

**ASME B107.100-2020**  
(Revision of ASME B107.100-2010)

# Flat Wrenches

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**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

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Two Park Avenue • New York, NY • 10016 USA

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# CONTENTS

|   |           |
|---|-----------|
| Foreword .....  | v         |
| Committee Roster .....  | vi        |
| Correspondence With the B107 Committee .....  | vii       |
| <b>1</b> Scope .....  | <b>1</b>  |
| <b>2</b> Definitions .....  | <b>1</b>  |
| <b>3</b> References .....   | <b>1</b>  |
| <b>4</b> Classification .....   | <b>2</b>  |
| <b>5</b> Performance Requirements .....   | <b>2</b>  |
| <b>6</b> Tests .....  | <b>37</b> |
| <b>7</b> Safety Requirements and Limitations of Use .....                             | <b>42</b> |
| <br><b>Nonmandatory Appendix</b>  |           |
| A Designations .....  | 43        |
| <br><b>Figures</b>  |           |
| 5.1.1-1 Category 6 Combination Wrench .....   | 3         |
| 5.1.2-1 Category 9, Type I Box Wrench .....   | 8         |
| 5.1.2-2 Category 9, Type I Box Wrench (Alternate Construction) .....                  | 8         |
| 5.1.2-3 Category 9, Type II Box Wrench .....  | 9         |
| 5.1.2-4 Category 9, Type III Box Wrench .....   | 10        |
| 5.1.3-1 Category 39, Type I Engineer's Wrench .....                                   | 15        |
| 5.1.3-2 Category 39, Type II, Class 1 Angle Wrench .....                              | 16        |
| 5.1.3-3 Category 39, Type II, Classes 2 and 3 Angle Wrench .....                      | 17        |
| 5.1.3-4 Category 39, Type III Tappet Wrench .....                                     | 17        |
| 5.1.4-1 Category 40, Type I Flare Nut Wrench .....                                    | 23        |
| 5.1.4-2 Category 40, Type II Flare Nut Combination Wrench .....                       | 23        |
| 5.2-1 Category 8 Adjustable Wrench .....  | 27        |
| 5.3.1-1 Category 21, Type I, Class 1 Crowfoot Wrench, Flare Nut, Standard Duty .....  | 28        |
| 5.3.1-2 Category 21, Type I, Class 2 Crowfoot Wrench, Flare Nut, Heavy Duty .....     | 28        |
| 5.3.2-1 Category 21, Type II Crowfoot Wrench, Open End .....                          | 32        |
| 5.4-1 Category 66 Laminated Ratcheting Box Wrench .....                               | 36        |
| 5.4-2 Category 66 Laminated Ratcheting Box Wrench (Offset) .....                      | 36        |
| 5.4-3 Category 66 Nonlaminated Ratcheting Box Wrench .....                            | 36        |
| 5.4-4 Category 66 Nonlaminated Ratcheting Box Wrench (With Reversing Mechanism) ..... | 36        |
| 5.9.1-1 Flash Restrictions .....  | 37        |
| 6.2.2-1 Category 8 Test Configuration .....   | 37        |
| 6.2.2-2 Category 8 Mandrel Configuration .....  | 38        |
| 6.4-1 Category 8 Jaw Clearance Measurement .....                                      | 41        |



|               |  |    |
|---------------|--|----|
| 6.5-1         | Parallelism Measurement . . . . .  | 41 |
| <b>Tables</b> |  |    |
| 4-1           | Flat Wrenches . . . . .  | 2  |
| 5.1.1-1       | Category 6 Combination Wrench (U.S. Customary) . . . . .   | 4  |
| 5.1.1-1M      | Category 6 Combination Wrench (Metric) . . . . .   | 5  |
| 5.1.1-2       | Category 6 Lengths (U.S. Customary) . . . . .  | 6  |
| 5.1.1-2M      | Category 6 Lengths (Metric) . . . . .  | 7  |
| 5.1.2-1       | Category 9 Box Wrench (U.S. Customary) . . . . .   | 11 |
| 5.1.2-1M      | Category 9 Box Wrench (Metric) . . . . .   | 12 |
| 5.1.2-2       | Category 9 Lengths (U.S. Customary) . . . . .  | 13 |
| 5.1.2-2M      | Category 9 Lengths (Metric) . . . . .  | 14 |
| 5.1.3-1       | Category 39 Open-End Wrench (U.S. Customary) . . . . .   | 18 |
| 5.1.3-1M      | Category 39 Open-End Wrench (Metric) . . . . .   | 19 |
| 5.1.3-2       | Category 39, Type I Lengths (U.S. Customary) . . . . .   | 20 |
| 5.1.3-2M      | Category 39, Type I Lengths (Metric) . . . . .   | 20 |
| 5.1.3-3       | Category 39, Type II, Class 1 Lengths (U.S. Customary) . . . . .   | 21 |
| 5.1.3-3M      | Category 39, Type II, Class 1 Lengths (Metric) . . . . .   | 21 |
| 5.1.3-4       | Category 39, Type II, Class 2 Lengths (U.S. Customary) . . . . .   | 22 |
| 5.1.3-4M      | Category 39, Type II, Class 2 Lengths (Metric) . . . . .   | 22 |
| 5.1.3-5       | Category 39, Type III Lengths (U.S. Customary) . . . . .   | 22 |
| 5.1.3-5M      | Category 39, Type III Lengths (Metric) . . . . .   | 22 |
| 5.1.4-1       | Category 40, Type I Flare Nut Wrench (U.S. Customary) . . . . .  | 24 |
| 5.1.4-1M      | Category 40, Type I Flare Nut Wrench (Metric) . . . . .  | 24 |
| 5.1.4-2       | Category 40, Type II Flare Nut Combination Wrench (U.S. Customary) . . . . .                               | 25 |
| 5.1.4-2M      | Category 40, Type II Flare Nut Combination Wrench (Metric) . . . . .                                       | 25 |
| 5.1.4-3       | Category 40, Type I Lengths (U.S. Customary) . . . . .   | 26 |
| 5.1.4-3M      | Category 40, Type I Lengths (Metric) . . . . .   | 26 |
| 5.1.4-4       | Category 40, Type II Lengths (U.S. Customary) . . . . .  | 26 |
| 5.1.4-4M      | Category 40, Type II Lengths (Metric) . . . . .  | 26 |
| 5.2-1         | Category 8 Adjustable Wrench (U.S. Customary) . . . . .  | 27 |
| 5.3.1-1       | Category 21, Type I, Class 1 Flare Nut, $\frac{1}{4}$ in. Square Drive, Standard Duty (U.S. Customary) . . | 29 |
| 5.3.1-2       | Category 21, Type I, Class 1 Flare Nut, $\frac{3}{8}$ in. Square Drive, Standard Duty (U.S. Customary) . . | 29 |
| 5.3.1-3       | Category 21, Type I, Class 1 Flare Nut, $\frac{1}{2}$ in. Square Drive, Standard Duty (U.S. Customary) . . | 30 |



# 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. This revision integrates the component standards, resulting in a more traditional document. To maintain continuity within the user community, the former component standard numbers are renamed as categories in the consolidated standard, and designations are provided in [Nonmandatory Appendix A](#).

The purpose of ASME B107.100 is to define essential performance and safety requirements specifically applicable to various categories of wrenches. It specifies test methods to evaluate performance related to the defined requirements and safety, and indicates limitations of safe use.

This Standard was titled “Wrenches” when it was first issued in 2002. It superseded the following ASME standards: B107.6, Combination Wrenches; B107.9, Box Wrenches, Double Head; B107.39, Open End Wrenches, Double Head; and B107.40, Wrenches, Flare Nut. The 2010 edition was retitled “Flat Wrenches” and incorporated and superseded ASME B107.8, Adjustable Wrenches; ASME B107.21, Wrench, Crowfoot; and ASME B107.66, Ratcheting Box Wrenches.

Principal changes in this edition are to specific proof loads to align the progression of loads, the normalization of the  $F$  dimension in Category 21 wrenches so that the dimension is the same for a given drive size and wrench opening, the addition of a failure mode test in response to the Additive Manufacturing initiative by ASME, and the reorganization of content into the structure used by previous editions of the component standards, in accordance with the consolidation project objectives. A significant change in this revision is the return of lengths, presented in two styles for Category 6 wrenches: Style 1 minimizes overlap and meets the requirements of SAE AS954H; Style 2 meets the requirements of SAE AS954H without reducing overlap from the 2002 version of ASME B107.100. As noted in the Scope, producers may make other lengths that meet the performance and safety requirements of this Standard.

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.

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

ASME B107.100-2020 was approved by the B107 Standards Committee on August 19, 2019, and by the Board on Standards and Testing on January 3, 2020. It was approved by the American National Standards Institute (ANSI) as an American National Standard on January 21, 2020.

# ASME B107 COMMITTEE

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<http://go.asme.org/Inquiry>

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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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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.                                 |



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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# FLAT WRENCHES

## 1 SCOPE

This Standard provides performance and safety requirements for combination, open end, box, and flare nut wrenches; open end adjustable wrenches, with rack and worm adjustment, generally used on both hexagonal and square fasteners; crowfoot wrenches having a wrench component of the open end type or flare nut type; and ratcheting box wrenches used in hexagonal (6-point), double-hexagonal (12-point), square (4-point), and double-square (8-point) wrenching applications. The tools covered herein are listed by Category number in [Table 4-1](#).

Inclusion of dimensional data in this Standard is not intended to imply that all of the products described herein are stock production sizes. Manufacturers may make sizes not listed in this Standard. Consumers are requested to consult with manufacturers concerning lists of stock production sizes.

## 2 DEFINITIONS

*adjusting worm*: portion of the wrench used to adjust the clearance between the fixed and movable jaws.

*angle wrench*: a wrench with one end having an angle over 55 deg.

*box wrench*: wrench with an enclosed opening that grips all faces of the fastener.

*combination wrench*: a wrench that is open on one end and box on the other.

*engineer's wrench*: in this Standard, a wrench that is open on one end, different size open on the other.

NOTE: Industry may refer to single-ended open end wrenches as engineer's wrenches.

*fixed jaw*: portion of the frame that contacts the fastener.

*flare nut wrench*: wrench that is used for gripping the nuts on the ends of tubes, with a slotted box end.

*frame*: portion of the wrench containing the fixed jaw and handle.

*handle*: portion of the wrench by which the tool is held.

*ignition wrench*: a thin angle wrench.

*movable jaw*: movable portion of an adjustable wrench that contacts the fastener.

*offset*: pitch, or rotation around a transverse horizontal axis.

*open end wrench*: wrench with a U-shaped opening that grips two opposite faces of a fastener. The other end may be another open end or a nonwrenching end (handle).

*proof torque*: predetermined test torque to which a sample is subjected.

*reversing lever*: device to control the reversing mechanism.

*reversing torque*: force to rotate the wrench in the ratcheting or nonloading direction.

*shifter*: device to control the reversing mechanism.

*slotted box*: box wrench end with an opening smaller than the width across flats. See also *flare nut wrench*.

*tappet wrench*: open end wrench where the head or opening is thinner than standard wrenches to allow clearance to adjust valve trains.

*worm pin*: pin used to retain the adjusting worm in the frame.

*worm spring*: spring used to induce friction between the frame and adjusting worm for holding the adjusting worm in any preset position.

## 3 REFERENCES

The following is a list of publications referenced in this Standard. The latest available edition shall be used.

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

ASME B107.17, Gages and Mandrels for Wrench Openings  
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B537, Standard Practice for Rating of Electroplated Panels Subjected to Atmospheric Exposure

ASTM B571, Standard Practice for Qualitative Adhesion Testing of Metallic Coatings

ASTM D968, Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM E18, Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E92, Standard Test Method for Vickers Hardness of Metallic Materials



**Table 4-1 Flat Wrenches**

| Category      | Common Name                  | Type | Class                             | Configuration   | Figures          |
|---------------|------------------------------|------|-----------------------------------|---|------------------|
| 6 [Note (1)]  | Combination wrench           | ...  | ...                               | Open end and 15 deg offset box opening                | 5.1.1-1          |
| 8             | Adjustable wrench            | I    | ...                               | Standard openings                                     | 5.2-1            |
|               |                              | II   | ...                               | Wide openings   |                  |
| 9 [Note (1)]  | Box wrench, double head      | I    | ...                               | 15 deg offset each end                                | 5.1.2-1, 5.1.2-2 |
|               |                              | II   | ...                               | Modified offset each end                              | 5.1.2-3          |
|               |                              | III  | ...                               | Deep offset each end                                  | 5.1.2-4          |
| 21            | Crowfoot wrench              | I    | 1: standard duty<br>2: heavy duty | Flare nut   | 5.3.1-1, 5.3.1-2 |
|               |                              | II   | 1: standard duty<br>2: heavy duty | Open end  | 5.3.2-1          |
| 39 [Note (1)] | Open end wrench, double head | II   | ...                               | Engineer's wrench, 15 deg angle                       | 5.1.3-1          |
|               |                              |      | 1                                 | Angle wrench, 30 deg and 60 deg                       | 5.1.3-2          |
|               |                              |      | 2                                 | Ignition wrench, 15 deg and 60 deg                    | 5.1.3-3          |
|               |                              |      | 3                                 | Angle wrench, 15 deg and 60 deg                       |                  |
|               |                              | III  | ...                               | Tappet wrench, 15 deg                                 | 5.1.3-4          |
| 40 [Note (1)] | Flare nut wrench             | I    | ...                               | Double head   | 5.1.4-1          |
|               |                              | II   | ...                               | Combination: open end and 15 deg offset flare nut end | 5.1.4-2          |
| 66            | Ratcheting box wrench        | I    | ...                               | Laminated construction                                | 5.4-1, 5.4-2     |
|               |                              | II   | ...                               | Nonlaminated construction                             | 5.4-3, 5.4-4     |

NOTE: (1) Categories 6, 9, 39, and 40 are available in styles describing lengths.

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

SAE J1703, Motor Vehicle Brake Fluid  
Publisher: SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001 (www.sae.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

Categories, Types, and Classes of flat wrenches are shown in Table 4-1 and the applicable figures indicated therein.

## 5 PERFORMANCE REQUIREMENTS

The illustrations shown herein are descriptive and not restrictive; they are not intended to preclude the manufacture of wrenches that are otherwise in accordance with this Standard.

Wrenches shall provide a well-proportioned comfortable handgrip and be similar to the figure to which reference is made. The engaging surfaces of the wrench

openings shall be finished in a smooth and well-defined manner.

Wrenches shall pass applicable tests in section 6. Conformance with marking and other requirements not determined by test shall be verified by visual examination.

When tested as specified, wrenches shall withstand the proof torque specified in applicable tables without failure or permanent deformation (set) that might affect the durability or serviceability of the wrenches.

U.S. Customary table values are in inches unless otherwise specified. Metric table values are in millimeters unless otherwise specified. Wrenches shall meet the dimensional requirements in applicable tables.

