ASME B107.300-2021
[Revision of ASME B107.300-2010 (R2016)]

Hand Torque Tools and Torque Testers

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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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FOREWORD

The American National Standards Committee B107, Socket Wrenches and Drives, under sponsorship of The American Society of Mechanical Engineers (ASME), was reorganized on June 28, 1967, as an ASME Standards Committee, and its title was changed to Hand Tools and Accessories. In 1996, its scope was expanded to include safety considerations.

In 1999, ASME initiated a project to consolidate hand tool standards by category of tool. The initial implementation included distinct standards within a single publication bearing a three-digit number corresponding to the responsible B107 subcommittee. To maintain continuity within the user community, the former component standard numbers are renamed as categories in the consolidated standard.

This edition completes the integration of the component standards into a single document. Prior editions of B107.14, Hand Torque Tools (Mechanical); B107.28, Electronic Torque Instruments; and B107.29, Electronic Tester, Hand Torque Tools, are obsolete.

The purpose of B107.300 is to define essential performance and safety requirements for the following three types of torque instruments:

(a) manually operated torque instruments, commonly used for mechanical measurement of torque for control of the tightness of threaded fasteners

(b) electronic torque testers used for checking manually operated, hand-held torque wrenches and screwdrivers

(c) manually operated electronic torque instruments with integral or interchangeable heads

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 tools covered.

This edition includes requirements for endurance, torque value ranges, and accuracy for these torque instruments; specifies test methods to evaluate performance related to the defined requirements; and indicates limitations of safe use. Calculation examples and a cross-reference to tools described in ISO 6789 are provided in the appendices.

This Foreword is not a part of ASME B107.300 and is included for information purposes only.

Members of the Hand Tools Institute Torque Instrument Standards Committee, through their knowledge and hard work, have been major contributors to the development of the B107 wrench standards. Their active efforts in the promotion of these standards is acknowledged and appreciated.

ASME B107.300-2021 was approved by the B107 Standards Committee on March 12, 2021, and by the Board on Standards and Testing on March 12, 2021. It was approved as an American National Standard on June 10, 2021, and takes effect when issued.

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Hand Tools and Accessories

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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.

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Interpretations. Upon request, the B107 Standards 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.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the B107 Standards Committee at the above address. The request for an 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 the topic of the inquiry in one or two words.
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. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

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

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

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.

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HAND TORQUE TOOLS AND TORQUE TESTERS

1 SCOPE

This Standard provides performance and safety requirements for manually operated torque instruments, commonly used for measurement of torque to control the tightness of threaded fasteners. It also provides performance and safety requirements for manually operated electronic torque instruments with integral or interchangeable heads. It includes requirements for endurance, torque value ranges, angle measurements, and accuracy for these torque instruments. It further provides performance and safety requirements for electronic torque testers used for checking manually operated, hand-held torque wrenches and torque screwdrivers. 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 DEFINITIONS

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

angle: the amount of axial rotational displacement from a start point to an end point.

break-over: a temporary reduction in torque indicating a target value has been achieved, indicated by a displacement of the handle of at least 10 deg.

click: a temporary reduction in torque indicating a target value has been achieved, indicated by a displacement of the handle of less than 5 deg.

first peak: the maximum torque value just prior to the torque drop-off, which on Category 14, Types II and IV torque wrenches occurs as the wrench begins its momentary reduction in torque.

flex-head: see *flexible ratchet head*.

flexible ratchet head: a handle with the capability of operating at an angle other than perpendicular to the axis of rotation.

full scale: see *rated capacity*.

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

hand torque instrument: a 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 Category 14, Type I, the value the instrument displays when torque is applied; for Types II, III, and IV, 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.

peak: the maximum torque value reached during the process of applying the load to the wrench.

pivot: a short rod or shaft on which a related part rotates or swings.

rated capacity: the maximum intended torque the user shall measure or apply.

resolution: the smallest distinguishable change in displayed value.

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.

torque-to-angle: a method of assembly where a threshold torque is applied and then more torque is applied to produce a specific angle.

track: continuous readout of torque applied at any moment.

usable range of the transducer: the range to which the accuracy requirements of para. 5.9 are applied.

3 REFERENCES

The following documents form a part of this Standard to the extent specified herein. The latest edition shall be used.

ASME B107.4, Driving and Spindle Ends for Portable Hand, Impact, Air, and Electric Tools (Percussion Tools Excluded)

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ASME B107.110, Socket Wrenches, Handles, and Attachments
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

Guide to Hand Tools — Selection, Safety Tips, Proper Use and Care
Publisher: Hand Tools Institute (HTI), 25 North Broadway, Tarrytown, NY 10591 (www.hti.org)

4 CLASSIFICATION

See Tables 4-1, 4-2, and 4-3.

5 PERFORMANCE REQUIREMENTS

Figures 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.

Torque instruments shall pass all applicable tests in section 6.

Unless otherwise specified, torque instruments shall be calibrated in the direction(s) of intended use.

Torque instruments shall be capable of being calibrated to the specified accuracy by a method traceable to the National Institute of Standards and Technology (NIST).

5.1 Design — Category 14 Mechanical

5.1.1 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 that shown in Figure 5.1.1-1. Type I, Class B deflecting beam torque instruments may be similar to that shown in Figure 5.1.1-2.

(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 that 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 that shown in Figure 5.1.1-3. Type I, Class D rigid housing torque instruments may be similar to that shown in Figure 5.1.1-4.

(3) Type I, Classes B and D — Interchangeable Head Connection for Adapters and Extensions. 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. Indicating torque instruments with an interchangeable head may be similar to Figure 5.1.1-2 (Class B) or Figure 5.1.1-4 (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 not be greater than one-half the adjacent space width. The width of the pointer tip or indicator line shall not be 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 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, a pivot shall be located 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.

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

(f) 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.

(g) 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.

5.1.2 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 auxiliary driving means, such as a T-handle.

(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 Figure 5.1.2-1.

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Table 4-1 Classification: Category 14 Hand Torque Tools, Mechanical

Type	Class	Style	Design
I — indicating	A — deflecting beam	1 — plain scale	...
		2 — scale with signal mechanism	...
		3 — scale with memory indicator	...
	B — deflecting beam with interchangeable head connection for adapters and extensions	1 — plain scale	...
		2 — scale with signal mechanism	...
		3 — scale with memory indicator	...
	C — rigid	1 — plain scale	...
		2 — scale with signal mechanism	...
		3 — scale with memory indicator	...
	D — rigid housing with interchangeable head connection for adapters and extensions	1 — plain scale	...
		2 — scale with signal mechanism	...
		3 — scale with memory indicator	...
	E — screwdriver grip	1 — enclosed dial	...
		2 — exposed dial	...
II — setting	A — graduated	1 — nonratcheting	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
		2 — ratcheting	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
		3 — interchangeable head connection for adapters and extensions	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
		4 — flexible ratchet head	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
	B — nongraduated	1 — nonratcheting	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
		2 — ratcheting	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
		3 — interchangeable head connection for adapters and extensions	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing

