ASME B107.14-2004
(Revision of ASME B107.14M-1994)

Hand Torque Tools (Mechanical)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Three Park Avenue • New York, NY 10016

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://www.asme.org/codes/ as they are issued.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

CONTENTS

FOREWORD

The American National Standards Committee B107, Socket Wrenches and Drives, under sponsorship of The American Society of Mechanical Engineers, was reorganized as an ASME Standards Committee and its title was changed to Hand Tools and Accessories. In 1996, its scope was expanded to address safety considerations.

The purposes of this Standard are to define performance and safety considerations specifically applicable to setting and limiting torque instruments and specify test methods to evaluate performance relating to the defined requirements.

Members of the Hand Tools Institute Striking and Struck Tools Standards Committee have been major contributors to the development of this Standard in their committee work, their knowledge of the products, and their active efforts in the promotion of the adoption of this Standard.

This Standard is a revision of ASME B107.14M-1994, Hand Torque Tools. Principal changes in this edition of the Standard are the inclusion of safety considerations and addition of flexible head instruments. Updated finish requirements and dimensional data are included, as are updated references.

The format of this standard is in accordance with *The ASME Codes & Standards Writing Guide.* Requests for interpretations, and suggestions for the improvement of this Standard, should be addressed to the Secretary, B107 Standards Committee, Three Park Avenue, New York, NY 10016-5990.

The requirements of this Standard become effective at the time of publication. ASME B107.14-2004 was approved as an American National Standard on December 16, 2004.

ASME B107 STANDARDS COMMITTEE
Hand Tools and Accessories

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B107 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Interpretations. Upon request, the B107 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B107 Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings, which are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The B107 Standards Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B107 Standards Committee.

HAND TORQUE TOOLS (MECHANICAL)

1 SCOPE

This Standard provides performance and safety requirements for manually operated torque instruments, commonly used for mechanical measurement of torque for control of the tightness of threaded fasteners. It is not intended to describe products infrequently utilized or those designed for special purposes.

This Standard may be used as a guide by state authorities or other regulatory bodies in the formulation of laws or regulations. It is also intended for voluntary use by establishments that use or manufacture the instruments covered.

2 CLASSIFICATION

Type I: Indicating
- *Class A*: Deflecting beam
  - Style 1: Plain scale
  - Style 2: Scale with signal mechanism
  - Style 3: Scale with memory indicator
- *Class B*: Deflecting beam with interchangeable head
  - Style 1: Plain scale
  - Style 2: Scale with signal mechanism
  - Style 3: Scale with memory indicator
- *Class C*: Rigid housing
  - Style 1: Plain scale
  - Style 2: Scale with signal mechanism
  - Style 3: Scale with memory indicator
- *Class D*: Rigid housing with interchangeable head
  - Style 1: Plain scale
  - Style 2: Scale with signal mechanism
  - Style 3: Scale with memory indicator
- *Class E*: Screwdriver grip
  - Style 1: Enclosed dial
  - Style 2: Exposed dial

Type II: Setting
- *Class A*: Graduated
  - Style 1: Nonratcheting
    - Design A: Clockwise (right hand) and counter clockwise (left hand) torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
  - Style 2: Ratcheting
    - Design A: Clockwise and counterclockwise torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
  - Style 3: Interchangeable head
    - Design A: Clockwise (right hand) and counterclockwise (left hand) torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
  - Style 4: Flexible ratchet head
    - Design A: Clockwise and counterclockwise torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
- *Class B*: Nongraduated
  - Style 1: Nonratcheting
    - Design A: Clockwise and counterclockwise torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
  - Style 2: Standard ratcheting head
    - Design A: Clockwise and counterclockwise torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
  - Style 3: Interchangeable head
    - Design A: Clockwise and counterclockwise torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing
  - Style 4: Flexible ratchet head
    - Design A: Clockwise and counterclockwise torquing
    - Design B: Clockwise torquing
    - Design C: Counterclockwise torquing

Type III: Limiting
- *Class A*: Screwdriver grip
  - Style 1: Graduated
    - Design A: External square drive
    - Design B: Internal hex drive
  - Style 2: Nongraduated
    - Design A: External square drive
    - Design B: Internal hex drive
- *Class B*: "T" handle grip
  - Style 1: Nonratcheting
  - Style 2: Ratcheting

3 REFERENCES

The following is a list of publications referenced in this Standard.