### 5.1 Design — Categories 6, 9, 39, and 40

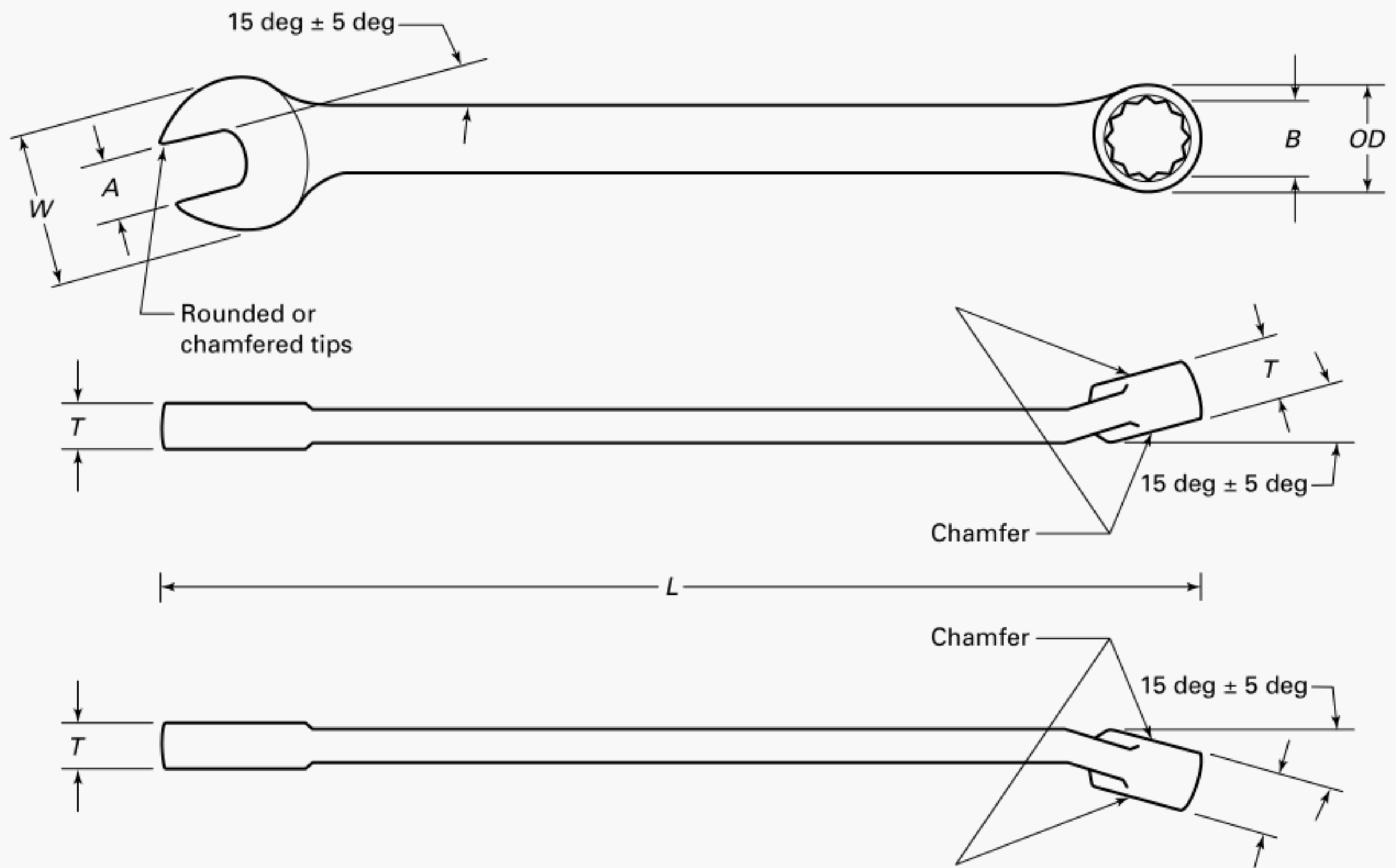
**5.1.1 Category 6 — Combination Wrench.** Wrenches shall have one open end and one 15-deg offset box opening (Figure 5.1.1-1) and meet the requirements of Table 5.1.1-1 (Table 5.1.1-1M).

NOTE: Typical lengths are shown in Table 5.1.1-2 (Table 5.1.1-2M).

**5.1.2 Category 9 — Box Wrench.** Wrenches shall have two box ends (Figures 5.1.2-1 through 5.1.2-4) and meet the requirements of Table 5.1.2-1 (Table 5.1.2-1M).

NOTE: Typical lengths are shown in Table 5.1.2-2 (Table 5.1.2-2M).



**Figure 5.1.1-1 Category 6 Combination Wrench**

**5.1.3 Category 39 — Open End Wrench.** Wrenches shall have two open ends (Figures 5.1.3-1 through 5.1.3-4) and meet the requirements of Table 5.1.3-1 (Table 5.1.3-1M).

NOTE: Typical lengths are shown in Tables 5.1.3-2 through 5.1.3-5 (Tables 5.1.3-2M through Table 5.1.3-5M).

**5.1.4 Category 40 — Flare Nut Wrench.** Wrenches shall have two 6- or 12-point flare nut wrench ends of different sizes (Type I, Figure 5.1.4-1) or one open end and one end with a 6- or 12-point flare nut opening of identical nominal size (Type II, Figure 5.1.4-2) for use with hexagonal flare nuts. They shall meet the requirements of Table 5.1.4-1 (Table 5.1.4-1M) or Table 5.1.4-2 (Table 5.1.4-2M), as applicable.

NOTE: Typical lengths are shown in Tables 5.1.4-3 and 5.1.4-4 (Tables 5.1.4-3M and 5.1.4-4M).

## 5.2 Design — Category 8: Adjustable Wrenches

Adjustable wrenches shall consist essentially of a frame (fixed jaw and handle), a movable jaw, and a jaw opening adjustment mechanism (see Figure 5.2-1). When the wrench is in the full open position, the jaw shall extend to provide full contact across the flat hexagonal bar of a size that fits the full jaw opening specified for Type I wrenches (see Table 5.2-1). The wrench shall

be designed to allow free movement of the working parts. The wrench may be provided with or without a movable jaw-locking device.

**5.2.1 Frame (Fixed Jaw and Handle).** Means shall be provided in the wrench end of the frame for accepting the assembly of the movable jaw and adjusting mechanism. The handgrip end of the handle may be provided with a hole.

**5.2.2 Movable Jaw.** The movable jaw shall be designed to permit free travel throughout the range of opening.

**5.2.3 Adjusting Mechanism.** The adjusting mechanism shall allow the movable jaw to be positioned at any point in its range and shall include means to hold the movable jaw in position.

## 5.3 Design — Category 21: Crowfoot Wrench

Wrenches shall be designed to allow accessibility to fasteners in confined and restricted areas. The internal drive surfaces, and the nut and bolt head engaging surfaces of the flare nut and open end openings, shall be finished in a smooth and well-defined manner. The corners and/or serrations in the openings shall be clearly defined (not smeared or torn).

**Table 5.1.1-1 Category 6 Combination Wrench (U.S. Customary)**

| Nominal Wrench<br>Opening Across<br>Flat, <i>A</i> or <i>B</i> | Maximum<br>Width of Open<br>Head, <i>W</i> | Maximum Outside<br>Diameter of Box<br>Head, <i>OD</i> | Maximum Permitted Eccentricity<br>of Box Head Opening to Outside<br>Diameter | Maximum<br>Thickness of<br>Heads, <i>T</i> |             | Minimum Proof<br>Torque, lbf-in. |             |
|--|--|---|--|--|-------------|----------------------------------|-------------|
|  |  |   |  | Open<br>Head                               | Box<br>Head | Open<br>Head                     | Box<br>Head |
| $\frac{1}{8}$  | 0.359                                      | 0.297   | 0.015  | 0.141                                      | 0.172       | 20                               | 60          |
| $\frac{5}{32}$   | 0.438                                      | 0.313   | 0.015  | 0.141                                      | 0.172       | 35                               | 90          |
| $\frac{3}{16}$   | 0.500                                      | 0.375   | 0.015  | 0.172                                      | 0.203       | 45                               | 150         |
| $\frac{7}{32}$   | 0.563                                      | 0.406   | 0.015  | 0.172                                      | 0.234       | 50                               | 165         |
| $\frac{1}{4}$  | 0.654                                      | 0.478   | 0.015  | 0.205                                      | 0.295       | 67                               | 220         |
| $\frac{9}{32}$   | 0.688                                      | 0.500   | 0.015  | 0.215                                      | 0.300       | 78                               | 248         |
| $\frac{5}{16}$   | 0.811                                      | 0.572   | 0.015  | 0.223                                      | 0.330       | 138                              | 300         |
| $\frac{11}{32}$  | 0.813                                      | 0.612   | 0.015  | 0.237                                      | 0.335       | 193                              | 370         |
| $\frac{3}{8}$  | 0.906                                      | 0.663   | 0.015  | 0.250                                      | 0.344       | 275                              | 605         |
| $\frac{7}{16}$   | 0.996                                      | 0.730   | 0.015  | 0.281                                      | 0.391       | 413                              | 715         |
| $\frac{1}{2}$  | 1.142                                      | 0.824   | 0.015  | 0.344                                      | 0.394       | 550                              | 1,020       |
| $\frac{9}{16}$   | 1.272                                      | 0.924   | 0.018  | 0.375                                      | 0.425       | 770                              | 1,500       |
| $\frac{5}{8}$  | 1.402                                      | 1.000   | 0.018  | 0.380                                      | 0.531       | 1,100                            | 2,200       |
| $\frac{11}{16}$  | 1.536                                      | 1.094   | 0.020  | 0.400                                      | 0.535       | 1,375                            | 2,640       |
| $\frac{3}{4}$  | 1.672                                      | 1.175   | 0.020  | 0.406                                      | 0.594       | 1,650                            | 2,860       |
| $\frac{13}{16}$  | 1.828                                      | 1.344   | 0.020  | 0.516                                      | 0.609       | 2,200                            | 3,300       |
| $\frac{7}{8}$  | 1.959                                      | 1.375   | 0.023  | 0.516                                      | 0.688       | 2,475                            | 3,630       |
| $\frac{15}{16}$  | 2.078                                      | 1.469   | 0.023  | 0.594                                      | 0.701       | 3,025                            | 4,510       |
| 1  | 2.250                                      | 1.531   | 0.023  | 0.625                                      | 0.719       | 3,575                            | 5,390       |
| $1\frac{1}{16}$  | 2.344                                      | 1.688   | 0.023  | 0.625                                      | 0.790       | 3,850                            | 5,940       |
| $1\frac{1}{8}$   | 2.500                                      | 1.724   | 0.023  | 0.656                                      | 0.860       | 4,400                            | 6,430       |
| $1\frac{3}{16}$  | 2.630                                      | 1.813   | 0.023  | 0.688                                      | 0.890       | 5,200                            | 7,200       |
| $1\frac{1}{4}$   | 2.766                                      | 1.906   | 0.023  | 0.719                                      | 0.940       | 5,775                            | 7,920       |
| $1\frac{5}{16}$  | 2.938                                      | 2.063   | 0.027  | 0.719                                      | 0.940       | 6,600                            | 8,400       |
| $1\frac{3}{8}$   | 3.063                                      | 2.113   | 0.027  | 0.750                                      | 0.940       | 7,425                            | 8,970       |
| $1\frac{7}{16}$  | 3.188                                      | 2.227   | 0.027  | 0.813                                      | 0.953       | 8,250                            | 9,240       |
| $1\frac{1}{2}$   | 3.375                                      | 2.395   | 0.027  | 0.813                                      | 1.008       | 8,500                            | 10,365      |
| $1\frac{9}{16}$  | 3.563                                      | 2.438   | 0.027  | 0.813                                      | 1.031       | 8,750                            | 11,495      |
| $1\frac{5}{8}$   | 3.625                                      | 2.641   | 0.031  | 0.813                                      | 1.063       | 9,000                            | 12,800      |
| $1\frac{11}{16}$   | 3.750                                      | 2.790   | 0.031  | 0.813                                      | 1.063       | 10,500                           | 13,570      |
| $1\frac{3}{4}$   | 4.000                                      | 2.938   | 0.031  | 0.875                                      | 1.125       | 11,100                           | 14,300      |
| $1\frac{13}{16}$   | 4.188                                      | 2.938   | 0.037  | 0.875                                      | 1.125       | 11,750                           | 15,100      |
| $1\frac{7}{8}$   | 4.344                                      | 3.125   | 0.037  | 0.938                                      | 1.125       | 12,400                           | 15,390      |
| 2  | 4.469                                      | 3.125   | 0.037  | 0.938                                      | 1.125       | 13,650                           | 17,400      |
| $2\frac{1}{16}$  | 4.594                                      | 3.313   | 0.037  | 0.938                                      | 1.234       | 14,300                           | 18,200      |
| $2\frac{1}{8}$   | 5.000                                      | 3.313   | 0.046  | 0.938                                      | 1.234       | 14,900                           | 19,000      |
| $2\frac{3}{16}$  | 5.000                                      | 3.313   | 0.046  | 0.938                                      | 1.234       | 15,500                           | 19,700      |
| $2\frac{1}{4}$   | 5.000                                      | 3.313   | 0.050  | 0.938                                      | 1.234       | 16,200                           | 20,500      |
| $2\frac{3}{8}$   | 5.250                                      | 3.750   | 0.050  | 1.000                                      | 1.375       | 17,500                           | 22,000      |
| $2\frac{1}{2}$   | 5.250                                      | 3.750   | 0.050  | 1.031                                      | 1.375       | 19,000                           | 25,000      |