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Table 4-1 Classification: Category 14 Hand Torque Tools, Mechanical (Cont'd)

Type	Class	Style	Design
II — setting (Cont'd)	B — nongraduated (Cont'd)	4 — flexible ratchet head	A — clockwise (right-hand) and counterclockwise (left-hand) torquing
			B — clockwise torquing
			C — counterclockwise torquing
III — limiting	A — screwdriver grip	1 — graduated	A — external square drive
			B — internal hex drive
		2 — nongraduated	A — external square drive
			B — internal hex drive
	B — T-handle grip	1 — nonratcheting	...
		2 — ratcheting	...
IV — break-over (nongraduated)	A — fixed head	1 — clockwise (right-hand) and counterclockwise (left-hand) torquing	...
		2 — clockwise torquing	...
		3 — counterclockwise torquing	...
	B — interchangeable head for adapters and extensions	1 — clockwise (right-hand) and counterclockwise (left-hand) torquing	...
		2 — clockwise torquing	...
		3 — counterclockwise torquing	...

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Table 4-2 Classification: Category 28 Electronic Torque Instruments

Type	Class	Style	Design	Accuracy
I — torque only	A — nonratcheting	...	A	1%
			B	4%
	B — ratcheting	1 — nonflexible head	A	1%
			B	4%
		2 — flexible ratchet head	A	1%
			B	4%
	C — interchangeable head connection for adapters and extensions	...	A	1%
		...	B	4%
II — torque and angle	A — nonratcheting	...	A	1%
		...	B	4%
	B — ratcheting	1 — nonflexible head	A	1%
			B	4%
		2 — flexible ratchet head	A	1%
			B	4%
	C — interchangeable head connection for adapters and extensions	...	A	1%
		...	B	4%
III — screwdriver grip, torque only	A — nonratcheting	...	A	1%
			B	4%
	B — ratcheting	...	A	1%
		...	B	4%
IV — screwdriver grip, torque and angle	A — nonratcheting	...	A	1%
		...	B	4%
	B — ratcheting	...	A	1%
		...	B	4%

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Table 4-3 Classification: Category 29 Electronic Torque Testers

Type	Class	Accuracy
I — with torque-generating unit	A	±0.25% of indicated value
	B	±0.50% of indicated value
	C	±1% of indicated value
II — with hand actuation	A	±0.25% of indicated value
	B	±0.50% of indicated value
	C	±1% of indicated value

Figure 5.1.1-1 Category 14, Type I, Class A

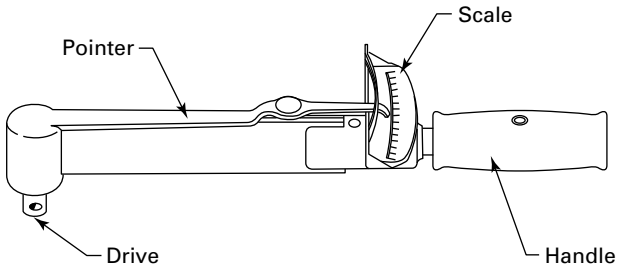


Figure 5.1.1-2 Category 14, Type I, Class B

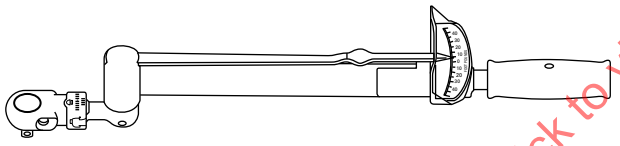


Figure 5.1.1-3 Category 14, Type I, Class C

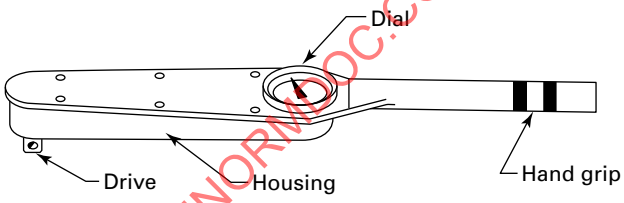
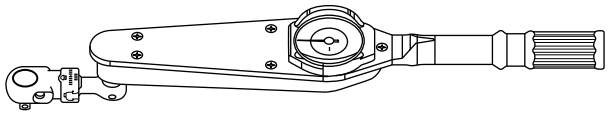


Figure 5.1.1-4 Category 14, Type I, Class D



(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 Figure 5.1.2-2.

5.1.3 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 applied torque. Operation shall be such as to minimize abrupt over-travel. Reset shall be automatic upon release of load application.

(b) Hand Position. If, 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, provided it otherwise conforms to the requirements of this Standard.

(d) Type II, Class A — Graduated. A graduated scale with increments appropriately numbered shall be located 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 shall not require a separate tool or implement.

Graduated setting type torque instruments may be similar to those shown in Figures 5.1.3-1 and 5.1.3-2.

(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 Figures 5.1.3-3 and 5.1.3-4.

(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.

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Figure 5.1.2-1 Category 14, Type I, Class E, Style 1

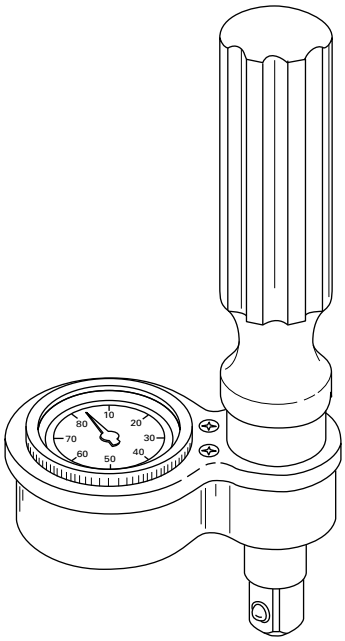


Figure 5.1.2-2 Category 14, Type I, Class E, Style 2

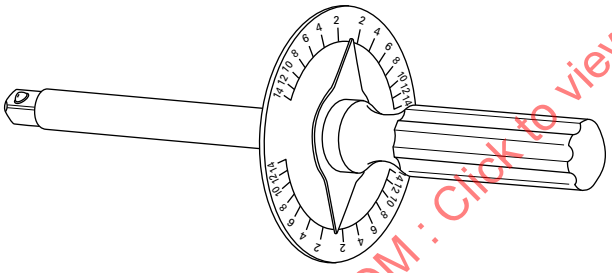


Figure 5.1.3-1 Category 14, Type II, Class A, Style 2

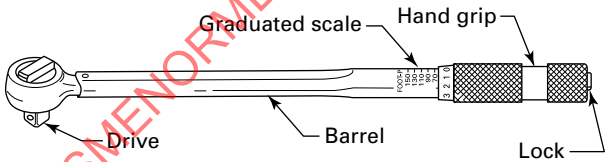


Figure 5.1.3-2 Category 14, Type II, Class A, Style 3 (Shown Without Interchangeable Head)