ASME B107.4-1995, Driving and Spindle Ends for Portable Hand Air and Electric Tools

ASME B107.10M-1996, Handles and Attachments for Hand Socket Wrenches — Inch and Metric Series

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

Guide to Hand Tools — Selection, Safety Tips, Proper Use, and Care

Publisher: Hand Tools Institute (HTI), 25 North Broadway, Tarrytown, NY 10591

4 DEFINITIONS

accuracy: the allowable inaccuracy, also known as permissible deviation, tolerance, or error band. A higher value means a lower certainty of correctness.

full scale: see rated capacity.

graduation: a mark on the instrument indicating a torque value.

hand torque instrument: tool combining hand wrenching and torque measurement functions, formerly referred to as "hand torque wrench."

increment: the value of the difference between adjacent graduations.

indicated value: for Type I, the value the instrument displays when torque is applied; for Types II and III, the value to which the instrument is set or preset.

measured value: the actual torque determined by a torque tester.

operating load: the operating load shall be calculated by dividing the rated capacity by the distance between the axis of the torque moment and the center of the grip or designated load point.

rated capacity: for graduated instruments, the maximum graduated torque value, also known as full scale; for nongraduated instruments, the maximum manufacturer-specified torque.

scale: the representation of the range of the instrument, divided into increments marked by numbered and unnumbered graduations.

setting: the amount of torque the instrument is expected to apply.

5 REQUIREMENTS

Figures 1 through 20 are descriptive and not restrictive. They are not intended to preclude the manufacture or purchase of other forms of torque instruments conforming to this Standard.

5.1 Torque Instruments

Torque instruments shall pass all applicable tests in para. 6.

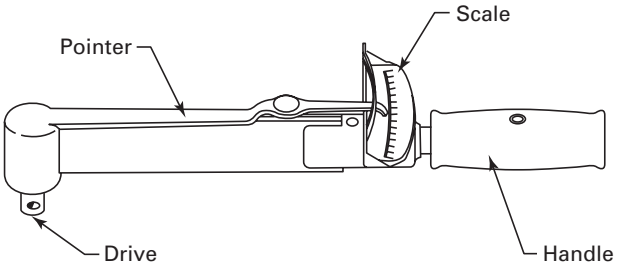

Fig. 1 Type I, Class A

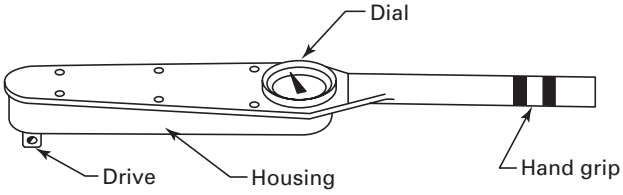

Fig. 2 Type I, Class C

5.2 Design

5.2.1 Type I, Classes A, B, C, and D—Indicating

(a) Operation. Instruments shall indicate torque applied through a deflecting member. They shall operate in both clockwise and counterclockwise directions.

(1) Type I, Classes A and B — Deflecting Beam. Flexing of a cantilever beam connecting the square drive and hand grip shall provide the basis of operation. Type I, Class A deflecting beam torque instruments may be similar to those shown in Fig. 1.

(2) Type I, Classes C and D — Rigid Housing. The deflecting member and dial mechanism shall be enclosed within the rigid housing. The pointer and dial face shall be protected by a transparent cover, which shall be so located and constructed as to be reasonably free from accidental damage resulting from being struck or abraded. Type I, Class C rigid housing torque instruments may be similar to those shown in Fig. 2.

(3) Type I, Classes B and D — Interchangeable Head. The torque instrument shall be equipped with a connection, suitable for accepting a variety of mating wrenching heads. The connection and standard wrenching heads shall be designed so that the requirements of para. 5.10 are met throughout the specified accuracy range. The wrenching heads shall comply with the requirements of para. 5.7. Interchangeable head indicating torque instruments may be similar to Fig. 3 (Class B) or Fig. 4 (Class D).

(b) Indicator. A dial or scale shall be located to permit convenient and accurate reading. The graduation marks shall be colored and shaped to be distinct and easily read. The width of the graduation mark shall be not greater than one-half the adjacent space width. The width of the pointer tip or indicator line shall be not

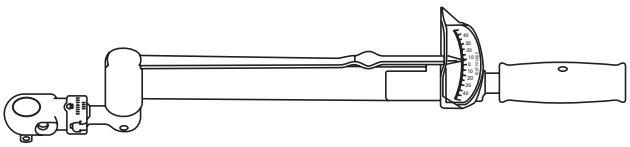

Fig. 3 Type I, Class B

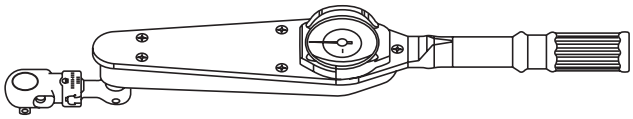

Fig. 4 Type I, Class D

greater than the widest graduation mark, nor shall the pointer completely cover any graduation mark on the outer scale. The pointer shall be located close to the scale face so as to meet the parallax error requirements of para. 6.2.

(c) Hand Position. If, in order to achieve the required accuracy, it is necessary to apply the load at a specific point on the hand grip, the hand grip shall be pivoted at that point.

(d) Auxiliary Functions. Additional features may be incorporated on the torque instrument to improve accuracy or usefulness. The inclusion of such features shall not be cause for rejection of the torque instrument providing it conforms to the performance requirements of this Standard.