**Table 5.1.1-1M Category 6 Combination Wrench (Metric)**

| Nominal Wrench<br>Opening Across Flat,<br><i>A</i> or <i>B</i> | Maximum<br>Width of Open<br>Head, <i>W</i> | Maximum Outside<br>Diameter of Box<br>Head, <i>OD</i> | Maximum Permitted Eccentricity of<br>Box Head Opening to Outside<br>Diameter | Maximum<br>Thickness of<br>Heads, <i>T</i> |             | Minimum Proof<br>Torque, N·m |             |
|--|--|---|--|--|-------------|------------------------------|-------------|
|  |  |   |  | Open<br>Head                               | Box<br>Head | Open<br>Head                 | Box<br>Head |
| 4  | 10.8                                       | 7.6   | 0.38   | 3.7  | 4.0         | 4                            | 12          |
| 5  | 12.5                                       | 9.0   | 0.38   | 3.9  | 4.6         | 5                            | 17          |
| 5.5  | 15.5                                       | 11.8  | 0.38   | 5.3  | 6.0         | 5                            | 18          |
| 6  | 17.3                                       | 12.7  | 0.38   | 5.8  | 7.4         | 7                            | 20          |
| 7  | 18.3                                       | 14.3  | 0.38   | 6.3  | 7.7         | 8                            | 27          |
| 8  | 21.4                                       | 15.0  | 0.38   | 6.3  | 8.2         | 15                           | 35          |
| 9  | 21.8                                       | 17.4  | 0.38   | 6.6  | 9.0         | 21                           | 45          |
| 10   | 26.0                                       | 18.8  | 0.38   | 6.9  | 9.0         | 31                           | 71          |
| 11   | 26.0                                       | 19.9  | 0.38   | 7.0  | 10.0        | 46                           | 80          |
| 12   | 27.7                                       | 21.4  | 0.46   | 8.0  | 10.0        | 49                           | 91          |
| 13   | 30.2                                       | 23.1  | 0.46   | 8.9  | 10.5        | 62                           | 115         |
| 14   | 32.8                                       | 24.4  | 0.46   | 8.9  | 11.5        | 86                           | 158         |
| 15   | 34.8                                       | 26.0  | 0.46   | 8.9  | 11.5        | 104                          | 200         |
| 16   | 36.4                                       | 27.0  | 0.46   | 9.4  | 12.1        | 124                          | 248         |
| 17   | 30.7                                       | 29.3  | 0.46   | 9.8  | 12.7        | 139                          | 267         |
| 18   | 41.3                                       | 29.3  | 0.46   | 10.0                                       | 12.7        | 155                          | 304         |
| 19   | 42.7                                       | 31.2  | 0.46   | 10.1                                       | 14.8        | 186                          | 323         |
| 20   | 46.4                                       | 32.9  | 0.51   | 11.4                                       | 14.8        | 217                          | 347         |
| 21   | 47.6                                       | 33.8  | 0.51   | 11.7                                       | 16.3        | 248                          | 372         |
| 22   | 48.3                                       | 35.6  | 0.51   | 12.0                                       | 16.3        | 279                          | 408         |
| 23   | 52.4                                       | 37.3  | 0.51   | 12.4                                       | 16.5        | 310                          | 455         |
| 24   | 53.5                                       | 38.1  | 0.51   | 12.5                                       | 17.8        | 341                          | 509         |
| 25   | 55.7                                       | 40.2  | 0.51   | 12.7                                       | 17.9        | 372                          | 559         |
| 26   | 57.2                                       | 42.2  | 0.58   | 14.0                                       | 18.0        | 403                          | 608         |
| 27   | 60.2                                       | 44.2  | 0.58   | 14.7                                       | 19.8        | 432                          | 671         |
| 28   | 62.3                                       | 45.3  | 0.58   | 14.9                                       | 19.8        | 497                          | 710         |
| 29   | 65.5                                       | 45.3  | 0.58   | 14.9                                       | 19.8        | 514                          | 750         |
| 30   | 67.0                                       | 47.5  | 0.58   | 15.2                                       | 20.0        | 570                          | 795         |
| 31   | 68.6                                       | 48.6  | 0.58   | 15.2                                       | 20.5        | 610                          | 850         |
| 32   | 71.0                                       | 49.8  | 0.58   | 15.7                                       | 22.0        | 650                          | 905         |
| 33   | 73.0                                       | 50.3  | 0.58   | 15.7                                       | 22.3        | 700                          | 950         |
| 34   | 75.0                                       | 52.0  | 0.58   | 16.0                                       | 23.2        | 745                          | 994         |
| 36   | 76.8                                       | 56.1  | 0.58   | 19.0                                       | 25.1        | 894                          | 1 165       |
| 41   | 88.9                                       | 62.9  | 0.70   | 19.3                                       | 25.3        | 1 154                        | 1 579       |
| 46   | 95.3                                       | 68.0  | 0.70   | 22.4                                       | 25.8        | 1 453                        | 2 067       |
| 50   | 103.2                                      | 76.0  | 0.70   | 25.0                                       | 27.6        | 1 716                        | 2 512       |



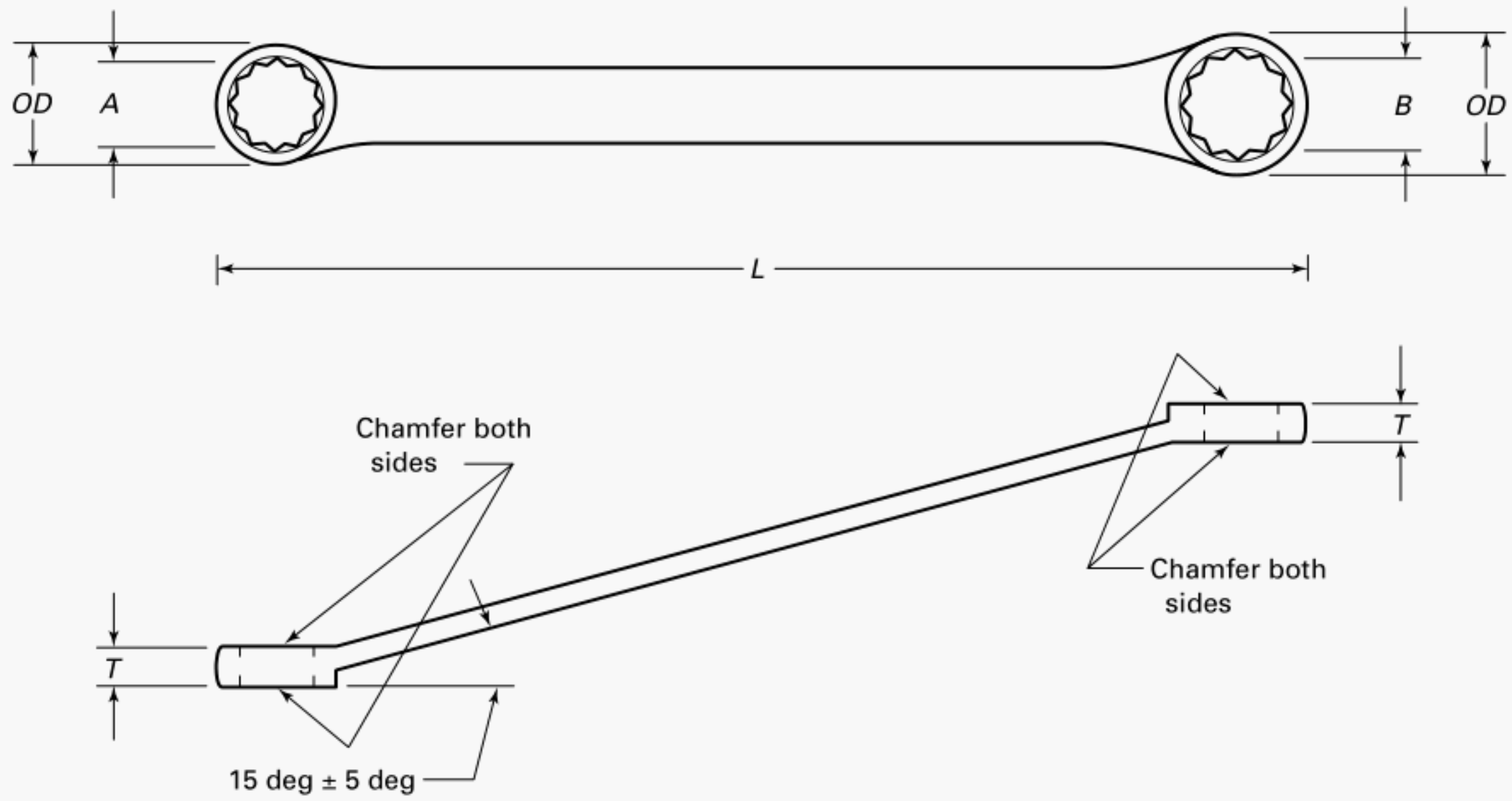
**Table 5.1.1-2 Category 6 Lengths (U.S. Customary)**

| Nominal Wrench Opening<br>Across Flat, <i>A</i> or <i>B</i> | Style 1     |         |        |            | Style 2     |         |        |            |
|---|-------------|---------|--------|------------|-------------|---------|--------|------------|
|   | Short, Max. | Regular |        | Long, Max. | Short, Max. | Regular |        | Long, Min. |
|   |             | Min.    | Max.   |            |             | Min.    | Max.   |            |
| $\frac{1}{8}$   | 3.000       | 3.016   | 4.625  | 4.641      | 3.125       | 2.500   | 4.625  | 4.641      |
| $\frac{5}{32}$  | 3.000       | 3.016   | 4.750  | 4.766      | 3.250       | 2.750   | 4.750  | 4.766      |
| $\frac{3}{16}$  | 3.000       | 3.016   | 4.875  | 4.891      | 3.375       | 2.875   | 4.875  | 4.891      |
| $\frac{7}{32}$  | 3.000       | 3.516   | 5.000  | 5.016      | 3.500       | 3.000   | 5.000  | 5.016      |
| $\frac{1}{4}$   | 3.000       | 3.516   | 5.313  | 5.391      | 3.625       | 3.000   | 5.313  | 4.250      |
| $\frac{9}{32}$  | 3.500       | 3.516   | 5.719  | 5.766      | 3.750       | 3.250   | 5.719  | 4.500      |
| $\frac{5}{16}$  | 3.760       | 3.766   | 6.344  | 6.359      | 4.250       | 3.250   | 6.344  | 5.000      |
| $\frac{11}{32}$   | 4.000       | 4.016   | 6.703  | 6.719      | 4.500       | 3.250   | 6.703  | 5.500      |
| $\frac{3}{8}$   | 4.000       | 4.016   | 6.891  | 6.906      | 4.750       | 3.500   | 6.891  | 5.938      |
| $\frac{7}{16}$  | 4.469       | 4.500   | 7.500  | 7.516      | 5.750       | 4.500   | 7.500  | 6.375      |
| $\frac{1}{2}$   | 5.000       | 5.016   | 8.281  | 8.296      | 6.000       | 5.016   | 8.281  | 6.938      |
| $\frac{9}{16}$  | 5.000       | 5.016   | 9.000  | 9.016      | 6.375       | 5.016   | 9.000  | 7.500      |
| $\frac{5}{8}$   | 5.969       | 6.000   | 10.000 | 10.016     | 6.625       | 6.000   | 10.000 | 8.125      |
| $\frac{11}{16}$   | 6.469       | 6.500   | 11.000 | 11.016     | 7.126       | 6.500   | 11.000 | 8.938      |
| $\frac{3}{4}$   | 6.719       | 6.750   | 12.000 | 12.016     | 7.250       | 6.750   | 12.000 | 9.750      |
| $\frac{13}{16}$   | 8.750       | 8.766   | 13.000 | 13.016     | 8.750       | 7.125   | 13.000 | 10.250     |
| $\frac{7}{8}$   | 9.000       | 9.625   | 14.000 | 14.016     | 9.000       | 9.625   | 14.000 | 11.500     |
| $\frac{15}{16}$   | 9.063       | 10.500  | 15.000 | 15.016     | 9.063       | 10.500  | 15.000 | 12.500     |
| 1   | 9.250       | 11.375  | 15.500 | 15.516     | 9.250       | 11.375  | 15.500 | 13.500     |
| $1\frac{1}{16}$   | 9.500       | 13.000  | 16.250 | 16.266     | 9.500       | 13.000  | 16.250 | 14.500     |
| $1\frac{1}{8}$  | 9.750       | 14.000  | 17.750 | 17.766     | 9.750       | 14.000  | 17.750 | 15.500     |
| $1\frac{3}{16}$   | 10.000      | 15.000  | 18.250 | 18.266     | 10.000      | 15.000  | 18.250 | 16.310     |
| $1\frac{1}{4}$  | 10.250      | 15.750  | 19.500 | 19.516     | 10.250      | 15.750  | 19.500 | 16.750     |
| $1\frac{5}{16}$   | 10.500      | 16.500  | 21.000 | 21.016     | 10.500      | 16.500  | 21.000 | 18.500     |
| $1\frac{3}{8}$  | 10.750      | 17.250  | 21.500 | 21.516     | 10.750      | 17.250  | 21.500 | 19.375     |
| $1\frac{7}{16}$   | ...         | 18.000  | 22.500 | 22.516     | ...         | 18.000  | 22.500 | 20.375     |
| $1\frac{1}{2}$  | ...         | 18.750  | 23.000 | 23.016     | ...         | 18.750  | 23.000 | 21.375     |
| $1\frac{9}{16}$   | ...         | 19.500  | 23.500 | 23.516     | ...         | 19.500  | 23.500 | 22.250     |
| $1\frac{5}{8}$  | ...         | 20.250  | 24.500 | 24.516     | ...         | 20.250  | 24.500 | 22.375     |
| $1\frac{11}{16}$  | ...         | 20.750  | 25.000 | 25.016     | ...         | 20.750  | 25.000 | 23.375     |
| $1\frac{3}{4}$  | ...         | 21.750  | 26.500 | 26.516     | ...         | 21.750  | 26.500 | 24.250     |
| $1\frac{13}{16}$  | ...         | 22.500  | 27.500 | 27.516     | ...         | 22.500  | 27.500 | 25.250     |
| $1\frac{7}{8}$  | ...         | 23.250  | 29.000 | 29.016     | ...         | 23.250  | 29.000 | 26.250     |
| 2   | ...         | 23.875  | 29.000 | 29.016     | ...         | 23.875  | 29.000 | 27.250     |
| $2\frac{1}{16}$   | ...         | 23.938  | 30.250 | 30.266     | ...         | 23.938  | 30.250 | 30.266     |
| $2\frac{1}{8}$  | ...         | 24.875  | 30.750 | 30.766     | ...         | 24.875  | 30.750 | 30.766     |
| $2\frac{3}{16}$   | ...         | 24.875  | 31.250 | 32.266     | ...         | 24.875  | 31.250 | 31.266     |
| $2\frac{1}{4}$  | ...         | 24.875  | 31.750 | 31.766     | ...         | 24.875  | 31.750 | 31.766     |

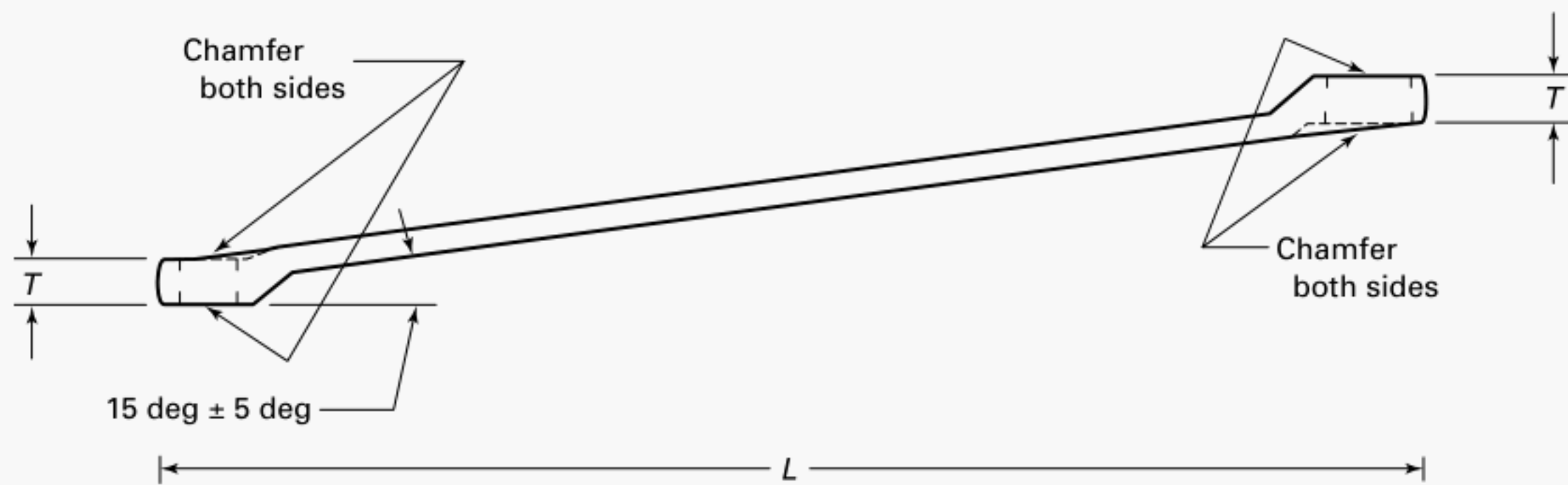
**Table 5.1.1-2M Category 6 Lengths (Metric)**