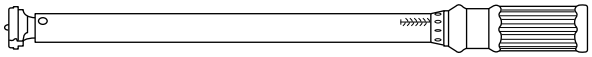


Figure 5.1.3-3 Category 14, Type II, Class B, Style 2

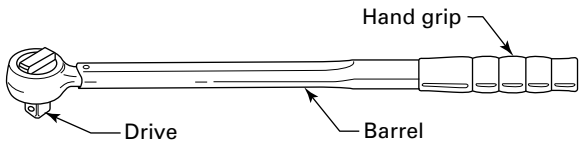


Figure 5.1.3-4 Category 14, Type II, Class B, Style 3 (Shown Without Interchangeable Head)

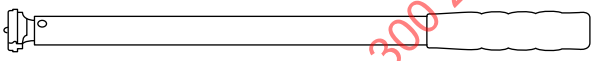
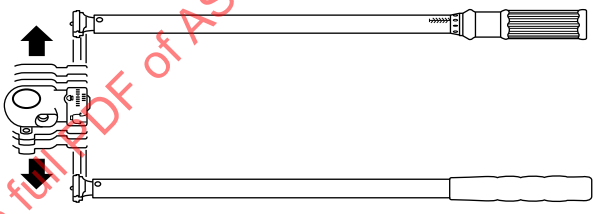


Figure 5.1.3-5 Category 14, Type II, Classes A and B, Style 3 (Shown With Interchangeable Head)



(h) Type II, Classes A and B, Style 3 — Interchangeable Head Connection for Adapters and Extensions. 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. 5.7.4. Setting torque instruments with an interchangeable head may be similar to that shown in Figure 5.1.3-5.

(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 Figure 5.1.3-6). 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.

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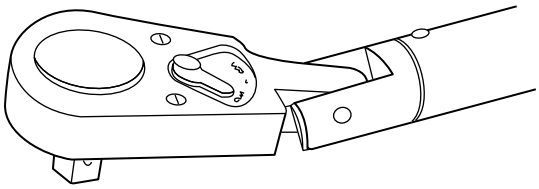
Figure 5.1.3-6 Flexible Head



5.1.4 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 should not cause a reverse torque (backlash), which might 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).

NOTE: This limitation is for safety reasons.

(1) Type III, Class A, Style 1 — Graduated. A graduated scale with increments appropriately numbered shall be located on the instrument and positioned 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 Figures 5.1.4-1 and 5.1.4-2.

(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 in order 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 Figures 5.1.4-3 and 5.1.4-4.

(c) Type III, Class A, Styles 1 and 2, Design A — External Square Drive. A ¼-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 ¼-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 Figure 5.1.4-5. 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 in order 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.

(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 eight times in one full revolution of the drive.

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

5.1.5 Type IV Break-Over. The drive tang of the torque instrument shall stay stationary while the body of the instrument shall pivot about a holding pin when torque is reached. The minimum amount of rotation shall be 10 deg. The torque instrument may or may not reset when force is released on the handle (see Figure 5.1.5-1).

5.2 Design — Category 28 Electronic

The torque instrument shall be capable of electronically indicating the torque applied clockwise and counterclockwise using a transducer and digital display. The torque value readout shall be visible at a viewing angle up to 45 deg from normal. It shall have an integral power supply capable of meeting the requirements specified in para. 5.15.

Type I shall indicate torque only.

Type II shall indicate torque and angle either alternatively or simultaneously.

Type III shall indicate torque and have the grip and drive 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 auxiliary driving means, such as a T-handle.

Figure 5.1.4-1 Category 14, Type III, Class A, Style 1, Design A

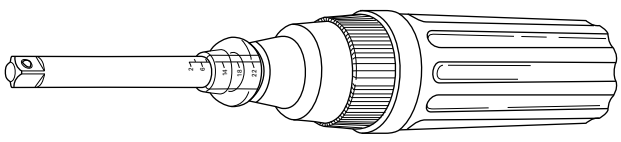


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Figure 5.1.4-2 Category 14, Type III, Class A, Style 1, Design B

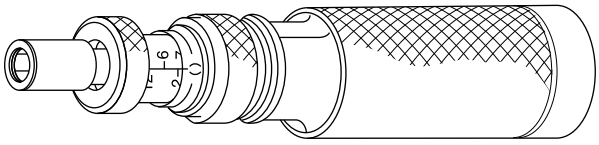


Figure 5.1.4-3 Category 14, Type III, Class A, Style 2, Design A

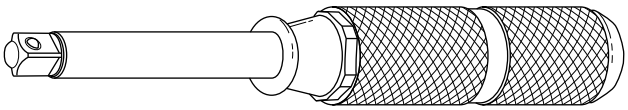


Figure 5.1.4-4 Category 14, Type III, Class A, Style 2, Design B

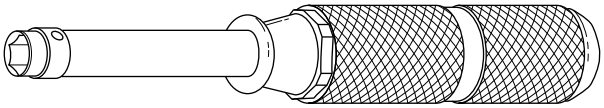
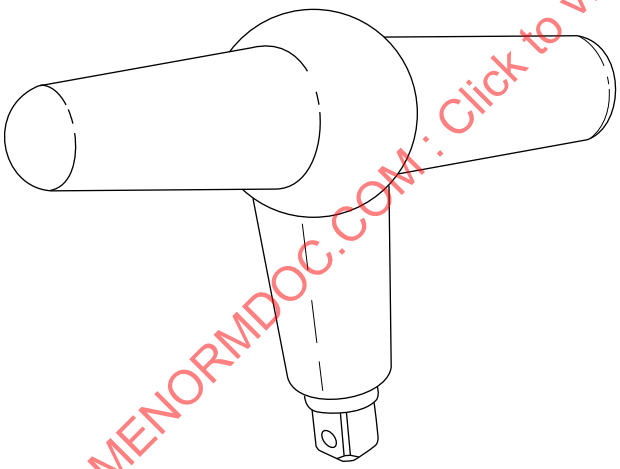


Figure 5.1.4-5 Category 14, Type III, Class B



Type IV shall indicate torque and angle either alternatively or simultaneously and shall have a grip to allow the instrument to be used like a screwdriver.

5.3 Design — Category 29 Electronic Tester

The tester shall be designed for checking clockwise and counterclockwise hand torque tools produced to this Standard. The tester shall consist of the following components:

(a) Electronic Torque Indicator. The tester shall have an electronic digital indicator. The digital indicator must be easily viewed and accessed by the operator. Indications shall be provided on the panel of the digital indicator to indicate, at a minimum, the following conditions:

(1) power on
(2) torque units of measure
(3) operating modes
(-a) first peak
(-b) peak
(-c) track
(4) clockwise or counterclockwise operation

(b) Controls. All controls shall be readily accessible and clearly identified.

(c) Overload Indication. A visual, audible, or both, overload indication shall be provided.

(d) Calibration Adjustment. A means shall be provided to calibrate the equipment or change any calibration factor or other correction data stored in the memory of the equipment.

