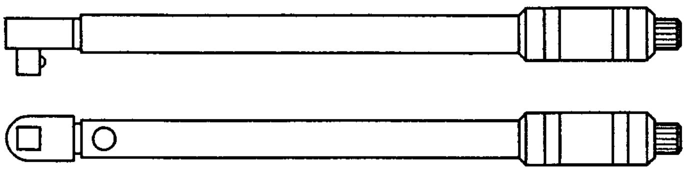


Figure B.3 — Class C: wrench, adjustable, non-graduated

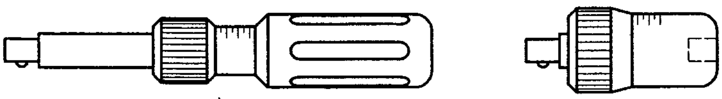


Figure B.4 — Class D: screwdriver, adjustable, graduated or with display

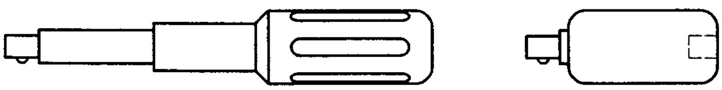


Figure B.5 — Class E: screwdriver, fixed adjustment

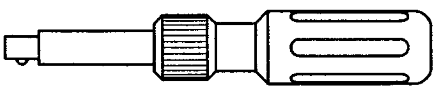


Figure B.6 — Class F: screwdriver, adjustable, non-graduated

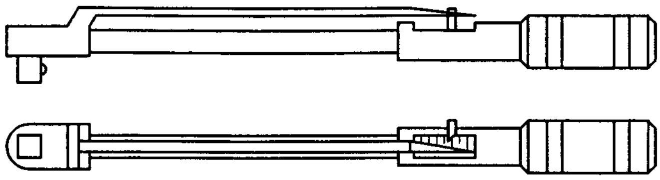


Figure B.7 — Class G: wrench flexion bar, adjustable, graduated

Bibliography

[1] ISO 1174-1, *Assembly tools for screws and nuts — Driving squares — Part 1: Driving squares for hand socket tools*

[2] ISO 1703:1983, *Assembly tools for screws and nuts — Nomenclature*

[3] ISO 9001, *Quality management systems — Requirements*

[4] *Fundamental standards — International vocabulary of basic and general terms in metrology (VIM)*. BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2nd edition, 1993