| Nominal Wrench Opening Across<br>Flat, <i>A</i> or <i>B</i> | Style 1     |         |      |            | Style 2     |         |       |            |
|---|-------------|---------|------|------------|-------------|---------|-------|------------|
|   | Short, Max. | Regular |      | Long, Max. | Short, Max. | Regular |       | Long, Min. |
|   |             | Min.    | Max. |            |             | Min.    | Max.  |            |
| 4   | 75          | ...     | ...  | 4.641      | 3.125       | 2.500   | 4.625 | 4.641      |
| 5   | 79          | ...     | ...  | 4.766      | 3.250       | 2.750   | 4.750 | 4.766      |
| 5.5   | 82          | 83      | 130  | 4.891      | 3.375       | 2.875   | 4.875 | 4.891      |
| 6   | 85          | 86      | 135  | 5.016      | 3.500       | 3.000   | 5.000 | 5.016      |
| 7   | 88          | 89      | 145  | 5.391      | 3.625       | 3.000   | 5.313 | 4.250      |
| 8   | 93          | 94      | 161  | 5.766      | 3.750       | 3.250   | 5.719 | 4.500      |
| 9   | 100         | 101     | 170  | 6.359      | 4.250       | 3.250   | 6.344 | 5.000      |
| 10  | 109         | 110     | 177  | 6.719      | 4.500       | 3.250   | 6.703 | 5.500      |
| 11  | 119         | 120     | 193  | 6.906      | 4.750       | 3.500   | 6.891 | 5.938      |
| 12  | 124         | 125     | 205  | 7.516      | 5.750       | 4.500   | 7.500 | 6.375      |
| 13  | 127         | 128     | 215  | 216        | 140         | 133     | 215   | 200        |
| 14  | 140         | 141     | 229  | 230        | 150         | 146     | 229   | 214        |
| 15  | 146         | 147     | 245  | 246        | 155         | 153     | 245   | 226        |
| 16  | 152         | 153     | 255  | 256        | 160         | 155     | 260   | 231        |
| 17  | 164         | 165     | 275  | 276        | 165         | 163     | 275   | 241        |
| 18  | 167         | 168     | 290  | 291        | 170         | 170     | 290   | 250        |
| 19  | 170         | 171     | 305  | 306        | 185         | 175     | 305   | 265        |
| 20  | 215         | 216     | 325  | 326        | 215         | 190     | 325   | 275        |
| 21  | 222         | 223     | 345  | 346        | 222         | 195     | 345   | 290        |
| 22  | 229         | 230     | 365  | 366        | 229         | 200     | 365   | 305        |
| 23  | 230         | 231     | 384  | 385        | 230         | 205     | 384   | 315        |
| 24  | 230         | 231     | 396  | 397        | 230         | 210     | 396   | 330        |
| 25  | 235         | 259     | 409  | 410        | 235         | 259     | 409   | 345        |
| 26  | 238         | 280     | 415  | 416        | 238         | 280     | 415   | 367        |
| 27  | 241         | 300     | 430  | 431        | 241         | 300     | 430   | 374        |
| 28  | 244         | 320     | 445  | 446        | 244         | 320     | 445   | 387        |
| 29  | 248         | 340     | 460  | 461        | 248         | 340     | 460   | 390        |
| 30  | 254         | 365     | 475  | 476        | 254         | 365     | 475   | 395        |
| 31  | 257         | 395     | 490  | 491        | 257         | 395     | 490   | 420        |
| 32  | 260         | 405     | 505  | 506        | 260         | 405     | 505   | 425        |
| 33  | 264         | 415     | 535  | 536        | 264         | 425     | 535   | 454        |
| 34  | 267         | 425     | 565  | 566        | 267         | 445     | 565   | 566        |
| 36  | ...         | 455     | 615  | 616        | ...         | 480     | 615   | 616        |
| 41  | ...         | 520     | 665  | 666        | ...         | 535     | 665   | 666        |
| 46  | ...         | 585     | 715  | 716        | ...         | 585     | 715   | 716        |
| 50  | ...         | 635     | 765  | 766        | ...         | 635     | 765   | 766        |

**Figure 5.1.2-1 Category 9, Type I Box Wrench**



**Figure 5.1.2-2 Category 9, Type I Box Wrench (Alternate Construction)**





**Figure 5.1.2-3 Category 9, Type II Box Wrench**

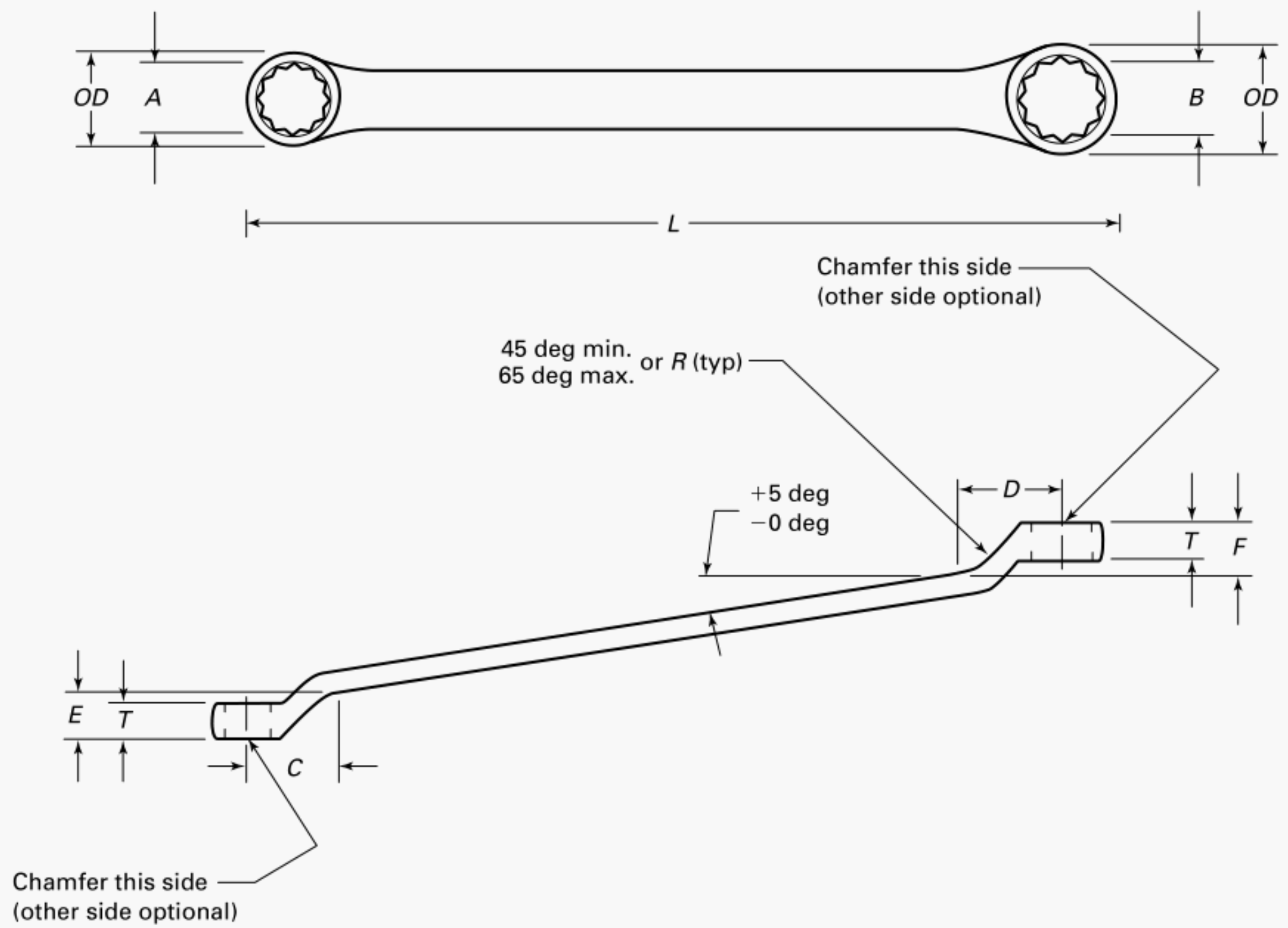


Figure 5.1.2-4 Category 9, Type III Box Wrench

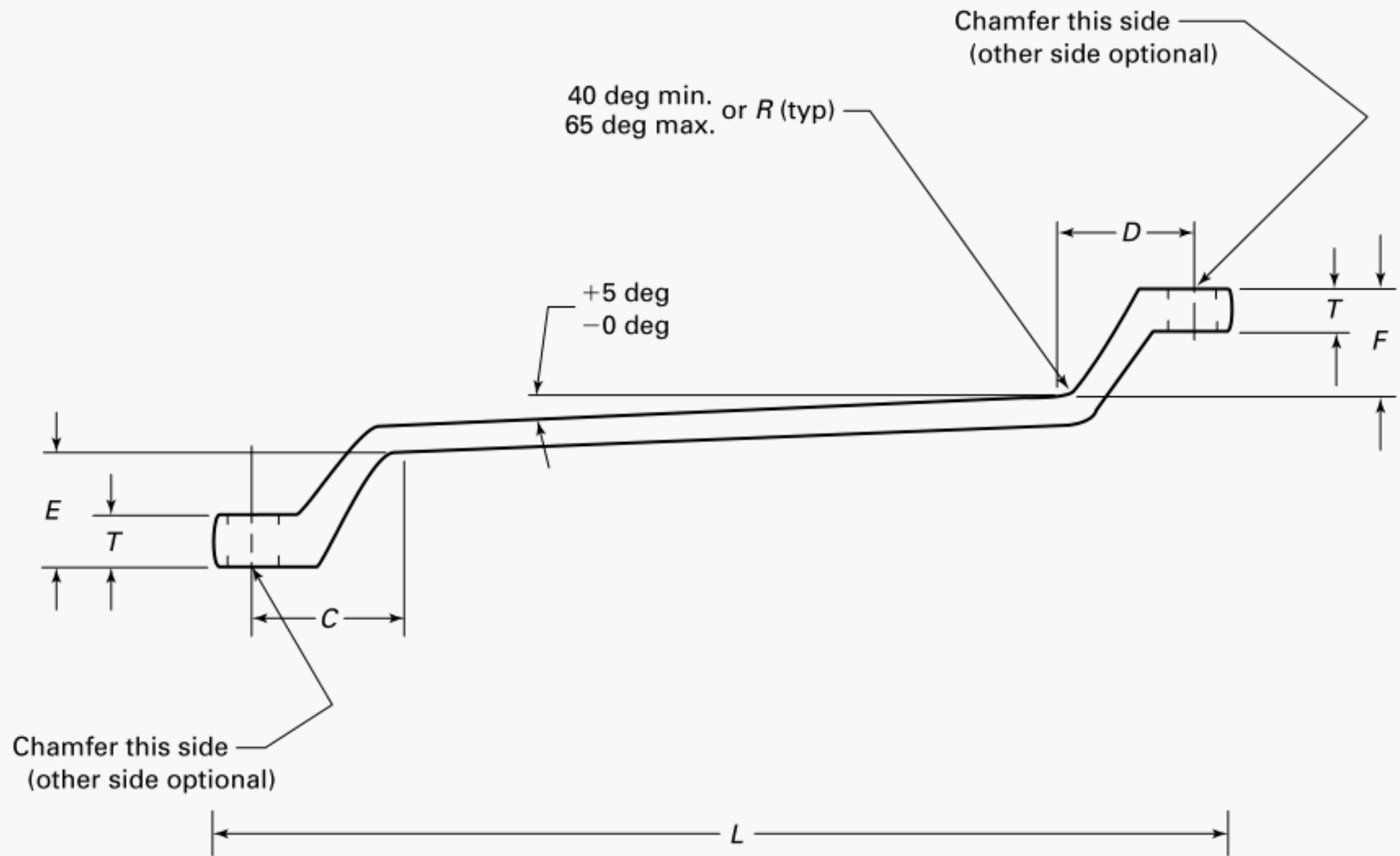


Table 5.1.2-1 Category 9 Box Wrench (U.S. Customary)

| Nominal Wrench<br>Opening Across<br>Flat, <i>A</i> or <i>B</i> | Maximum<br>Outside Diameter<br>of Box Head, <i>OD</i> | Maximum Permitted<br>Eccentricity of Box Head<br>Opening to Outside Diameter | Maximum<br>Thickness of<br>Box Head, <i>T</i> | Maximum<br>Centerline of<br>Opening to Point<br>Where Offset<br>Blends With<br>Handles, <i>C</i> and <i>D</i> |             | Minimum<br>Height From<br>Opening to Point<br>Where Offset<br>Blends With<br>Handles, <i>E</i> and <i>F</i> |             | Minimum<br>Proof<br>Torque,<br>lbf-in. |
|--|---|--|---|---|-------------|---|-------------|--|
|  |   |  |   | Type<br>II  | Type<br>III | Type<br>II  | Type<br>III |  |
| $\frac{3}{16}$   | 0.375   | 0.015  | 0.203   | 0.906   | 0.906       | 0.156   | 0.188       | 150                                    |
| $\frac{13}{64}$  | 0.391   | 0.015  | 0.203   | 0.906   | 0.906       | 0.188   | 0.250       | 160                                    |
| $\frac{7}{32}$   | 0.406   | 0.015  | 0.234   | 0.969   | 0.969       | 0.188   | 0.281       | 165                                    |
| $\frac{15}{64}$  | 0.406   | 0.015  | 0.234   | 1.125   | 1.031       | 0.219   | 0.281       | 184                                    |
| $\frac{1}{4}$  | 0.473   | 0.015  | 0.295   | 1.125   | 1.250       | 0.219   | 0.219       | 220                                    |
| $\frac{9}{32}$   | 0.500   | 0.015  | 0.300   | 1.125   | 1.250       | 0.219   | 0.281       | 248                                    |
| $\frac{5}{16}$   | 0.572   | 0.015  | 0.330   | 1.125   | 1.375       | 0.275   | 0.297       | 300                                    |
| $\frac{11}{32}$  | 0.612   | 0.015  | 0.335   | 1.188   | 1.375       | 0.281   | 0.344       | 370                                    |
| $\frac{3}{8}$  | 0.663   | 0.015  | 0.344   | 1.188   | 1.375       | 0.287   | 0.500       | 605                                    |
| $\frac{7}{16}$   | 0.730   | 0.015  | 0.391   | 1.375   | 1.375       | 0.295   | 0.500       | 715                                    |
| $\frac{1}{2}$  | 0.824   | 0.015  | 0.394   | 1.603   | 1.438       | 0.297   | 0.500       | 1,020                                  |
| $\frac{9}{16}$   | 0.924   | 0.018  | 0.425   | 1.792   | 1.438       | 0.375   | 0.500       | 1,500                                  |
| $\frac{19}{32}$  | 0.969   | 0.018  | 0.438   | ...   | ...         | ...   | ...         | 1,850                                  |
| $\frac{5}{8}$  | 1.000   | 0.018  | 0.531   | 2.051   | 1.563       | 0.452   | 0.625       | 2,200                                  |
| $\frac{11}{16}$  | 1.109   | 0.020  | 0.535   | 2.217   | 1.563       | 0.461   | 0.719       | 2,640                                  |
| $\frac{3}{4}$  | 1.175   | 0.020  | 0.594   | 2.276   | ...         | 0.500   | ...         | 2,860                                  |
| $\frac{25}{32}$  | 1.250   | 0.020  | 0.602   | ...   | ...         | ...   | ...         | 3,080                                  |
| $\frac{13}{16}$  | 1.344   | 0.020  | 0.609   | 2.477   | 1.688       | 0.625   | 0.750       | 3,300                                  |
| $\frac{7}{8}$  | 1.375   | 0.020  | 0.688   | 2.518   | 1.750       | 0.625   | 0.750       | 3,630                                  |
| $\frac{15}{16}$  | 1.469   | 0.023  | 0.701   | 2.790   | 2.063       | 0.688   | 0.750       | 4,510                                  |
| 1  | 1.531   | 0.023  | 0.719   | 2.826   | ...         | 0.750   | ...         | 5,390                                  |
| $1\frac{1}{16}$  | 1.688   | 0.023  | 0.790   | 3.500   | 2.188       | 0.766   | ...         | 5,940                                  |
| $1\frac{1}{8}$   | 1.724   | 0.023  | 0.860   | 3.875   | ...         | 0.797   | ...         | 6,430                                  |
| $1\frac{3}{16}$  | 1.813   | 0.023  | 0.890   | 3.875   | ...         | 0.797   | ...         | 7,200                                  |
| $1\frac{1}{4}$   | 1.906   | 0.023  | 0.940   | 4.125   | ...         | 0.875   | ...         | 7,920                                  |
| $1\frac{5}{16}$  | 2.063   | 0.027  | 0.940   | ...   | 2.563       | ...   | 1.000       | 8,400                                  |
| $1\frac{3}{8}$   | 2.113   | 0.027  | 0.940   | 4.250   | ...         | 1.125   | ...         | 8,970                                  |
| $1\frac{7}{16}$  | 2.227   | 0.027  | 0.953   | ...   | 2.813       | ...   | 1.000       | 9,240                                  |
| $1\frac{1}{2}$   | 2.395   | 0.027  | 1.008   | 4.375   | ...         | 1.225   | ...         | 10,365                                 |
| $1\frac{5}{8}$   | 2.641   | 0.031  | 1.063   | ...   | 2.813       | ...   | 1.313       | 12,800                                 |
| $1\frac{11}{16}$   | 2.790   | 0.031  | 1.063   | ...   | 2.813       | ...   | 1.313       | 13,570                                 |