(e) Torque Transducers. Multiple torque transducers may be used to cover the range of the torque tester.

Transducers shall be interchangeable. The usable range of the transducer shall be clearly indicated on the transducer's label. The drives on the transducer, adapter, or both, shall conform to ASME B107.4.

(f) Torque-Generating Unit. The Type I tester shall have a torque-generating unit. During testing, the application of the load on the handle shall be applied in accordance with the applicable test procedure.

5.4 Materials

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

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) serial number (Category 28)
(d) units of torque
(e) rated capacity with units of measure (Category 28)
(f) load position (on instruments for which accuracy is dependent upon load position)

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.

(g) arrow or arrows with the word "TORQUES" or "TORQUE" indicating the direction of torque for instruments that are calibrated in one direction (Category 14).

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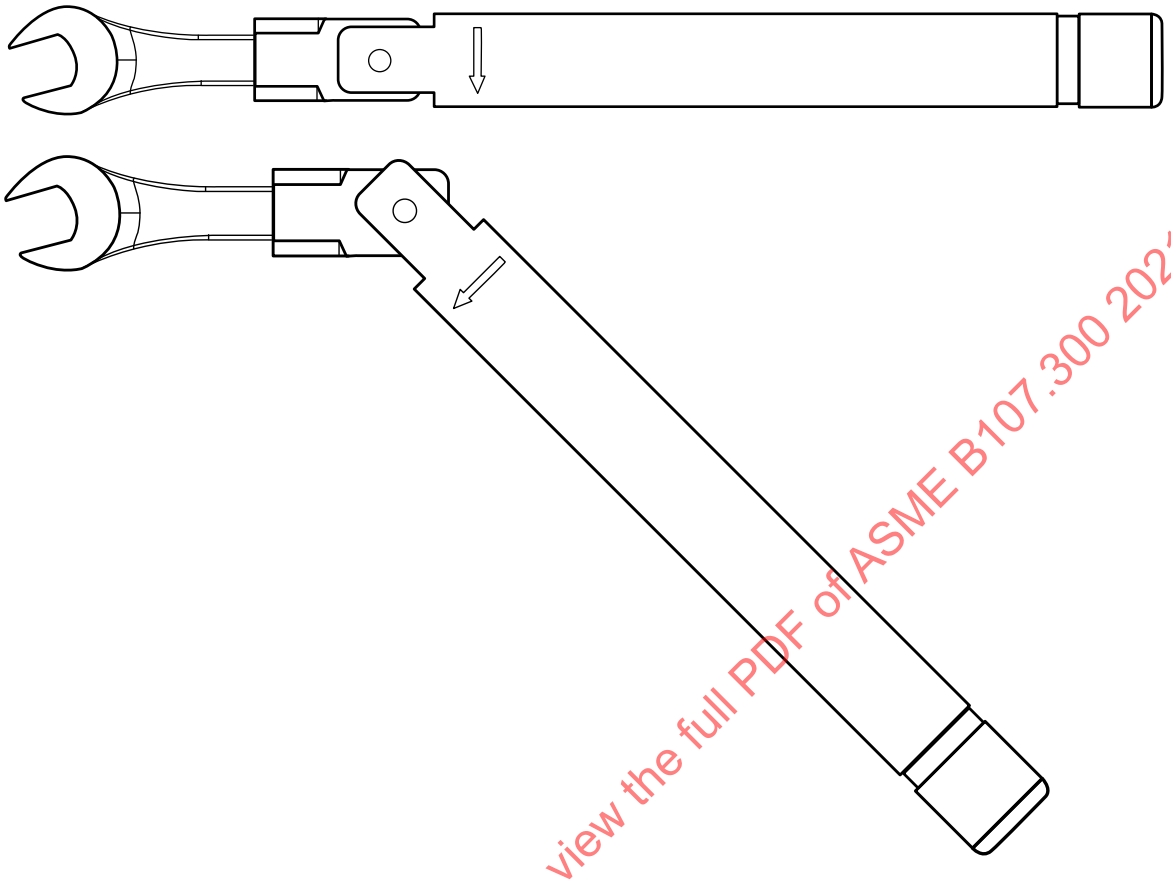
Figure 5.1.5-1 Category 14, Type IV Break-Over Wrench



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Optional markings such as serial number, conversion table, secondary torque scale, date code, or month and year of manufacture (e.g., 12/21 for December 2021), 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. Sharp edges and corners capable of causing injury shall be removed, and parts subject to corrosion shall be appropriately protected. Minor blemishes shall be permitted, provided they do not detract substantially from the appearance or operation of the torque instrument. Protection from environmental damage shall be provided by suitable coating or transparent cover.

5.6.2 Coating. Coatings 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 two of the opposite flats are 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 Figure 5.7.1-1.

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 B107.110 (excluding test requirements).

5.7.3 Internal Hex Drives. Internal hex drives used in Category 14, Type III, Class A, Styles 1 and 2, Design B instruments shall accommodate screwdriver bits meeting the requirements of ASME B107.4. Insertion

Figure 5.7.1-1 Drive Ball Location

Table 5.8-1 Torque Instrument Capacity

Drive Size		Maximum Torque		
in.	mm	lbf-in.	lbf-ft	N·m
1/4	6.3	250	...	30
3/8	10.0	1,500	125	170
1/2	12.5	3,600	300	406
3/4	20.0	8,400	700	1 000
1	25.0	...	2,000	2 700
1 1/2	40.0	...	6,000	9 000

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 shall meet the appropriate dimensional and testing requirements of the corresponding ASME standard for the head type (ratchet, box head, open end, flare nut, etc.). If the corresponding ASME test requirements exceed the capacity of the interchangeable connection, then the maximum torque rating of the head shall be used in place of the ASME requirement.

5.8 Capacity

The rated capacity of the torque instrument shall not exceed the limit specified in Table 5.8-1. The lowest indicated value shall be no greater than 20% of the rated capacity for Category 28 instruments.

5.9 Increments

The range between the lowest and highest graduated values shall be divided into equal increments. The value of each increment shall be equal to or less than that specified by Table 5.9-1.

For Category 14, Type I instruments, graduations shall be identified by appropriate numbers at intervals not greater than each tenth increment. The lowest graduated value shall be no greater than 20% of the highest graduated value on Category 14, Types I and II torque instruments.

Table 5.9-1 Maximum Torque Instrument Increment Value as Percent of Rated Capacity

Category	Instrument Type	Torque	Angle, deg
14	I	5	...
	II	2	...
	III	6	...
	IV	N/A	...
28	All, Design A	0.1	...
	All, Design B	0.4	...
	II	...	...

This requirement shall not apply to nongraduated instruments.

5.10 Accuracy

5.10.1 Torque Accuracy. The difference between the indicated value and measured value of a torque instrument shall not exceed values shown in Table 5.10.1-1 when tested in the horizontal (with the drive in the vertical) orientation (see Figure 5.10.1-1).