(1) Type I, Classes A, B, C, and D, Style 1 — Plain Scale. No auxiliary operational features are required.

(2) Type I, Classes A, B, C, and D, Style 2 — Scale With Signal Mechanism. A signal mechanism capable of being adjusted without the use of tools to any graduated value of the instrument shall be provided. The signal shall operate automatically within the accuracy requirements of this Standard.

(3) Type I, Classes A, B, C, and D, Style 3 — Scale With Memory Indicator. An auxiliary pointer or other device capable of retaining an indication of the maximum torque transmitted through the instrument shall be provided. The auxiliary pointer shall function at any graduated torque value within the accuracy requirements of this Standard. Means shall be provided for resetting the auxiliary pointer. Normal handling of the instrument shall not cause the auxiliary pointer to be displaced.

(e) Type I, Classes A, B, C, and D torque instruments shall be calibrated in the direction(s) of intended use.

5.2.2 Type I, Class E—Indicating, Screwdriver Grip. The grip and drive shall lie on the same axis of rotation to allow the instrument to be used like a screwdriver. Instruments shall be limited to a capacity of 100 lbf-in. (11.3 N·m), and those with capacities over 40 lbf-in. (4.5 N·m) shall be equipped with a $\frac{1}{4}$ in. (6.3 mm) internal square drive on the top of the handle or with other auxiliary driving means.

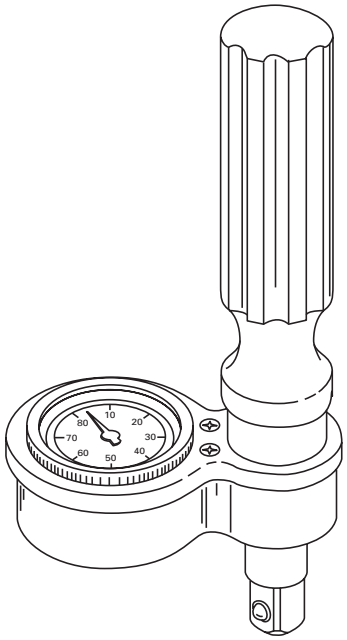

Fig. 5 Type I, Class E, Style 1

(a) Type I, Class E, Style 1 — Enclosed Dial. The pointer and face shall be protected by a suitable transparent cover. The instrument may be similar to that shown in Fig. 5.

(b) Type I, Class E, Style 2 — Exposed Dial. The pointer and face shall be left unprotected. The instrument may be similar to that shown in Fig. 6.

(c) Type I, Class E torque instruments shall be calibrated in the direction(s) of intended use.

5.2.3 Type II—Setting

(a) Operation. Instruments shall sense torque transmitted by comparing the torque applied with a self-contained standard. The transmission of the preselected value shall be indicated by a physical impulse, with or without audible signal, which shall cause a temporary reduction in the torque applied. Operation shall be such as to minimize abrupt overtravel. Reset shall be automatic upon release of load application.

(b) Hand Position. If, in order to achieve the required accuracy, it is necessary to apply the load at a specific location on the handgrip other than the center, the handgrip shall be so designed or marked.

(c) Auxiliary Functions. Additional features may be incorporated in the torque instrument to improve accuracy or usefulness. The inclusion of such features shall not be cause for rejection of the torque instrument providing it otherwise conforms to the requirements of this Standard.

(d) Type II, Class A — Graduated. A graduated scale with increments appropriately numbered shall be lo-