**Table 5.1.2-1M Category 9 Box Wrench (Metric)**

| Nominal Wrench<br>Opening Across<br>Flat, <i>A</i> or <i>B</i> | Maximum Outside<br>Diameter of Box<br>Head, <i>OD</i> | Maximum Permitted<br>Eccentricity of Box Head<br>Opening to Outside Diameter | Maximum<br>Thickness of<br>Box Head, <i>T</i> | Maximum<br>Centerline of<br>Opening to<br>Point Where<br>Offset Blends<br>With Handles,<br><i>C</i> and <i>D</i> |             | Minimum<br>Height From<br>Opening to<br>Point Where<br>Offset Blends<br>With Handles,<br><i>E</i> and <i>F</i> |             | Minimum<br>Proof<br>Torque,<br>N·m |
|--|---|--|---|--|-------------|--|-------------|------------------------------------|
|  |   |  |   | Type<br>II   | Type<br>III | Type<br>II   | Type<br>III |                                    |
| 6  | 12.7  | 0.38   | 7.4   | 16.3   | 20.3        | 4.5  | 5.0         | 20                                 |
| 7  | 14.3  | 0.38   | 7.7   | 20.0   | ...         | 5.0  | ...         | 27                                 |
| 8  | 15.0  | 0.38   | 8.2   | 25.0   | 21.6        | 6.0  | 5.1         | 35                                 |
| 9  | 17.4  | 0.38   | 9.0   | 30.0   | 22.9        | 7.1  | 7.0         | 45                                 |
| 10   | 18.8  | 0.38   | 9.0   | 31.8   | 24.1        | 7.3  | 7.6         | 71                                 |
| 11   | 0.500   | 0.38   | 10.0  | 35.3   | 29.6        | 7.3  | 8.5         | 80                                 |
| 12   | 0.572   | 0.46   | 10.0  | 35.6   | 30.0        | 7.5  | 9.5         | 91                                 |
| 13   | 0.612   | 0.46   | 10.5  | 41.3   | 30.6        | 7.5  | 10.0        | 115                                |
| 14   | 0.663   | 0.46   | 11.5  | 41.6   | 30.6        | 9.5  | 10.2        | 158                                |
| 15   | 0.730   | 0.46   | 11.5  | ...  | 33.5        | ...  | 10.8        | 200                                |
| 16   | 0.824   | 0.46   | 12.1  | 52.1   | 34.0        | 12.7   | 11.4        | 248                                |
| 17   | 0.924   | 0.46   | 12.7  | 54.0   | 35.8        | 12.7   | 11.4        | 267                                |
| 18   | 0.969   | 0.46   | 12.7  | ...  | 37.0        | ...  | 12.7        | 304                                |
| 19   | 1.000   | 0.46   | 14.8  | 57.8   | 41.7        | 12.7   | 13.3        | 323                                |
| 20   | 1.109   | 0.51   | 14.8  | 63.2   | 42.5        | 16.2   | 14.0        | 347                                |
| 21   | 33.8  | 0.51   | 16.3  | 63.5   | ...         | 16.2   | ...         | 372                                |
| 22   | 35.6  | 0.51   | 16.3  | ...  | 45.7        | ...  | 20.3        | 408                                |
| 23   | 37.3  | 0.51   | 16.5  | 68.6   | ...         | 16.6   | ...         | 455                                |
| 24   | 38.1  | 0.51   | 17.8  | 71.6   | 50.0        | 17.1   | 20.6        | 509                                |
| 25   | 40.2  | 0.51   | 17.9  | 71.8   | 52.8        | 18.1   | 25.0        | 559                                |
| 26   | 42.2  | 0.58   | 18.0  | 75.7   | 56.0        | 18.1   | 26.8        | 608                                |
| 27   | 44.2  | 0.58   | 19.8  | 88.9   | ...         | 19.4   | ...         | 671                                |
| 28   | 45.3  | 0.58   | 19.8  | ...  | ...         | ...  | ...         | 710                                |
| 29   | 45.3  | 0.58   | 19.8  | 93.7   | 61.9        | 20.2   | 32.1        | 750                                |
| 30   | 47.5  | 0.58   | 20.0  | 94.5   | ...         | 21.8   | ...         | 795                                |
| 32   | 49.8  | 0.58   | 22.0  | 96.8   | 63.9        | 21.8   | 37.5        | 905                                |

**Table 5.1.2-2 Category 9 Lengths (U.S. Customary)**

| Nominal Wrench Opening Across Flat |                  | Type I      |               | Type II     |               | Type III    |               |
|------------------------------------|------------------|-------------|---------------|-------------|---------------|-------------|---------------|
| <i>A</i>                           | <i>B</i>         | Short, Max. | Regular, Min. | Short, Max. | Regular, Min. | Short, Max. | Regular, Min. |
| $\frac{3}{16}$                     | $\frac{13}{64}$  | ...         | ...           | 3.000       | ...           | 3.000       | ...           |
| $\frac{3}{16}$                     | $\frac{7}{32}$   | ...         | ...           | ...         | ...           | 4.000       | ...           |
| $\frac{7}{32}$                     | $\frac{15}{64}$  | ...         | ...           | 3.250       | ...           | 3.250       | ...           |
| $\frac{7}{32}$                     | $\frac{1}{4}$    | ...         | 4.500         | ...         | ...           | ...         | ...           |
| $\frac{1}{4}$                      | $\frac{9}{32}$   | ...         | ...           | 4.500       | ...           | 4.375       | ...           |
| $\frac{1}{4}$                      | $\frac{5}{16}$   | 5.000       | 5.000         | 4.750       | ...           | 5.000       | 6.375         |
| $\frac{5}{16}$                     | $\frac{11}{32}$  | ...         | ...           | 4.750       | ...           | 5.000       | ...           |
| $\frac{5}{16}$                     | $\frac{3}{8}$    | 5.000       | 6.000         | 5.000       | ...           | 5.000       | ...           |
| $\frac{3}{8}$                      | $\frac{7}{16}$   | 5.125       | 6.500         | 5.250       | 7.375         | 5.500       | 6.813         |
| $\frac{7}{16}$                     | $\frac{1}{2}$    | 5.500       | 7.500         | 5.750       | 7.750         | 5.750       | 7.750         |
| $\frac{7}{16}$                     | $\frac{9}{16}$   | ...         | ...           | ...         | ...           | ...         | 7.750         |
| $\frac{1}{2}$                      | $\frac{9}{16}$   | 5.625       | 7.500         | 6.000       | 8.500         | 6.250       | 7.969         |
| $\frac{9}{16}$                     | $\frac{5}{8}$    | 6.000       | 8.250         | 6.250       | 8.750         | 6.500       | 8.500         |
| $\frac{19}{32}$                    | $\frac{25}{32}$  | ...         | 9.375         | ...         | ...           | ...         | ...           |
| $\frac{5}{8}$                      | $\frac{11}{16}$  | 6.250       | 9.375         | 6.500       | 9.625         | 6.781       | 9.250         |
| $\frac{5}{8}$                      | $\frac{3}{4}$    | 6.750       | 9.375         | 6.750       | 9.750         | 7.000       | 9.750         |
| $\frac{11}{16}$                    | $\frac{3}{4}$    | ...         | 9.438         | ...         | 10.000        | ...         | 9.750         |
| $\frac{11}{16}$                    | $\frac{13}{16}$  | ...         | 9.438         | ...         | ...           | 7.250       | 10.000        |
| $\frac{3}{4}$                      | $\frac{13}{16}$  | ...         | ...           | ...         | 11.000        | ...         | ...           |
| $\frac{3}{4}$                      | $\frac{7}{8}$    | ...         | 10.875        | ...         | 11.250        | ...         | 11.250        |
| $\frac{13}{16}$                    | $\frac{7}{8}$    | ...         | 11.750        | ...         | 11.500        | ...         | 11.375        |
| $\frac{13}{16}$                    | $\frac{15}{16}$  | ...         | ...           | ...         | ...           | ...         | 11.375        |
| $\frac{7}{8}$                      | $\frac{15}{16}$  | ...         | ...           | ...         | 12.000        | ...         | 12.000        |
| $\frac{15}{16}$                    | 1                | ...         | 13.188        | ...         | 13.000        | ...         | 13.500        |
| $\frac{15}{16}$                    | $1\frac{1}{16}$  | ...         | 13.750        | ...         | ...           | ...         | ...           |
| 1                                  | $1\frac{1}{16}$  | ...         | ...           | ...         | 13.875        | ...         | ...           |
| $1\frac{1}{16}$                    | $1\frac{1}{8}$   | ...         | 15.063        | ...         | 14.500        | ...         | 15.813        |
| $1\frac{1}{16}$                    | $1\frac{1}{4}$   | ...         | 15.875        | ...         | 14.625        | ...         | ...           |
| $1\frac{1}{8}$                     | $1\frac{3}{16}$  | ...         | ...           | ...         | 14.750        | ...         | ...           |
| $1\frac{1}{8}$                     | $1\frac{5}{16}$  | ...         | 17.000        | ...         | 15.500        | ...         | ...           |
| $1\frac{1}{8}$                     | $1\frac{3}{8}$   | ...         | ...           | ...         | ...           | ...         | 16.000        |
| $1\frac{3}{16}$                    | $1\frac{5}{16}$  | ...         | ...           | ...         | 16.000        | ...         | ...           |
| $1\frac{1}{4}$                     | $1\frac{5}{16}$  | ...         | 17.375        | ...         | 16.000        | ...         | ...           |
| $1\frac{1}{4}$                     | $1\frac{3}{8}$   | ...         | 18.250        | ...         | ...           | ...         | ...           |
| $1\frac{1}{4}$                     | $1\frac{7}{16}$  | ...         | 19.000        | ...         | ...           | ...         | 18.000        |
| $1\frac{5}{16}$                    | $1\frac{1}{2}$   | ...         | ...           | ...         | ...           | ...         | 19.500        |
| $1\frac{3}{8}$                     | $1\frac{7}{16}$  | ...         | ...           | ...         | 17.500        | ...         | ...           |
| $1\frac{3}{8}$                     | $1\frac{1}{2}$   | ...         | ...           | ...         | ...           | ...         | 19.500        |
| $1\frac{7}{16}$                    | $1\frac{1}{2}$   | ...         | 21.000        | ...         | ...           | ...         | 20.000        |
| $1\frac{7}{16}$                    | $1\frac{5}{8}$   | ...         | 22.000        | ...         | ...           | ...         | 21.500        |
| $1\frac{1}{2}$                     | $1\frac{5}{8}$   | ...         | ...           | ...         | 18.500        | ...         | ...           |
| $1\frac{1}{2}$                     | $1\frac{11}{16}$ | ...         | ...           | ...         | ...           | ...         | 21.000        |

**Table 5.1.2-2M Category 9 Lengths (Metric)**

| Nominal Wrench Opening Across Flat |    | Type I, Regular, Min. | Type II     |               | Type III    |               |
|------------------------------------|----|-----------------------|-------------|---------------|-------------|---------------|
| A                                  | B  |                       | Short, Max. | Regular, Min. | Short, Max. | Regular, Min. |
| 6                                  | 7  | ...                   | 114         | 85            | 114         | 144           |
| 6                                  | 8  | 173                   | ...         | ...           | ...         | ...           |
| 7                                  | 8  | ...                   | ...         | 150           | ...         | ...           |
| 7                                  | 9  | 175                   | ...         | ...           | ...         | ...           |
| 8                                  | 9  | 176                   | 120         | 155           | 121         | 158           |
| 8                                  | 10 | 180                   | ...         | 182           | ...         | ...           |
| 9                                  | 10 | ...                   | 125         | ...           | 127         | ...           |
| 9                                  | 11 | ...                   | ...         | 175           | ...         | 170           |
| 10                                 | 11 | 191                   | 130         | 182           | 133         | 177           |
| 10                                 | 12 | ...                   | ...         | 188           | ...         | ...           |
| 10                                 | 13 | ...                   | ...         | 188           | 150         | 205           |
| 11                                 | 12 | ...                   | 140         | ...           | ...         | 210           |
| 11                                 | 13 | ...                   | ...         | 197           | 160         | 220           |
| 12                                 | 13 | 200                   | 145         | 207           | 167         | ...           |
| 12                                 | 14 | 205                   | ...         | 213           | 173         | 233           |
| 15                                 | 18 | ...                   | ...         | 236           | ...         | ...           |
| 16                                 | 17 | 241                   | ...         | 241           | 174         | 240           |
| 16                                 | 18 | 255                   | ...         | 244           | ...         | 245           |
| 16                                 | 19 | 259                   | ...         | ...           | ...         | ...           |
| 17                                 | 19 | 259                   | ...         | 249           | 180         | 255           |
| 18                                 | 19 | ...                   | ...         | 254           | 184         | 265           |
| 18                                 | 20 | ...                   | ...         | ...           | 188         | ...           |
| 18                                 | 21 | ...                   | ...         | 266           | ...         | ...           |
| 19                                 | 20 | ...                   | ...         | 279           | ...         | 280           |
| 19                                 | 21 | ...                   | ...         | ...           | ...         | 285           |
| 19                                 | 22 | 275                   | ...         | 285           | ...         | ...           |
| 20                                 | 22 | 296                   | ...         | 288           | ...         | 292           |
| 21                                 | 22 | ...                   | ...         | 292           | ...         | ...           |
| 21                                 | 23 | 307                   | ...         | 300           | ...         | 307           |
| 21                                 | 24 | ...                   | ...         | 307           | ...         | ...           |
| 22                                 | 23 | ...                   | ...         | ...           | ...         | 333           |
| 22                                 | 24 | 317                   | ...         | 314           | ...         | 340           |
| 23                                 | 24 | ...                   | ...         | 322           | ...         | ...           |
| 24                                 | 26 | 337                   | ...         | 330           | ...         | 349           |
| 24                                 | 27 | ...                   | ...         | 339           | ...         | ...           |
| 25                                 | 28 | 370                   | ...         | 350           | ...         | 379           |
| 26                                 | 29 | ...                   | ...         | 360           | ...         | 404           |
| 27                                 | 30 | 380                   | ...         | 369           | ...         | ...           |
| 27                                 | 32 | ...                   | ...         | 381           | ...         | 430           |
| 28                                 | 32 | 396                   | ...         | ...           | ...         | ...           |
| 30                                 | 32 | 396                   | ...         | 393           | ...         | ...           |

Type I wrenches shall be chamfered on both sides to provide a lead for the working surfaces. The slotted opening on Type I wrenches, and tips of all open ends on Type II wrenches, shall be chamfered or rounded to eliminate burrs.