5.10.2 Angle Accuracy. Category 28, Type II angle shall not deviate more than ±1% of angle reading, plus ±1 deg for rate variation (with angular velocity greater than 10 deg/sec but less than 180 deg/sec), plus ±1 deg allowance for fixture variation, over a 180-deg rotation throughout the graduated range of torque values (see Table 5.10.2-1).

5.10.3 Torque and Resolution Accuracy. The accuracy of the measured torque and resolution of Category 29 instruments shall not exceed the values shown below.

Class	Resolution (Percent of Rated Capacity)	Accuracy
A	0.06	±0.25
B	0.12	±0.50
C	0.25	±1.00

The accuracy test shall be conducted at a minimum of three values, including both ends of the usable range.

5.11 Operating Load

Loads applied to the center of the handgrip or designated load point and perpendicular to the instrument axis (centerline) shall not exceed those shown in Table 5.11-1 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 Category 14, Type I, Class E; Category 14, Type III; nor Category 28, Type III instruments.

5.12 Operating Modes Category 28

At least one of the following shall be provided:

(a) Track Mode. The torque instrument shall allow direct measurement of the torque applied and shall display the value.

Figure 5.10.1-1 Gravity-Independent Test Position

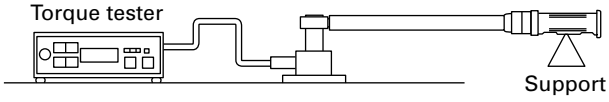

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Table 5.10.1-1 Torque Instrument Torque Accuracy

Category	Type	Class/Style/Design	20% to 100% of Rated Capacity (Times Indicated Value)	Below 20% of Rated Capacity (Times Rated Capacity)
14	I	All	±4%	±8%
14	II	Classes A and B, Styles 1, 2, and 3, Design A	±4% CW, ±6% CCW	±0.8% CW, ±1.2% CCW
14	II	Classes A and B, Style 4, Design A	±4% unflexed; +4%, −10% flexed CW	±0.8% unflexed; +0.8%, −2% flexed CW
			±6% unflexed; +6%, −12% flexed CCW	±1.2% unflexed; +1.2%, −2.4% flexed CCW
14	II	Classes A and B, Style 4, Designs B and C	±4% unflexed; +4%, −10% flexed	±0.8% unflexed; +0.8%, −2% flexed
14	II	All others	±4%	±0.8%
14	III	All	±6% CW only	±1.2% CW only
14	IV	All	±6% CW only	N/A
28	All	Design A	±1% unflexed; +1%, −6% flexed CW	±0.2% unflexed; +0.2%, −1.2% flexed CW
			±1.5% unflexed; +1.5%, −9% flexed CCW	±0.3% unflexed; +0.3%, −1.8% flexed CCW
28	All	Design B	±4% unflexed; +4%, −10% flexed CW	±0.8% unflexed; +0.8%, −2% flexed CW
			±6% unflexed; +6%, −12% flexed CCW	±1.2% unflexed; +1.2%, −2.4% flexed CCW

GENERAL NOTE: See Table A-3 for example of accuracy below 20% of rated capacity.

Table 5.10.2-1 Torque Instrument Angle Accuracy

Angle	Min.	Max.
45 deg	42.6	47.5
90 deg	87.1	92.9
135 deg	131.6	138.4
180 deg	176.2	183.8

Table 5.11-1 Torque Instrument Operating Load

Drive Size		Maximum Load	
in.	mm	lbf	N
1/4	6.3	50	220
3/8	10	125	555
1/2	12.5	175	780
3/4	20	250	1 110
1 and larger	25 and larger	300	1 335

(b) Peak Mode. The torque instrument shall allow direct measurement of the torque applied and shall display the highest value since the last reset for a minimum of 5 sec.

5.13 Operating Conditions — Category 29

The tester shall meet the requirements of the Standard within a temperature of 64°F (18°C) to 82°F (28°C) with relative humidity up to 90% (noncondensing).

5.14 Overload

The Category 28 instrument shall have a warning device to indicate when the applied torque has exceeded its rated capacity and shall pass the test in para. 6.11.

The Category 29 tester shall be capable of transmitting an amount of torque equal to 125% of the rated capacity in both directions without physical failure.

5.15 Battery Life Category 28

The torque instrument shall have an indicator to warn of a low battery condition. On a torque instrument having the capability of storing torque readings, the indicator shall store values internally or give sufficient notice to allow for downloading of the stored values to a data logger or similar device. A low battery condition shall not cause an incorrect torque value to be displayed.

6 TESTS

Many tests required herein are inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting such tests. These tests are designed to evaluate the tools and materials and do not condone the use of the tools in an environment, or in a manner, inconsistent with safe use of the tools.

Instruments with an interchangeable head connection 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 tests shall be established by visual examination. Coating composition and characteristics shall be determined either by appropriate tests or reference to the 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 handgrip, and

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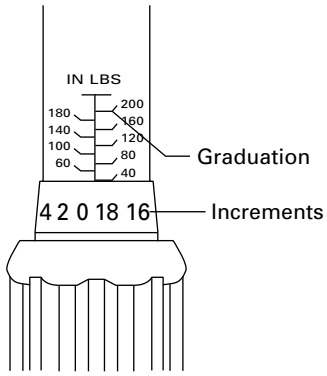
Figure 6.1-1 Graduated Range



one full rotation of the handgrip advances one graduation on the barrel, then the zero graduation on the handgrip must align with the corresponding graduation on the barrel within plus/minus one increment throughout its entire graduated range (see Figure 6.1-1).

6.2 Parallax Error — Category 14, 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.

6.3 Accuracy Tests — Category 14

(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 NIST. Testing shall be performed at a temperature not fluctuating by more than 2°F (1°C). This temperature shall be in the range of 64°F (18°C) to 82°F (28°C) (maximum relative humidity 90%) and shall be documented.

(b) Test Points. Refer to the flowchart in Figure 6.3-1 as applicable.

(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 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. Immediately following the taking of the tester reading, torque shall be removed from 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 over-travel causing the test equipment to indicate torque in excess of the release setting.

(3) Types III and IV. 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 Accuracy Tests — Category 28

6.4.1 Torque Test. See the flowchart in Figure 6.4.1-1. All test loads shall be applied at the midpoint of the handgrip or at the marked load position for Types I and II and concentric to the handgrip for Types III and IV.

The test shall be performed on equipment capable of indicating torque applied within an accuracy of ±0.25% for Design A and ±1% for Design B at any point within the calibrated range of the torque instrument. Interpolated readings of the measuring equipment shall be made no more precisely than one-half of the smallest increment.

Accuracy of test equipment shall be independently verified by a route traceable to NIST.

6.4.2 Types II and IV Angle Test. At the conclusion of the test in para. 6.4.1, the torque instrument shall be tested per the flowchart in Figure 6.4.2-1. All recorded measurements shall be within the requirements of para. 5.10 for Category 28, Type II instruments. The test shall be performed on angle-testing equipment capable of accurately measuring 0.5 deg (or better) and shall be independently verified by a route traceable to NIST.