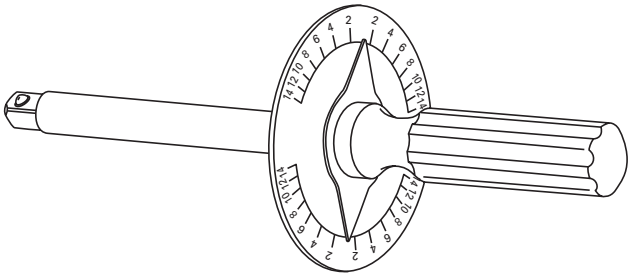

Fig. 6 Type I, Class E, Style 2

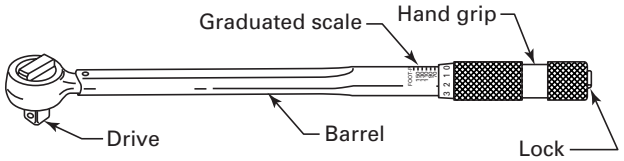

Fig. 7 Type II, Class A, Style 2

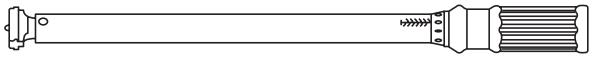

Fig. 8 Type II, Class A, Style 3

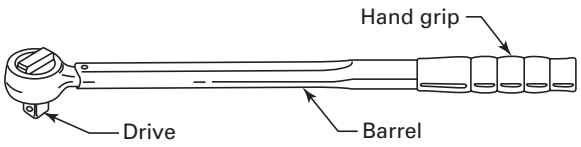

Fig. 9 Type II, Class B, Style 2

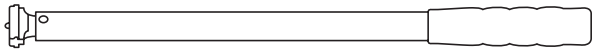

Fig. 10 Type II, Class B, Style 3

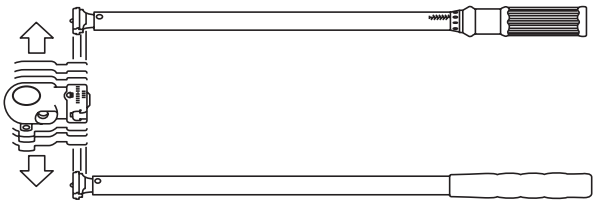

Fig. 11 Type II, Classes A and B, Style 3 With Interchangeable Head

cated on the instrument and positioned as to permit convenient reading. Selection of the desired torque value shall be made by manual means, using a handgrip, and shall not require a separate tool or implement. Provision shall be made to accurately indicate the selected torque value on the graduated scale. A suitable portion of the torque instrument grip shall be designed to facilitate turning of the adjustable portion of the grip. Means shall be provided to protect the torque setting from accidental changes and not require a separate tool or implement. Graduated setting type torque instruments may be similar to those shown in Figs. 7 and 8.

(e) Type II, Class B — Nongraduated. The torque instrument shall not be graduated or equipped with a means for graduated adjustment. A separate tool or implement shall be required to engage the adjustment provision of the instrument in order to select the controlling torque value. Means shall be provided to protect the torque setting from accidental changes. Nongraduated setting type torque instruments may be similar to those shown in Figs. 9 and 10.

(f) Type II, Classes A and B, Style 1 — Nonratcheting. A square drive tang without auxiliary operational features shall be provided. The drive shall comply with the requirements of para. 5.7.1.

(g) Type II, Classes A and B, Style 2 — Ratcheting. The square drive tang provided shall be equipped with a ratcheting mechanism. The ratchet shall comply with the requirements of para. 5.7.2.

(h) Type II, Classes A and B, Style 3 — Interchangeable Head. The torque instrument shall be equipped with a connection, suitable for accepting a variety of mating wrenching heads. The connection and standard wrenching heads shall be designed so that the requirements of para. 5.10 are met throughout the specified accuracy range. The wrenching heads shall comply with the requirements of para. 5.7. Interchangeable head setting torque instruments may be similar to that shown in Fig. 11.

(i) Type II, Classes A and B, Style 4 — Flexible Ratchet Head. A flexible joint shall be provided to allow the body to flex about an axis that is in a plane perpendicular to the axis of the drive tang and perpendicular to the axis of the body (see Fig. 12). Flex angle shall be limited to an amount that will contain the induced torque accuracy error, including the instrument tolerance error, to within the accuracy specified in para. 5.10. A mechanism shall be provided to maintain the ratchet head under its own weight in one or more positions, including one that places the drive axis perpendicular to the longitudinal axis of the instrument. The ratchet shall comply with the requirements of para. 5.7.2.

(j) Type II torque instruments shall be calibrated in the direction(s) of intended use.

5.2.4 Type III—Limiting

(a) Operation. Limiting torque instruments shall operate by releasing the drive tang at the preselected torque value followed by automatic reset. The release and reset sequence shall occur a minimum of two times in one full revolution of the drive. The reset action