Internal drive end dimensions shall conform to ASME B107.4, except as noted in this paragraph. Two sides of the internal drive square shall be parallel to the line from the center of the internal drive opening to the center of the wrench opening within  $\pm 3$  deg. When the internal drive end is furnished with a hole or recess for engagement of the ball/plunger on the corresponding external drive end, and the length of engagement of the external drive tang is less than twice the dimension of  $D_f$  in ASME B107.4, Table 8-1, the hole or recess shall be central in the corresponding internal drive.

**5.3.1 Type I Flare Nut.** Category 21, Type I wrenches shall have the flare nut design (see [Figures 5.3.1-1](#) and [5.3.1-2](#)). The wrench shall have an internal drive opening at one end and a wrench opening to drive hexagonal fasteners. See [Tables 5.3.1-1](#) through [5.3.1-4](#) ([Table 5.3.1-4M](#)). The slotted opening may be rotated from the centerline of the wrench.

**5.3.2 Type II Open End.** Category 21, Type II wrenches shall have the open-end design (see [Figure 5.3.2-1](#)). The wrench shall have an internal drive opening at one end and an open wrench end at the other end. See [Tables 5.3.2-1](#) through [5.3.2-3](#) ([Table 5.3.2-1M](#)).

## 5.4 Design — Category 66: Ratcheting Box Wrench

Wrenches shall have a ratchet at one or both ends of a flat handle section (see [Figures 5.4-1](#) through [5.4-4](#)). A ratcheting end shall include a head for housing a ratchet mechanism, a ratchet mechanism, and a wrench opening conforming to [para. 5.5\(a\)](#), [para. 5.5\(b\)](#), or [para. 5.5\(e\)](#).

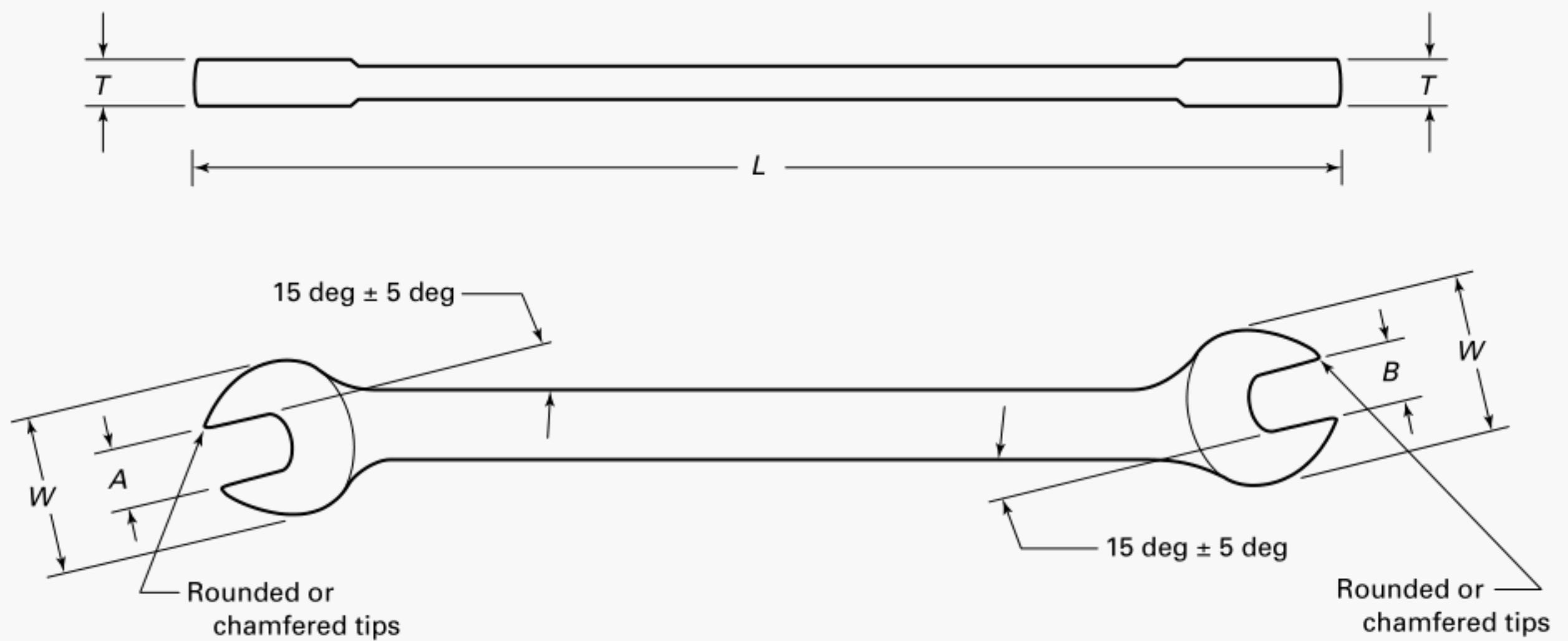
Ratcheting action may be reversible. The offset version ([Figure 5.4-2](#)) shall have the reversing feature. A nonratcheting end shall have one of the wrench configurations in [para. 5.5\(a\)](#), [para. 5.5\(b\)](#), [para. 5.5\(c\)](#), or [para. 5.5\(d\)](#).

## 5.5 Wrench Openings

Wrench openings shall be such as to ensure acceptance when gaged with gages conforming to ASME B107.17, and shall conform to one of the following wrench opening designs:

(a) *Standard Single or Double Hexagon Box Configuration.* This design consists of a simple geometric single hexagon (6-point) or double hexagon (12-point) configuration having an across-flats and an across-corner shape for fitting with hexagon fasteners.



**Figure 5.1.3-1 Category 39, Type I Engineer's Wrench**

(b) *Modified Single or Double Hexagon Box Configuration.* This design consists of a geometric single hexagon (6-point) or double hexagon (12-point) configuration that does not contact on the fasteners' corners.

(c) *Open-End Configuration.* This design consists of a simple geometric configuration having an across-flats shape suitable for use on hexagonal and square-headed bolts and nuts. The tips of all open ends shall have no burrs.

(d) *Flare nut configuration.*

(e) *Standard single or double square configuration,* consisting of a single geometric square (4-point) or a double square (8-point) configuration having an across-flats and an across-corner shape for fitting with square fasteners.

(f) *Adjustable open-end configuration.*

Wrenches that have a box end design shall be chamfered on at least one side to provide a lead for the working surfaces. Wrench opening configurations in (a), (b), (d), and (e) shall be countersunk with an included angle of 90 deg to 150 deg and a minimum diameter equal to the across-corner dimension of the opening.

## 5.6 Materials

The materials used in the manufacturing of wrenches shall be such as to produce wrenches conforming to this Standard.

## 5.7 Markings

Wrenches shall be marked in a legible and permanent manner with the manufacturer's name or with a trademark of such known character that the manufacturer may be readily determined. Each wrench shall be marked on one of the faces or on the handle, as close

to each nonadjustable head as is practical, in a legible and permanent manner, with the nominal wrench opening. Marking shall be as permanent as the normal life expectancy of the wrench to which it is applied (provided the marked surface has not been subjected to a fretting or abrading action) and be capable of withstanding the cleaning procedures normally experienced during its intended use. The marked area of the wrench may be exempt from the corrosion test in [para. 6.3.4](#) when mutually agreed upon by the manufacturer and customer.

## 5.8 Hardness

Hardness shall be tested per [para. 6.1](#).

Category 6, 9, 39, 40, and 66 (frame and wrenching surface) wrenches shall be heat treated to 38 HRC to 55 HRC. The pawl of Category 66 wrenches (when present) shall have a hardness of 35 HRC to 55 HRC.

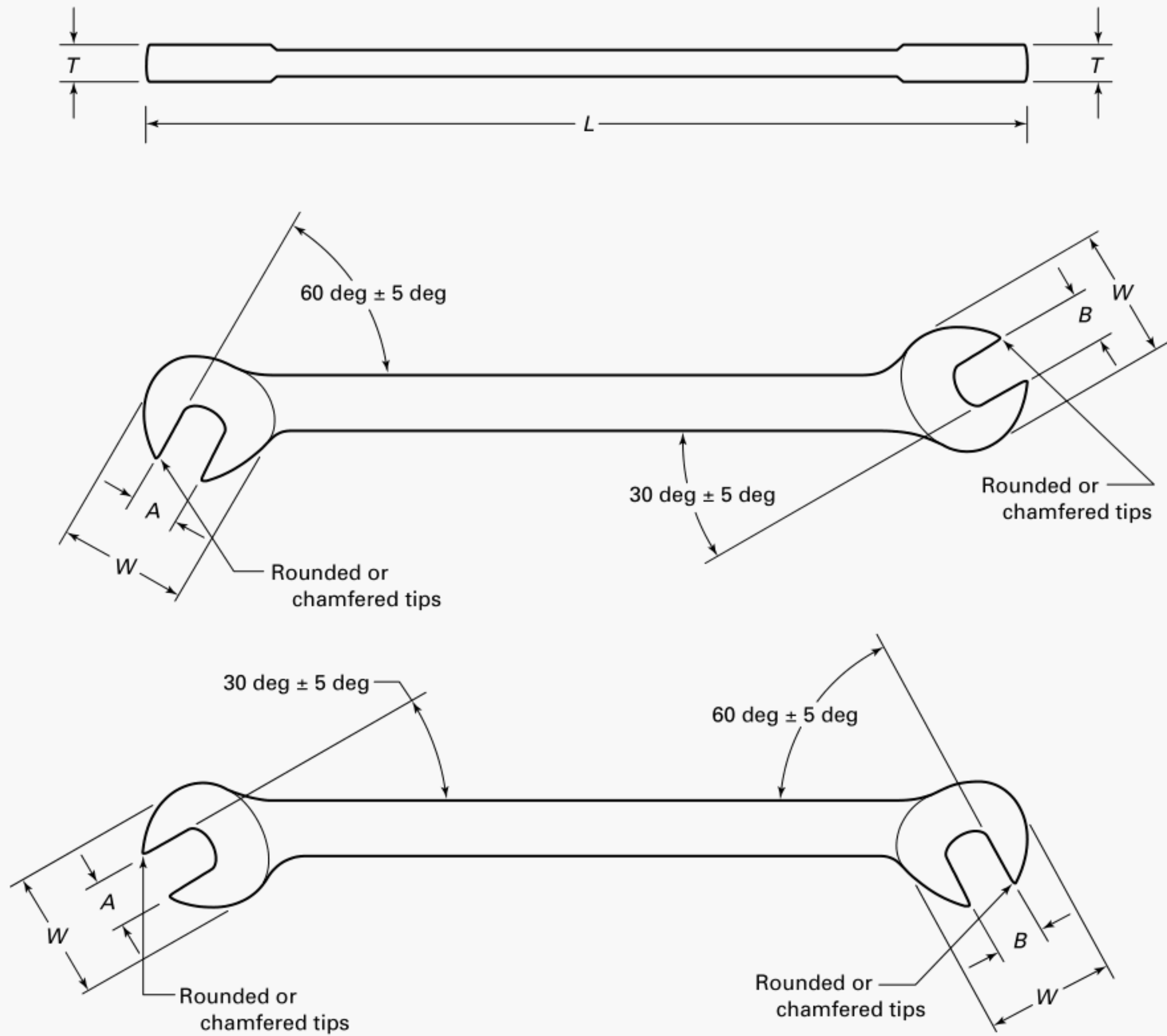
The frame (fixed jaw and handle) and movable jaw of Category 8 wrenches shall be heat treated to 40 HRC to 50 HRC.

Category 21 wrenches shall be heat treated to 38 HRC to 54 HRC.