6.5 Accuracy Tests — Category 29

6.5.1 Measuring Equipment. The accuracy of measuring equipment shall be at least four times better than the accuracy of the unit under test. Accuracy of measuring equipment shall be independently verified by a route traceable to NIST.

6.5.2 Test Sequence. See the flowchart in Figure 6.5.2-1.

6.6 Gravity Error — Category 14

6.6.1 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

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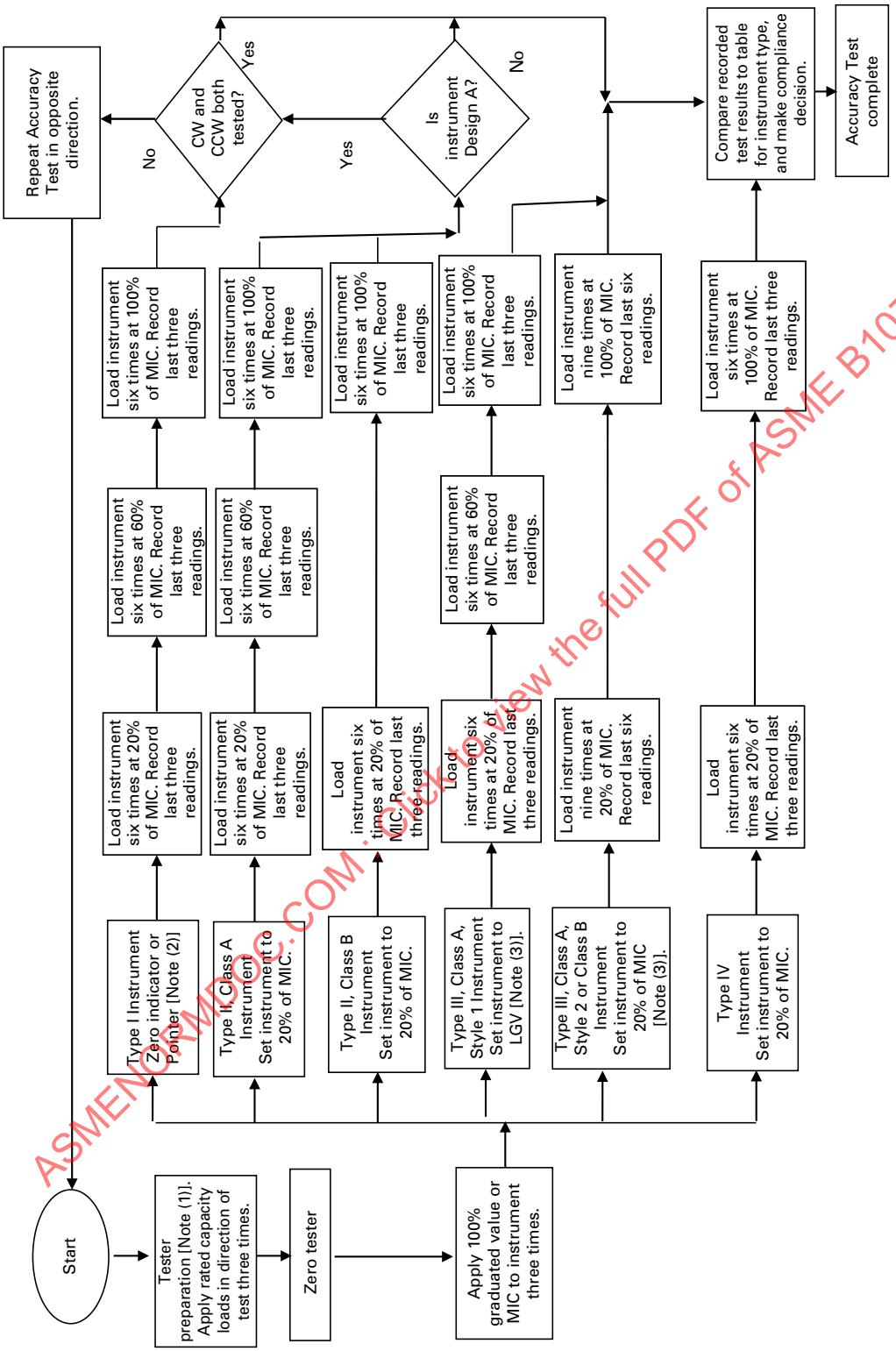
Figure 6.3-1 Accuracy Test Flowchart — Category 14



Legend:
LGV = lowest graduated value
MIC = maximum instrument capacity

NOTES:
(1) From para. 6.3(a).
(2) If instrument is Type I, Style 2, set signal mechanism to test point value prior to testing each point.
(3) Type III wrenches are tested in clockwise direction only.

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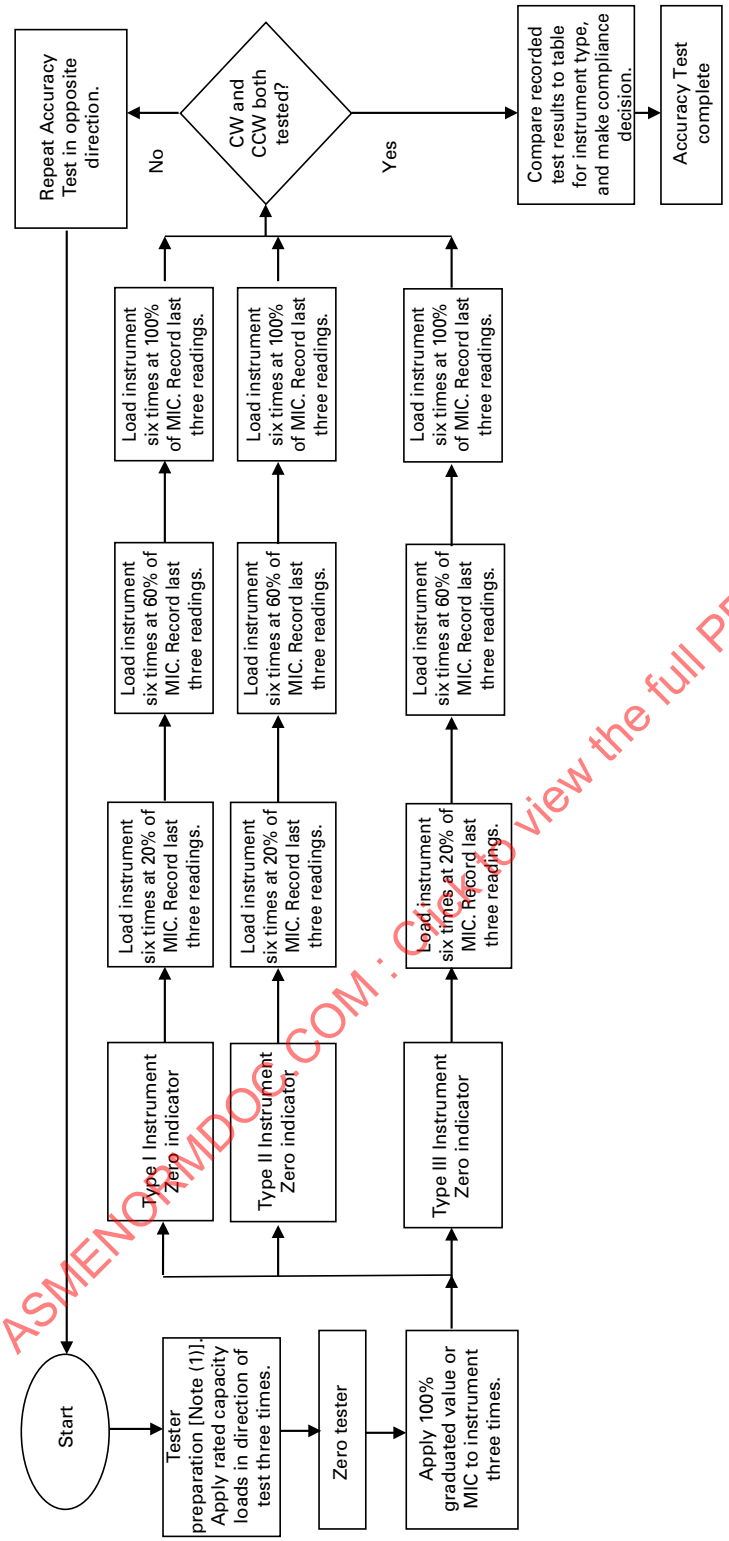
Figure 6.4.1-1 Accuracy Test Flowchart — Category 28 Torque Test