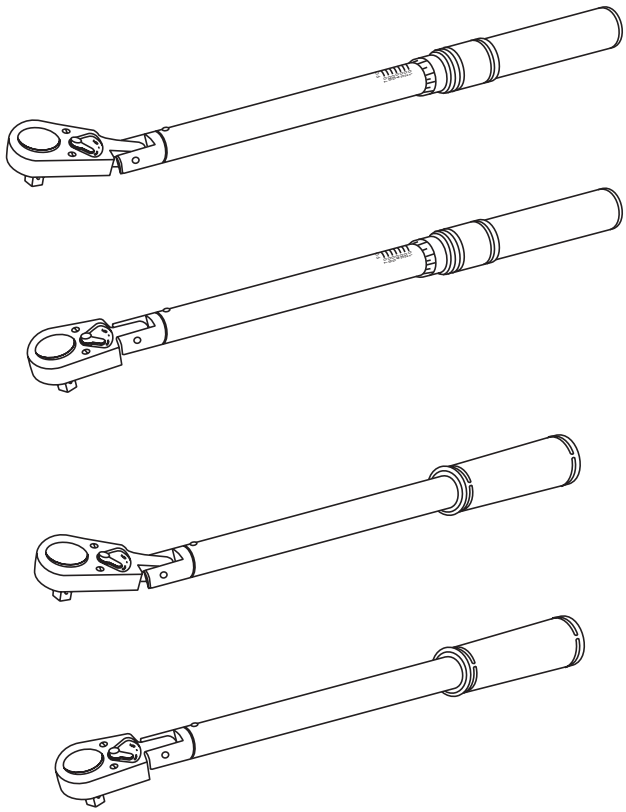

Fig. 12 Type II, Classes A and B, Style 4

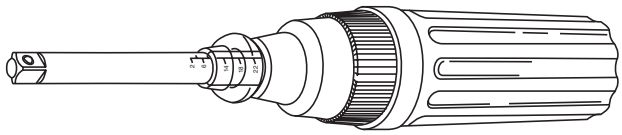

Fig. 13 Type III, Class A, Style 1, Design A

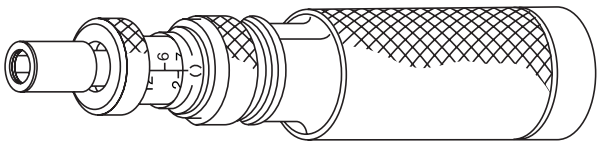

Fig. 14 Type III, Class A, Style 1, Design B

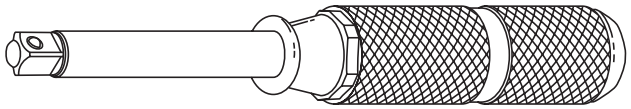

Fig. 15 Type III, Class A, Style 2, Design A

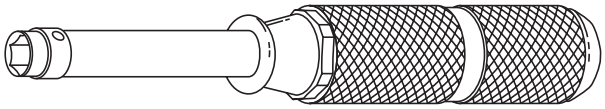

Fig. 16 Type III, Class A, Style 2, Design B

should not cause a reverse torque (backlash), which might tend to loosen the fastener being tightened.

(b) Type III, Class A — Screwdriver Grip. The instrument shall be in a screwdriver configuration. The full-scale setting of Type III, Class A instruments shall not exceed 40 lbf-in. (4.5 N·m).[1]

(1) Type III, Class A, Style 1 — Graduated. A graduated scale with increments appropriately numbered shall be located on the instrument and positioned so as to permit convenient reading. Selection of the torque value shall be made by manual means not requiring a separate tool or implement. Provision shall be made to accurately indicate the selected torque value on the graduated scale. The adjustment means shall be adequately protected against accidental change by an appropriate device or lock not requiring a separate tool or implement. The instrument may be similar to that shown in Figs. 13 and 14.

(2) Type III, Class A, Style 2 — Nongraduated. The torque instrument shall not be graduated or equipped with a means for graduated adjustment. A separate tool or implement shall be required to engage the adjustment provision of the instrument to select the torque value. Means shall be provided to protect the torque setting from accidental changes. The instrument may be similar to that shown in Figs. 15 and 16.

(c) Type III, Class A, Styles 1 and 2, Design A — External Square Drive. A $\frac{1}{4}$ in. (6.3 mm) square drive tang without auxiliary operational features shall be provided. The drive shall comply with the requirements of para. 5.7.1.

(d) Type III, Class A, Styles 1 and 2, Design B — Internal Hex Drive. A $\frac{1}{4}$ in. (6.3 mm) hexagon socket drive integral with the torque instrument shall be provided. The drive shall comply with the requirements of para. 5.7.3.

(e) Type III, Class B — "T" Handle Grip. The instrument shall be in a "T" handle configuration and may be similar to that shown in Fig. 17. The instrument shall not be graduated nor equipped with a means for graduated adjustment. A separate tool or implement shall be required to engage the adjustment provision of the instrument to select the controlling torque value. Means shall be provided to protect the torque setting from accidental changes. The full-scale setting shall not exceed 150 lbf-in. (16.9 N·m). The drive shall comply with the requirements of para. 5.7.1.

(1) Type III, Class B, Style 1 — Nonratcheting. A square drive tang without auxiliary operational features shall be provided.

[1] This limitation is for safety reasons.

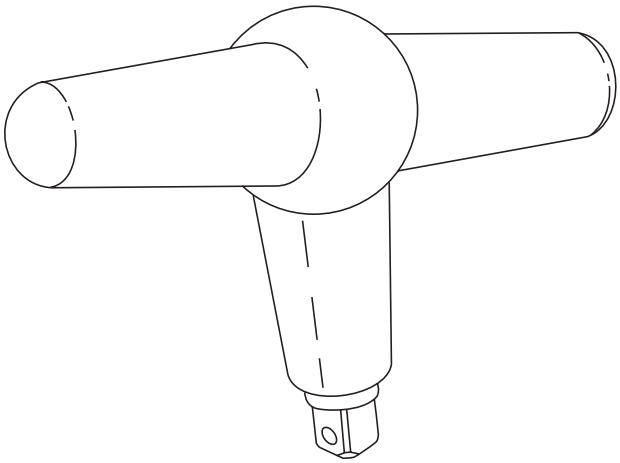

Fig. 17 Type III, Class B

(2) Type III, Class B, Style 2 — Ratcheting. A square drive tang with an integral ratcheting mechanism shall be provided. The ratchet shall be nonreversible and provide driving engagement in the clockwise direction. The ratchet shall index a minimum of 8 times in one full revolution of the drive.