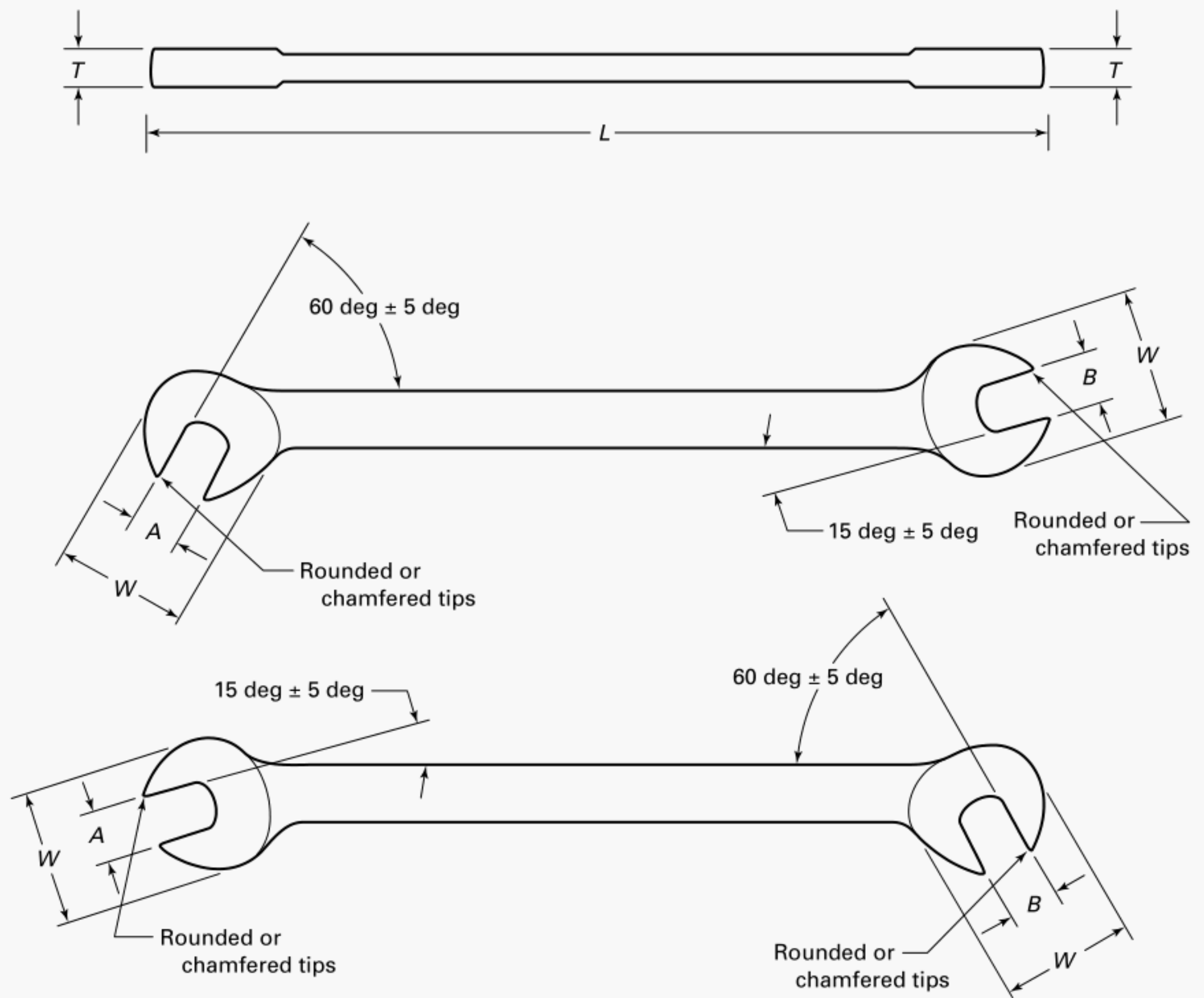
## 5.9 Finish

**5.9.1 Surface Finish.** All surfaces shall be free from cracks and essentially free from burrs, pits, nodules, and other detrimental conditions. Flash shall be completely removed from the periphery of the heads of all box ends, from the circumference of all open ends, and from that portion of the handle that shall be essentially straight and uniform in sectional dimensions, as shown in [Figure 5.9.1-1](#). Any remaining flash on any surface shall blend smoothly with adjacent surfaces; external

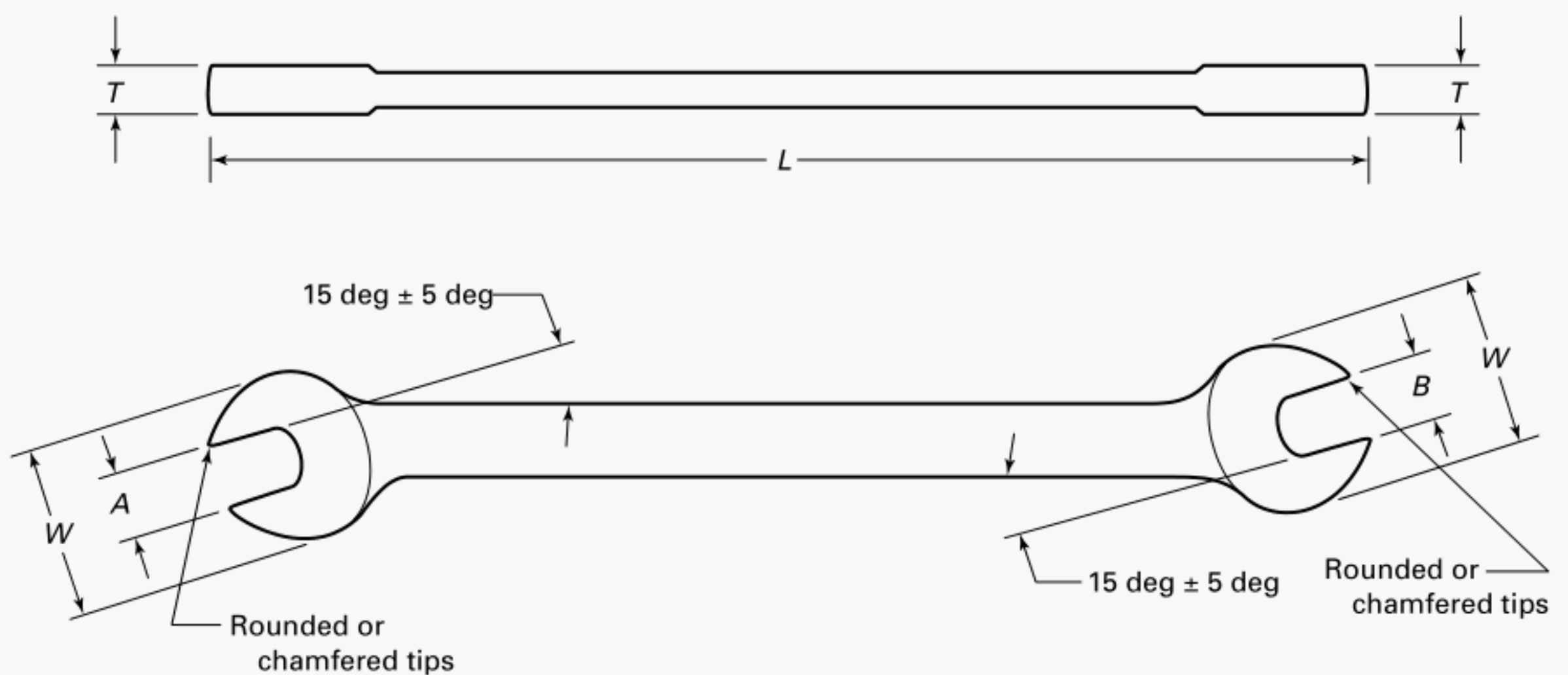
Figure 5.1.3-2 Category 39, Type II, Class 1 Angle Wrench



**Figure 5.1.3-3 Category 39, Type II, Classes 2 and 3 Angle Wrench**



**Figure 5.1.3-4 Category 39, Type III Tappet Wrench**





**Table 5.1.3-1 Category 39 Open-End Wrench (U.S. Customary)**

| Nominal<br>Wrench<br>Opening<br>Across Flat,<br>A or B | Types I and II,<br>Classes 1 and 2  |   | Type II, Class 3                    |   | Type III                            |   | Minimum Proof Torque, lbf-in. |            |            |            |             |
|--|-------------------------------------|---|-------------------------------------|---|-------------------------------------|---|-------------------------------|------------|------------|------------|-------------|
|  | Max.<br>Width of<br>Open<br>Head, W | Max.<br>Thickness<br>of Open<br>Head, T | Max.<br>Width of<br>Open<br>Head, W | Max.<br>Thickness<br>of Open<br>Head, T | Max.<br>Width of<br>Open<br>Head, W | Max.<br>Thickness<br>of Open<br>Head, T | Type II                       |            |            |            |             |
|  |                                     |   |                                     |   |                                     |   | Type<br>I                     | Class<br>1 | Class<br>2 | Class<br>3 | Type<br>III |
| $\frac{1}{8}$  | 0.359                               | 0.141                                   | ...                                 | ...                                     | ...                                 | ...                                     | ...                           | ...        | 15         | ...        | ...         |
| $\frac{5}{32}$   | 0.438                               | 0.141                                   | ...                                 | ...                                     | ...                                 | ...                                     | ...                           | ...        | 20         | ...        | ...         |
| $\frac{3}{16}$   | 0.500                               | Note (1)                                | ...                                 | ...                                     | ...                                 | ...                                     | 45                            | ...        | 24         | ...        | ...         |
| $\frac{7}{32}$   | 0.563                               | 0.172                                   | ...                                 | ...                                     | ...                                 | ...                                     | 50                            | ...        | 28         | ...        | ...         |
| $\frac{15}{64}$  | 0.600                               | 0.188                                   | ...                                 | ...                                     | ...                                 | ...                                     | ...                           | ...        | 38         | ...        | ...         |
| $\frac{1}{4}$  | 0.654                               | 0.205                                   | ...                                 | ...                                     | ...                                 | ...                                     | 67                            | 67         | 38         | ...        | ...         |
| $\frac{9}{32}$   | 0.688                               | 0.215                                   | ...                                 | ...                                     | ...                                 | ...                                     | ...                           | ...        | 43         | ...        | ...         |
| $\frac{5}{16}$   | 0.811                               | 0.223                                   | ...                                 | ...                                     | 0.750                               | 0.203                                   | 138                           | 138        | 62         | ...        | 75          |
| $\frac{11}{32}$  | 0.813                               | 0.237                                   | 0.781                               | 0.203                                   | ...                                 | ...                                     | 193                           | 193        | 105        | 40         | ...         |
| $\frac{3}{8}$  | 0.906                               | 0.250                                   | 0.781                               | 0.203                                   | 0.938                               | 0.203                                   | 275                           | 275        | 105        | 40         | 120         |
| $\frac{7}{16}$   | 0.996                               | 0.281                                   | 0.906                               | 0.250                                   | 1.187                               | 0.218                                   | 413                           | 413        | ...        | 75         | 165         |
| $\frac{1}{2}$  | 0.142                               | 0.344                                   | 1.603                               | 0.250                                   | 1.290                               | 0.218                                   | 550                           | 550        | ...        | 100        | 286         |
| $\frac{17}{32}$  | ...                                 | ...                                     | ...                                 | ...                                     | 1.290                               | 0.218                                   | ...                           | ...        | ...        | ...        | 300         |
| $\frac{9}{16}$   | 1.272                               | 0.375                                   | 1.188                               | 0.266                                   | 1.437                               | 0.218                                   | 770                           | 770        | ...        | 150        | 355         |
| $\frac{5}{8}$  | 1.402                               | 0.380                                   | 1.313                               | 0.266                                   | 1.500                               | 0.234                                   | 1,100                         | 1,100      | ...        | 200        | 432         |
| $\frac{11}{16}$  | 1.536                               | 0.400                                   | 1.438                               | 0.297                                   | 2.598                               | 0.234                                   | 1,375                         | 1,375      | ...        | 300        | 516         |
| $\frac{3}{4}$  | 1.672                               | 0.406                                   | 1.578                               | 0.297                                   | 1.705                               | 0.234                                   | 1,650                         | 1,650      | ...        | 500        | 607         |
| $\frac{13}{16}$  | 1.828                               | 0.516                                   | 1.609                               | 0.297                                   | 1.840                               | 0.234                                   | 2,200                         | 2,200      | ...        | 700        | 710         |
| $\frac{7}{8}$  | 1.959                               | 0.516                                   | 1.813                               | 0.297                                   | 1.990                               | 0.234                                   | 2,475                         | 2,475      | ...        | 825        | 812         |
| $\frac{15}{16}$  | 2.078                               | 0.594                                   | 1.938                               | 0.297                                   | 2.115                               | 0.250                                   | 3,025                         | 3,025      | ...        | 900        | 941         |
| 1  | 2.250                               | 0.625                                   | 2.109                               | 0.328                                   | 2.250                               | 0.250                                   | 3,575                         | 3,575      | ...        | 1,700      | 1,053       |
| $1\frac{1}{16}$  | 2.344                               | 0.625                                   | 2.109                               | 0.328                                   | 2.357                               | 0.250                                   | 3,850                         | 3,850      | ...        | 1,700      | 1,318       |
| $1\frac{1}{8}$   | 2.500                               | 0.656                                   | 2.297                               | 0.359                                   | 2.494                               | 0.250                                   | 4,400                         | 4,400      | ...        | 2,250      | 1,494       |
| $1\frac{3}{16}$  | 2.630                               | 0.688                                   | 2.400                               | 0.359                                   | ...                                 | ...                                     | 5,200                         | 5,200      | ...        | 2,375      | ...         |
| $1\frac{1}{4}$   | 2.766                               | 0.719                                   | 2.500                               | 0.359                                   | 2.768                               | 0.260                                   | 5,775                         | 5,775      | ...        | 2,500      | 1,886       |
| $1\frac{5}{16}$  | 2.938                               | 0.719                                   | 2.688                               | 0.359                                   | 2.905                               | 0.260                                   | 6,600                         | 6,600      | ...        | 2,800      | 2,100       |
| $1\frac{3}{8}$   | 3.063                               | 0.750                                   | 2.750                               | 0.422                                   | 3.042                               | 0.277                                   | 7,425                         | 7,425      | ...        | 3,200      | 2,326       |
| $1\frac{7}{16}$  | 3.188                               | 0.813                                   | 2.813                               | 0.422                                   | 3.179                               | 0.277                                   | 8,250                         | 8,250      | ...        | 3,500      | 2,564       |
| $1\frac{1}{2}$   | 3.375                               | 0.813                                   | 3.000                               | 0.422                                   | 3.315                               | 0.291                                   | 8,500                         | 8,500      | ...        | 3,800      | 2,815       |
| $1\frac{9}{16}$  | ...                                 | ...                                     | 3.120                               | 0.440                                   | ...                                 | ...                                     | ...                           | ...        | ...        | 4,300      | ...         |
| $1\frac{5}{8}$   | 3.625                               | 0.813                                   | 3.250                               | 0.470                                   | 3.589                               | 0.291                                   | 9,000                         | 9,000      | ...        | 4,750      | 3,353       |
| $1\frac{11}{16}$                                       | 3.750                               | 0.813                                   | 3.380                               | 0.500                                   | 3.725                               | 0.315                                   | ...                           | 10,500     | ...        | 5,200      | 3,641       |
| $1\frac{3}{4}$   | 4.000                               | 0.875                                   | 3.500                               | 0.530                                   | ...                                 | ...                                     | ...                           | 11,100     | ...        | 5,700      | ...         |
| $1\frac{13}{16}$                                       | 4.188                               | 0.875                                   | 3.620                               | 0.530                                   | ...                                 | ...                                     | 11,750                        | 11,750     | ...        | 6,200      | ...         |
| $1\frac{7}{8}$   | 4.344                               | 0.938                                   | 3.750                               | 0.560                                   | 4.136                               | 0.315                                   | ...                           | 12,400     | ...        | 6,700      | 4,550       |
| $1\frac{15}{16}$                                       | ...                                 | ...                                     | 3.880                               | 0.560                                   | ...                                 | ...                                     | ...                           | ...        | ...        | 7,250      | ...         |
| 2  | 4.469                               | 0.938                                   | 3.940                               | 0.590                                   | ...                                 | ...                                     | ...                           | 13,650     | ...        | 7,800      | ...         |

NOTE: (1) For Types I and II, Class 1, T max. = 0.172; for Type II, Class 2, T max. = 0.156.