Legend:
LGV = lowest graduated value
MIC = maximum instrument capacity

NOTE: (1) From para. 6.4.1.

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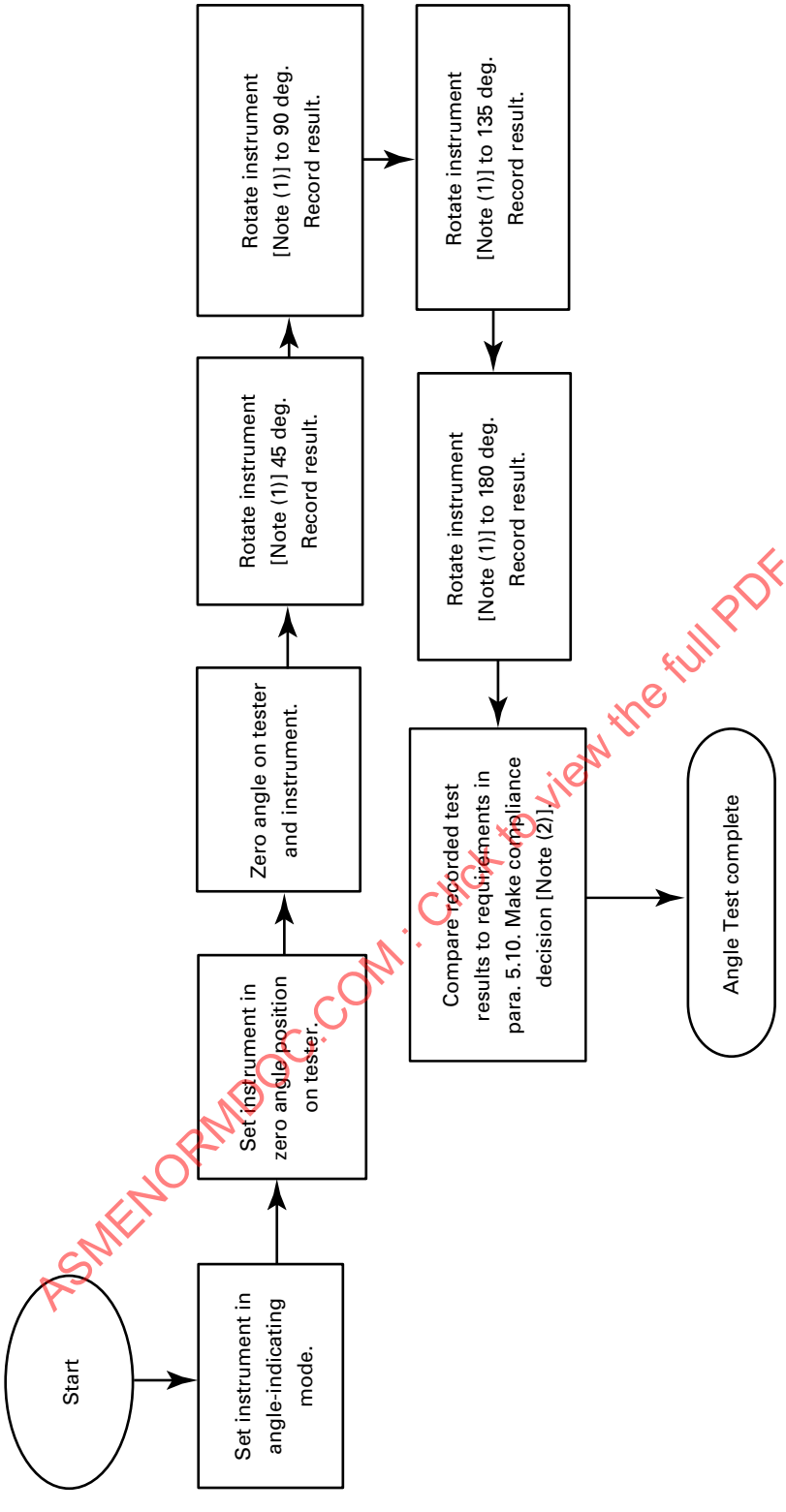
Figure 6.4.2-1 Accuracy Test Flowchart — Category 28, Types II and IV Angle Test



NOTES:
(1) Zero angle on tester and instrument first, if needed according to manufacturer's instructions.
(2) Test in opposite direction if required by manufacturer's instructions.