(f) Type III instruments shall be calibrated in a clockwise direction.

5.3 Materials

The materials used in the manufacture of torque instruments shall be such as to ensure compliance with the requirements of this Standard.

5.4 Instructions

Torque instruments shall be supplied with instructions indicating their accuracy limits, direction of operation, application, use, care, and guidance on the proper use of adapters and extensions. The instructions shall indicate the extent to which design features of the instrument, such as flexible or interchangeable heads, affect the accuracy of the instrument.

5.5 Marking

Torque instruments shall be marked in a legible and permanent manner with the following information:

(a) the manufacturer's name or a trademark of such known character that the source of manufacture and country of origin shall be readily determined

(b) model number

(c) units of torque

NOTE: While torque may commonly be expressed as in.-oz, in.-lb, or ft-lb, etc., it is proper to indicate that these measures use force, not mass. The preferred expressions are ozf-in., lbf-in., and lbf-ft.

(d) arrow or arrows with the word "TORQUES" or "TORQUE"' indicating the direction of torque for instruments that are calibrated in one direction

Optional markings, such as serial number, conversion tables, secondary torque scales, Date Code, or Month and Year of Manufacture (e.g., 12/02 for December 2002), etc., may also be included.

5.6 Finish

5.6.1 Surfaces. All exterior surfaces shall be thoroughly cleaned, free from cracks, and essentially free from burrs, pits, nodules, and other detrimental conditions.

5.6.2 Coating. Coatings shall be tightly adherent, uniform in appearance, and free from conditions that would prevent full compliance with the requirements of this Standard. They shall protect the base metal from corrosion under use and storage conditions normally associated with hand tools, and they shall not peel, crack, or blister in such use or storage. Minor blemishes shall be permitted provided they do not detract substantially from the appearance or operation of the torque instrument. Cadmium plating shall not be used as a coating.

5.7 Drives

5.7.1 Plain Square Drives. Drive tangs shall conform to the requirements of ASME B107.4. The square drive shall be oriented so that any two of the opposite flats shall be parallel within 5 deg of the longitudinal axis of the torque instrument. The drive ball or similar retaining mechanism shall be located as shown in Fig. 1.

5.7.2 Ratchet Drives. The operational characteristics of ratchet drives incorporated in all ratchet drive torque instruments shall conform to the requirements of ASME B107.10M.

5.7.3 Internal Hex Drives. Internal hex drives used in Type III, Class A, Styles 1 and 2, Design B instruments shall accommodate screwdriver bits meeting the requirements of ASME B107.4. Insertion and removal of bits shall be accomplished without the use of tools, and means shall be provided to hold the bits securely in place.

5.7.4. Interchangeable Heads. Heads other than plain square drives or ratchet drives shall meet the appropriate dimensional and testing requirements of the ASME specification covering the head type.

5.8 Capacity

The rated capacity of the torque instrument shall not exceed the limit specified in Table 1.

5.9 Increments

The range between the lowest and highest graduated values shall be divided into equal increments. The value

Table 1 Torque Instrument Capacity

Drive Size		Maximum Torque		
in.	mm	lbf-in.	lbf-ft	N·m
1/4	6.3	250	—	30
3/8	10	1,200	100	135
1/2	12.5	3,000	250	340
3/4	20	8,400	700	1,000
1	25	...	2,000	2,700
1 1/2	40	...	6,000	9,000

Table 2 Torque Instrument Increments

Instrument Type	Maximum Increment Value as Percentage of Rated Capacity
I	5
II	2
III	6

of each increment shall be equal to or less than that specified by Table 2. For Type I instruments, graduations shall be identified by appropriate numbers at intervals not greater than each tenth increment. The lowest graduated value shall be not greater than 20% of the highest graduated value on Types I and II torque instruments. This requirement shall not apply to nongraduated instruments.

5.10 Accuracy

The difference between the indicated value and measured value of a torque instrument shall not exceed values shown in Table 3 when tested in the horizontal (with the drive in the vertical) orientation (see Fig. 18).

5.11 Operating Load

Loads applied to the center of the hand grip or designated load point shall not exceed those shown in Table 4 when an amount of torque equal to the rated capacity has been transmitted through it. Appropriate extension handles shall be used as provided by the manufacturer. This requirement shall not apply to Type I, Class E nor Type III instruments.

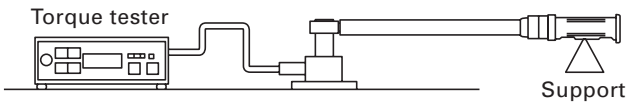

Fig. 18 Gravity-Independent Test Position

6 TESTS

Many tests required herein are inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting such tests. Interchangeable head instruments shall be tested with a properly rated head so that the head will not fail during testing.