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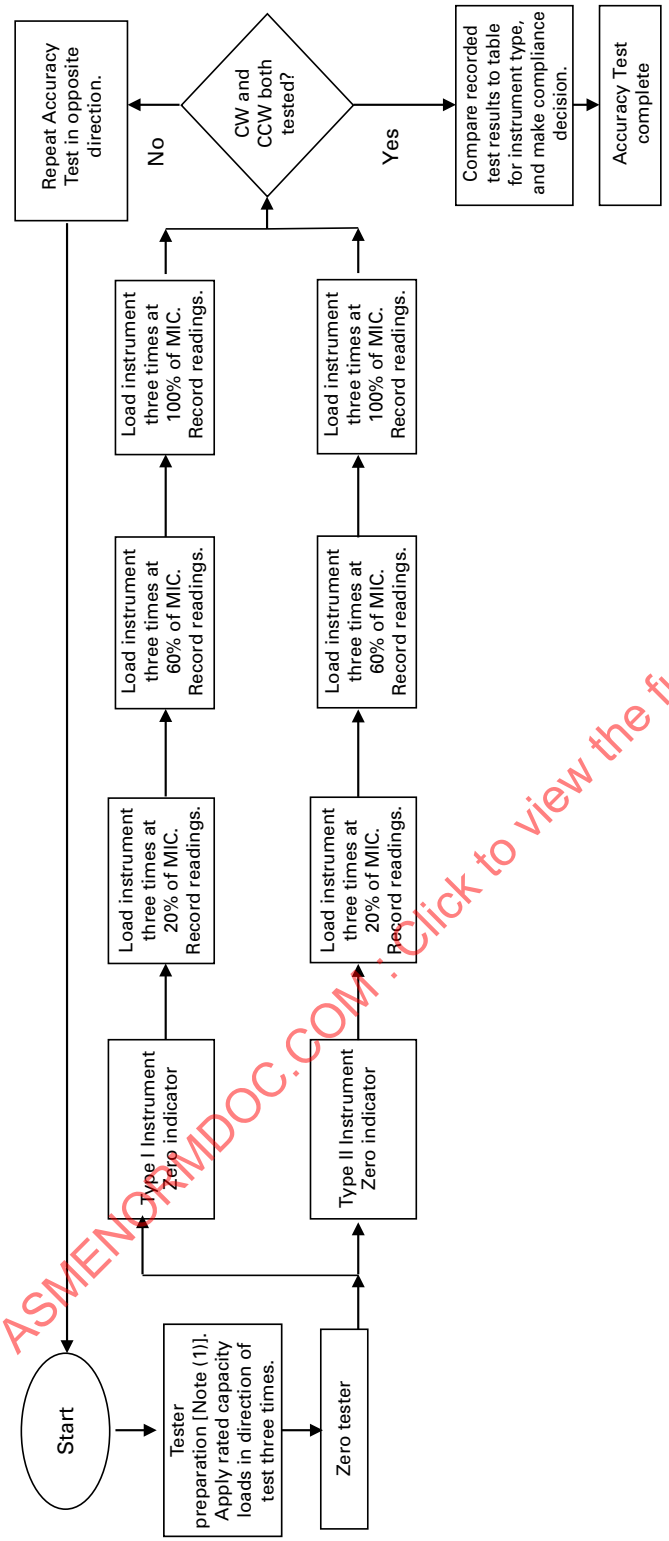
Figure 6.5.2-1 Accuracy Test Flowchart — Category 29



Legend:
LGV = lowest graduated value
MIC = maximum instrument capacity

NOTE: (1) From para. 6.5.1.

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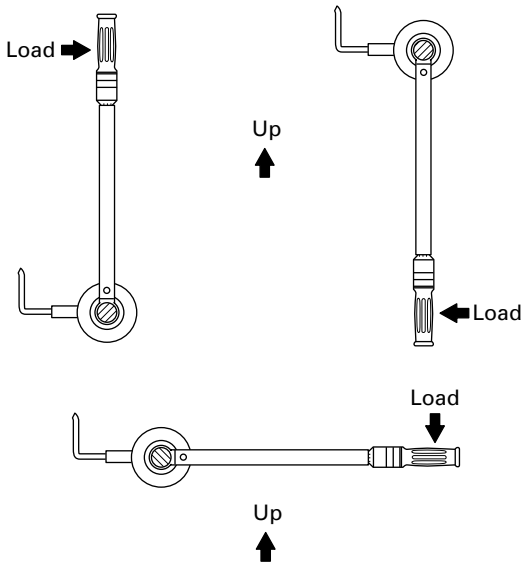
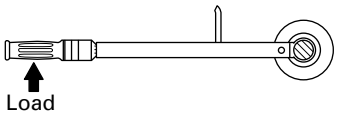
Figure 6.6.2-1 Gravity-Dependent Test Positions



(a) Gravity and Force in the Same Direction



(b) Gravity and Force in Opposing Directions

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.

6.6.2 Types II, III, and IV. 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 Figure 6.6.2-1.

Instruments shall operate within the accuracy limits in para. 5.10 in any orientation with respect to gravity, except that 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 lbf-in. (32.6 N•m) or over 250 lbf-ft (339 N•m).

Flexible head instruments shall be tested in the unflexed position.

6.7 Calibration Life and Overload — Category 14

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 less. Types I and II instruments shall then be loaded once to 125% of rated capacity in each calibrated direction of operation. Type II, Style 4 instruments shall be loaded in the maximum flexed position.

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

If the instrument passes the above tests, 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 after this test, but deformation or physical failure shall be cause for rejection.

6.8 Calibration and Cycle Life Test — Category 28

The torque instrument shall meet, without recalibration (adjustment of electronic circuitry) or adjustments to the instrument, the accuracy requirements after being stressed from no load to rated capacity, 5,000 times in a clockwise direction and then 5,000 times in a counterclockwise direction at a rate not to exceed 60 operations per minute. Subsequently, the instrument shall be stressed from no load to 50% of rated capacity, 20,000 times in a clockwise direction, and then 20,000 times in a counterclockwise direction at a rate not to exceed 60 times per minute. The instrument, after recalibration and minor adjustment if necessary, shall meet the accuracy requirements. Instrument display shall be active. Batteries may be replaced as required.

6.9 Overload Test — Categories 28 and 29

The torque instrument shall be loaded once to 125% of its rated capacity in each a clockwise and counterclockwise direction using a known torque reference. The torque instrument shall show no signs of permanent deformation or physical failure. Accurate performance shall not be required at the conclusion of this test.

6.10 Flexible Head Error Test

This test shall be conducted on Category 14, Type II, Class A, Style 4 and Category 28, Style 2 instruments (after the gravity error test for Category 14). The instrument shall be tested in accordance with para. 6.3 or para. 6.4 but with the body of the instrument at the maximum flexed angles. The accuracy of the instrument shall be within the limits in Table 5.10.1-1.

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6.11 Endurance Test — Category 29

The torque tester shall perform satisfactorily for 5,000 cycles in each direction of operation at maximum capacity without physical failure while maintaining the required level of accuracy. Subsequently, the torque tester shall perform for 50,000 cycles in each direction of operation at 50% of capacity without physical failure.

After the 50,000 cycles in each direction, the torque tester and generating unit shall be capable of being calibrated within the specified accuracy.

7 SAFETY REQUIREMENTS AND LIMITATIONS OF USE

(a) 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.

(b) 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.

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

(d) 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.

(e) The failure to follow manufacturer instructions [see (b)] 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.

(f) The torque tester shall be conveniently and easily operated and not constitute a hazard to the operator under normal operating conditions.

(g) The tester shall be supplied with instructions covering its accuracy, application, calibration, installation, setup, and safe use.

(h) Click and break-over torque instruments should be used with anticipation of a decrease in force when the target torque is reached.

(i) Lubricated and nonlubricated fastener applications have major differences in the determination of torque requirements. Designers of assembled joints shall consider torque requirements consistent with fastener characteristics.

(j) Do not tare out the weight of the wrench when using in a gravity-dependent position.

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