6.1 Visual Examination

Conformance with requirements not verified by test shall be established by visual examination. Coating composition and characteristics shall be determined either by appropriate tests or reference to manufacturer's specifications, drawings, or procurement documents. For graduated torque instruments, if the graduated scale is such that major graduations are on the barrel, minor graduations are on the hand grip, and one full rotation of the hand grip advances one graduation on the barrel, then the zero graduation on the hand grip must align with the corresponding graduation on the barrel within plus or minus one increment, throughout its entire graduated range (see Fig. 19).

6.2 Parallax Error Type I

The torque instrument scale shall be located so that it is in a horizontal plane. The pointer shall be adjusted to indicate zero when viewed from directly above the scale. The viewing plane shall be rotated 45 deg clockwise about an axis through the pointer and the apparent change in the relationship between the pointer and scale observed. The change shall not exceed 4% of the maximum graduated value.

Table 3 Torque Instrument Accuracy

Type	Class/Style Design	20% to 100% of Rated Capacity (× Indicated Value)	Below 20% of Rated Capacity (× Rated Capacity)
I	All	±4%	±0.8%
II	Classes A & B, Style 3, Design A	±4% CW ±6% CCW	±0.8% CW ±1.2% CCW
II	Classes A & B, Style 4, Design A	±4% unflexed, +4% −10% flexed CW ±6% unflexed, +6% −12% flexed CCW	±0.8% unflexed, +0.8% −2% flexed CW ±1.2% unflexed, +1.2% −2.4% flexed CCW
II	Classes A & B, Style 4, Designs B & C	±4% unflexed, +4% −10% flexed	±0.8% unflexed, +0.8% −2% flexed
II	All others	±4%	±0.8%
III	All	±6% CW only	±1.2% CW only

Table 4 Torque Instrument Operating Load

Drive Size		Maximum Load	
in.	mm	lbf	N
1/4	6.3	50	230
3/8	10	125	550
1/2	12.5	175	780
3/4	20	250	1,110
1 and larger	25 and larger	300	1,340

6.3 Accuracy

(a) Test Equipment. Accuracy testing shall be performed on equipment capable of indicating torque applied with an accuracy of 25% or less of the accuracy requirement of the instrument under test. Interpolated readings of measuring equipment shall be made no more precisely than one-half of the smallest increment. Accuracy of the test equipment shall be independently verified by a route traceable to the National Institute of Standards and Technology (NIST).

(b) Test Points. All torque instruments except nongraduated types shall be subjected to an accuracy test at the lowest graduated value and at, or nearest to, the graduated value at 20%, 60%, and 100% of maximum graduated value. Nongraduated instruments shall be tested at the value at which they are set, or if supplied not set, at the full-scale setting of the instrument maximum rated torque value and a value equal to 20% of the rated capacity.

(c) Load Position. All accuracy test loads shall be applied at the midpoint of the handgrip or designated load point in a plane perpendicular to the axis of the instrument drive tang. Flexible head instruments shall be tested in the unflexed position.

(d) Test Sequence. Accuracy test readings shall be taken in progression from lower torque values to higher. All instruments shall be operated three times at 100% of maximum graduated value in the direction of test before any test sequence is begun. After the unrecorded operations and before any test operation is begun, Type I instruments shall be adjusted to indicate zero torque applied in the plane of operation before the instrument is put onto the tester. Types II and III instruments shall be adjusted to lowest graduation prior to setting the first test point. Type I, Style 2 instruments shall have the signal device adjusted between each test operation.

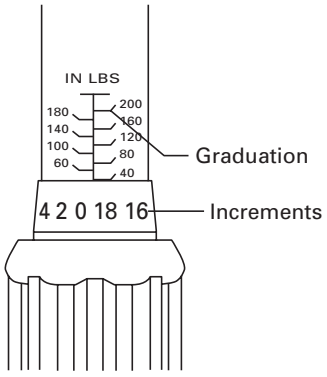

Fig. 19 Graduated Range

If, during a torque setting adjustment with a Type II or Type III graduated instrument, the target test value is exceeded on the scale, the instrument shall be first adjusted back to below the target value and then back to the target test value. All torque instruments shall also be operated three times at each test point before recording readings at that point.

(e) Test Operation. Torque shall be applied at the appropriate place within the designated hand position until the instrument indicates and/or signals the target torque value. The value shown by the tester shall be read and recorded. The indicated value of the memory device of Type I, Style 3 instruments shall be read and recorded following the application of each test load. Immediately following the taking of the tester reading, torque shall be removed from the instrument. On Type II instruments, three readings shall be taken at each of the three target torque settings beginning with the lowest. On Type III instruments, six readings shall be taken at each of the three target settings beginning with the lowest. Each reading taken at each test point shall be within the allowed tolerance of the instrument.

(1) Type I, Classes A, B, C, and D. The pointer or needle of the torque instrument shall be adjusted to indicate zero torque applied in the plane of operation before being mounted in the tester for any test sequence. Classes A, B, C, and D, Style 2 torque instruments shall have the signal device appropriately adjusted between each test operation.

(2) Type II. The torque shall be applied at a rate sufficiently slow and steady so that after the release, the instrument will not overtravel, causing the test equipment to indicate torque in excess of the release setting.

(3) Type III. The torque shall be applied at a rate sufficiently slow and steady so that the torque at the point of release can be accurately read.

6.4 Gravity Error

6.4.1 Type I. The torque instrument shall be located so it is in a horizontal plane and the drive in a vertical plane. The pointer shall be adjusted to indicate zero when viewed from directly above the scale. The torque instrument shall then be rotated and supported at each end so the scale is in a vertical plane and the pointer axis is horizontal. In this position, and when viewed at 90 deg to the scale, the pointer shall not be off the zero position more than ±2% of the maximum graduated value.

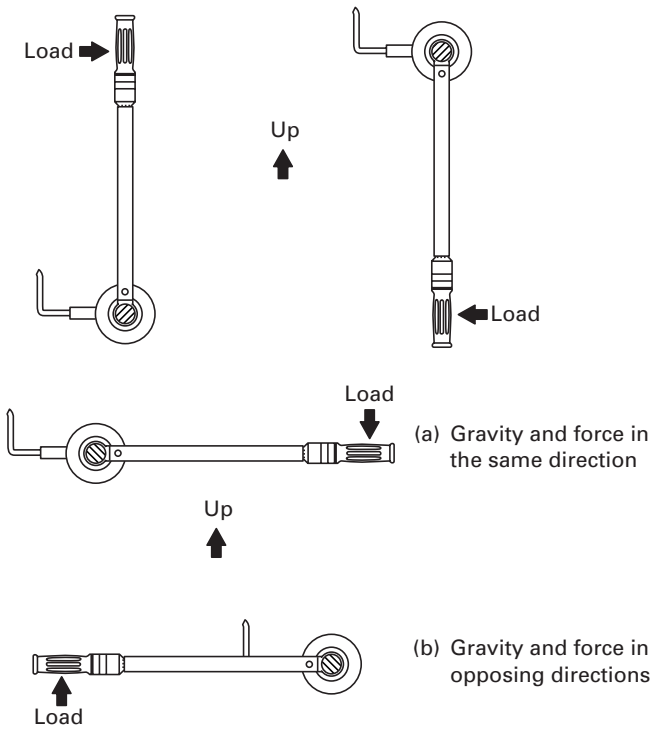

Fig. 20 Gravity-Dependent Test Positions

6.4.2 Types II and III. The gravity-induced error test shall be conducted immediately after the accuracy test at the lowest test point specified in para. 6.3(b). The instrument shall meet the accuracy requirements specified below with the instrument oriented in each position shown in Fig. 20.

Instruments shall operate within the accuracy limits in para. 5.10 in any orientation with respect to gravity except as follows: The allowable increase in accuracy percentage due to orientation influenced by gravity shall be limited to 2% of set torque when the rated capacity of the instrument is under 251 in.-lb or over 250 ft-lb.

Flexible head instruments shall be tested in the unflexed position.

6.5 Calibration Life and Overload

The calibration life tests shall be performed after the accuracy test has been satisfactorily completed.

The torque instrument shall be loaded to rated capacity and completely relieved 5,000 times in each calibrated direction of operation at the rate of 60 cycles per minute or fewer. Types I and II instruments shall then be loaded once to 125% of rated capacity in each calibrated direction of operation.

The instrument shall be examined for physical failure and rejected if evidence of physical failure is found. The instrument shall then be subjected to the requirements of para. 5.10 and test procedure of para. 6.3 and rejected if the tests are not satisfactorily completed.

If the instrument passes the above test, it shall then be loaded to 50% of rated capacity and completely relieved 20,000 times in each calibrated direction of operation. Accurate performance shall not be required at the conclusion of this test, but deformation or physical failure shall be cause for rejection.

6.6 Flexible Head Error Test

This test shall be conducted on Type II, Class A, Style 4 instruments after the gravity error test. The instrument shall be tested in accordance with para. 6.3 but with the body of the instrument at the maximum flexed angles. The accuracy of the instrument shall be within the limits in Table 3.

7 SAFETY REQUIREMENTS AND LIMITATIONS OF USE

Instructors and employers shall stress proper use and safety in the use of torque instruments, information about which can be found in the HTI publication, *Guide to Hand Tools — Selection, Safety Tips, Proper Use, and Care.*

(a) Torque instruments perform correctly only when properly used, cared for, and calibrated.

(b) A fastener improperly torqued with a torque instrument may be very dangerous even if the torque wrench is in proper working order or appears to be in proper working order but is out of calibration.

(c) The failure to follow manufacturer instructions (see para. 5.4) for the use of these instruments is far more serious than with most hand tools. For most hand tools, improper use will harm only the user, but improper use of a torque instrument could lead to systemic failure.

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