**Table 5.1.3-1M Category 39 Open-End Wrench (Metric)**

| Nominal<br>Wrench<br>Opening Across<br>Flat, <i>A</i> or <i>B</i> | Types I and II,<br>Classes 1 and 2         |  | Type II, Class 3                           |  | Type III                                   |  | Minimum Proof Torque, N·m |            |            |            |             |
|---|--|--|--|--|--|--|---------------------------|------------|------------|------------|-------------|
|   | Max.<br>Width of<br>Open<br>Head, <i>W</i> | Max.<br>Thickness<br>of Open<br>Head, <i>T</i> | Max.<br>Width of<br>Open<br>Head, <i>W</i> | Max.<br>Thickness<br>of Open<br>Head, <i>T</i> | Max.<br>Width of<br>Open<br>Head, <i>W</i> | Max.<br>Thickness<br>of Open<br>Head, <i>T</i> | Type II                   |            |            |            |             |
|   |  |  |  |  |  |  | Type<br>I                 | Class<br>1 | Class<br>2 | Class<br>3 | Type<br>III |
| 3.2   | 8.9  | 3.4  | ...  | ...  | ...  | ...  | ...                       | ...        | 1          | ...        | ...         |
| 4   | 10.8                                       | 3.7  | ...  | ...  | ...  | ...  | ...                       | ...        | 2          | ...        | ...         |
| 5   | 12.5                                       | 3.9  | ...  | ...  | ...  | ...  | ...                       | ...        | 3          | ...        | ...         |
| 5.5   | 15.5                                       | 5.3  | ...  | ...  | ...  | ...  | ...                       | ...        | 4          | ...        | ...         |
| 6   | 17.3                                       | 5.8  | ...  | ...  | 1.4  | 4.0  | 7                         | ...        | 6          | ...        | 4           |
| 7   | 18.3                                       | 6.3  | ...  | ...  | 18.4                                       | 4.0  | 8                         | ...        | 7          | ...        | 6           |
| 8   | 21.4                                       | 6.3  | ...  | ...  | 20.4                                       | 4.2  | 15                        | ...        | 13         | ...        | 9           |
| 9   | 21.8                                       | 6.6  | 19.8                                       | 5.1  | 21.9                                       | 4.2  | 21                        | 21         | 19         | 4.5        | 13          |
| 10  | 26.0                                       | 6.9  | 19.8                                       | 5.1  | 24.4                                       | 4.5  | 31                        | 31         | 28         | 4.5        | 17          |
| 11  | 26.0                                       | 7.0  | 23.1                                       | 6.4  | 26.4                                       | 4.5  | 46                        | 46         | 41         | 8          | 21          |
| 12  | 27.7                                       | 8.0  | 26.9                                       | 6.4  | 28.4                                       | 4.7  | 49                        | 49         | ...        | 10         | 26          |
| 13  | 30.2                                       | 8.9  | 26.9                                       | 6.4  | 30.4                                       | 4.8  | 62                        | 62         | ...        | 11         | 32          |
| 14  | 32.8                                       | 8.9  | 30.2                                       | 6.9  | 32.4                                       | 4.8  | 86                        | 86         | ...        | 17         | 38          |
| 15  | 34.8                                       | 8.9  | 33.0                                       | 6.9  | ...  | ...  | 104                       | 104        | ...        | 20         | ...         |
| 16  | 36.4                                       | 9.4  | 33.3                                       | 6.9  | 36.6                                       | 5.0  | 124                       | 124        | ...        | 25         | 53          |
| 17  | 39.7                                       | 9.8  | 36.6                                       | 7.6  | 38.8                                       | 5.1  | 139                       | 139        | ...        | 34         | 62          |
| 18  | 41.3                                       | 10.0   | 40.0                                       | 7.6  | 41.0                                       | 5.1  | 155                       | 155        | ...        | 42         | 71          |
| 19  | 42.7                                       | 10.1   | 40.1                                       | 7.6  | 43.2                                       | 5.6  | 186                       | 186        | ...        | 55         | 81          |
| 20  | 46.4                                       | 11.4   | ...  | ...  | ...  | ...  | 217                       | ...        | ...        | ...        | ...         |
| 21  | 47.6                                       | 11.7   | 40.9                                       | 7.6  | 46.3                                       | 6.0  | 248                       | 248        | ...        | 79         | 103         |
| 22  | 48.3                                       | 12.0   | 46.0                                       | 7.6  | 48.3                                       | 6.0  | 279                       | 279        | ...        | 95         | 116         |
| 23  | 52.4                                       | 12.4   | ...  | ...  | ...  | ...  | 310                       | ...        | ...        | ...        | ...         |
| 24  | 53.5                                       | 12.5   | 49.3                                       | 7.6  | 52.3                                       | 6.0  | 341                       | 341        | ...        | 110        | 143         |
| 25  | 55.7                                       | 12.7   | ...  | ...  | ...  | ...  | 372                       | ...        | ...        | ...        | ...         |
| 26  | 57.2                                       | 12.8   | ...  | ...  | ...  | ...  | 403                       | ...        | ...        | ...        | ...         |
| 27  | 60.2                                       | 14.7   | 54.0                                       | 8.4  | 56.0                                       | 7.1  | 432                       | 432        | ...        | 190        | 187         |
| 28  | 62.3                                       | 14.9   | 58.4                                       | 9.1  | ...  | ...  | 497                       | ...        | ...        | 210        | ...         |
| 29  | 65.5                                       | 14.9   | ...  | ...  | ...  | ...  | 514                       | ...        | ...        | ...        | ...         |
| 30  | 67.0                                       | 14.9   | 63.5                                       | 9.1  | 62.0                                       | 7.1  | 570                       | ...        | ...        | 250        | 238         |
| 32  | 71.0                                       | 15.7   | 64.0                                       | 9.1  | ...  | ...  | 650                       | ...        | ...        | 280        | ...         |
| 36  | 76.8                                       | 19.0   | 71.4                                       | 10.7   | ...  | ...  | 894                       | ...        | ...        | 395        | ...         |
| 41  | 88.9                                       | 19.3   | 82.6                                       | 11.9   | ...  | ...  | 1 154                     | ...        | ...        | 530        | ...         |
| 46  | ...  | ...  | 92.0                                       | 13.5   | ...  | ...  | ...                       | ...        | ...        | 700        | ...         |
| 50  | ...  | ...  | 100.1                                      | 15.0   | ...  | ...  | ...                       | ...        | ...        | 840        | ...         |

**Table 5.1.3-2 Category 39, Type I Lengths  
(U.S. Customary)**

| Nominal Wrench Opening<br>Across Flat |                  | Short, Max. | Regular, Min. |
|---------------------------------------|------------------|-------------|---------------|
| <i>A</i>                              | <i>B</i>         |             |               |
| $\frac{3}{16}$                        | $\frac{7}{32}$   | 2.875       | 2.890         |
| $\frac{3}{16}$                        | $\frac{1}{4}$    | 3.000       | 3.105         |
| $\frac{1}{4}$                         | $\frac{9}{32}$   | 3.375       | 3.390         |
| $\frac{1}{4}$                         | $\frac{5}{16}$   | 3.375       | 3.390         |
| $\frac{5}{16}$                        | $\frac{11}{32}$  | 3.625       | 3.640         |
| $\frac{5}{16}$                        | $\frac{3}{8}$    | 3.625       | 3.640         |
| $\frac{5}{16}$                        | $\frac{7}{16}$   | 3.625       | 3.640         |
| $\frac{3}{8}$                         | $\frac{7}{16}$   | 4.375       | 4.390         |
| $\frac{3}{8}$                         | $\frac{1}{2}$    | 4.375       | 4.390         |
| $\frac{13}{32}$                       | $\frac{1}{2}$    | 4.635       | 4.650         |
| $\frac{7}{16}$                        | $\frac{1}{2}$    | 5.000       | 5.015         |
| $\frac{1}{2}$                         | $\frac{9}{16}$   | 5.500       | 5.515         |
| $\frac{9}{16}$                        | $\frac{5}{8}$    | 6.000       | 6.015         |
| $\frac{5}{8}$                         | $\frac{11}{16}$  | 7.250       | 7.265         |
| $\frac{5}{8}$                         | $\frac{3}{4}$    | 7.250       | 7.265         |
| $\frac{11}{16}$                       | $\frac{3}{4}$    | 7.000       | 7.015         |
| $\frac{11}{16}$                       | $\frac{13}{16}$  | 7.500       | 7.515         |
| $\frac{3}{4}$                         | $\frac{13}{16}$  | 8.000       | 8.015         |
| $\frac{3}{4}$                         | $\frac{7}{8}$    | 8.250       | 8.265         |
| $\frac{13}{16}$                       | $\frac{7}{8}$    | 8.500       | 8.515         |
| $\frac{13}{16}$                       | $\frac{15}{16}$  | 9.000       | 9.015         |
| $\frac{7}{8}$                         | $\frac{15}{16}$  | 9.125       | 9.140         |
| $\frac{7}{8}$                         | 1                | 9.125       | 9.140         |
| $\frac{7}{8}$                         | $1\frac{1}{16}$  | 10.000      | 10.015        |
| $\frac{15}{16}$                       | 1                | 10.000      | 10.015        |
| $\frac{15}{16}$                       | $1\frac{1}{16}$  | 10.000      | 10.015        |
| 1                                     | $1\frac{1}{16}$  | 10.500      | 10.515        |
| 1                                     | $1\frac{1}{8}$   | 10.750      | 10.765        |
| 1                                     | $1\frac{1}{2}$   | 11.000      | 11.015        |
| $1\frac{1}{16}$                       | $1\frac{1}{8}$   | 11.750      | 11.765        |
| $1\frac{1}{16}$                       | $1\frac{1}{4}$   | 11.750      | 11.765        |
| $1\frac{1}{8}$                        | $1\frac{1}{4}$   | 12.000      | 12.015        |
| $1\frac{1}{8}$                        | $1\frac{5}{16}$  | 12.500      | 12.515        |
| $1\frac{1}{8}$                        | $1\frac{3}{8}$   | 13.000      | 13.015        |
| $1\frac{3}{16}$                       | $1\frac{5}{16}$  | 13.000      | 13.015        |
| $1\frac{1}{4}$                        | $1\frac{5}{16}$  | 13.500      | 13.515        |
| $1\frac{1}{4}$                        | $1\frac{3}{8}$   | 13.500      | 13.515        |
| $1\frac{1}{4}$                        | $1\frac{7}{16}$  | 13.500      | 13.515        |
| $1\frac{3}{8}$                        | $1\frac{7}{16}$  | 14.000      | 14.015        |
| $1\frac{3}{8}$                        | $1\frac{1}{2}$   | 15.500      | 15.515        |
| $1\frac{7}{16}$                       | $1\frac{5}{8}$   | 15.500      | 15.515        |
| $1\frac{7}{16}$                       | $1\frac{13}{16}$ | 15.500      | 15.515        |
| $1\frac{1}{2}$                        | $1\frac{5}{8}$   | 15.500      | 15.515        |

**Table 5.1.3-2M Category 39, Type I Lengths  
(Metric)**

| Nominal Wrench Opening<br>Across Flat |          | Regular, Min. |
|---------------------------------------|----------|---------------|
| <i>A</i>                              | <i>B</i> |               |
| 6                                     | 7        | 90            |
| 6                                     | 8        | 95            |
| 7                                     | 8        | 95            |
| 7                                     | 9        | 95            |
| 8                                     | 9        | 100           |
| 8                                     | 10       | 100           |
| 9                                     | 10       | 105           |
| 9                                     | 11       | 110           |
| 10                                    | 11       | 110           |
| 11                                    | 13       | 130           |
| 12                                    | 13       | 140           |
| 12                                    | 14       | 145           |
| 13                                    | 15       | 150           |
| 14                                    | 15       | 155           |
| 14                                    | 16       | 155           |
| 15                                    | 17       | 160           |
| 15                                    | 18       | 160           |
| 16                                    | 17       | 165           |
| 16                                    | 18       | 165           |
| 17                                    | 19       | 180           |
| 18                                    | 19       | 185           |
| 18                                    | 21       | 190           |
| 19                                    | 22       | 195           |
| 20                                    | 21       | 200           |
| 20                                    | 22       | 200           |
| 21                                    | 22       | 215           |
| 21                                    | 23       | 220           |
| 21                                    | 24       | 230           |
| 22                                    | 24       | 240           |
| 24                                    | 26       | 245           |
| 24                                    | 27       | 250           |
| 25                                    | 27       | 270           |
| 25                                    | 28       | 280           |
| 27                                    | 29       | 305           |
| 27                                    | 30       | 305           |
| 27                                    | 32       | 310           |
| 28                                    | 30       | 315           |
| 30                                    | 32       | 330           |
| 32                                    | 36       | 395           |
| 36                                    | 41       | 425           |



**Table 5.1.3-3 Category 39, Type II, Class 1 Lengths  
(U.S. Customary)**

| Nominal Wrench Opening<br>Across Flat, <i>A</i> or <i>B</i> | Regular, Max. |
|---|---------------|
| $\frac{1}{4}$   | 4.000         |
| $\frac{5}{16}$  | 4.500         |
| $\frac{11}{32}$   | 4.750         |
| $\frac{3}{8}$   | 6.050         |
| $\frac{7}{16}$  | 6.330         |
| $\frac{1}{2}$   | 6.700         |
| $\frac{9}{16}$  | 7.060         |
| $\frac{5}{8}$   | 7.500         |
| $\frac{11}{16}$   | 8.000         |
| $\frac{3}{4}$   | 8.510         |
| $\frac{13}{16}$   | 9.080         |
| $\frac{7}{8}$   | 9.700         |
| $\frac{15}{16}$   | 10.400        |
| 1   | 11.050        |
| $1\frac{1}{16}$   | 11.219        |
| $1\frac{1}{8}$  | 11.813        |
| $1\frac{3}{16}$   | 12.375        |
| $1\frac{1}{4}$  | 12.935        |
| $1\frac{5}{16}$   | 13.500        |
| $1\frac{3}{8}$  | 14.125        |
| $1\frac{7}{16}$   | 14.750        |
| $1\frac{1}{2}$  | 15.250        |
| $1\frac{5}{8}$  | 16.438        |
| $1\frac{11}{16}$  | 17.000        |
| $1\frac{3}{4}$  | 17.625        |
| $1\frac{13}{16}$  | 19.000        |
| $1\frac{7}{8}$  | 20.500        |
| 2   | 22.000        |

**Table 5.1.3-3M Category 39, Type II, Class 1 Lengths  
(Metric)**

| Nominal Wrench Opening<br>Across Flat, <i>A</i> or <i>B</i> | Regular, Max. |
|---|---------------|
| 9   | 130           |
| 10  | 135           |
| 11  | 142           |
| 12  | 150           |
| 13  | 160           |
| 14  | 170           |
| 15  | 180           |
| 16  | 190           |
| 17  | 200           |
| 18  | 210           |
| 19  | 220           |
| 21  | 236           |
| 22  | 247           |
| 24  | 262           |
| 27  | 291           |

**Table 5.1.3-4 Category 39, Type II, Class 2 Lengths  
(U.S. Customary)**

| Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i> |                 |               |
|--|-----------------|---------------|
| 15 deg   | 60 deg          | Regular, Max. |
| $\frac{1}{8}$  | $\frac{1}{8}$   | 3.130         |
| $\frac{5}{32}$   | $\frac{5}{32}$  | 3.190         |
| $\frac{3}{16}$   | $\frac{3}{16}$  | 3.280         |
| $\frac{7}{32}$   | $\frac{7}{32}$  | 3.380         |
| $\frac{15}{64}$  | $\frac{1}{4}$   | 3.400         |
| $\frac{1}{4}$  | $\frac{15}{64}$ | 3.440         |
| $\frac{1}{4}$  | $\frac{1}{4}$   | 3.500         |
| $\frac{9}{32}$   | $\frac{9}{32}$  | 3.590         |
| $\frac{9}{32}$   | $\frac{5}{16}$  | 3.560         |
| $\frac{5}{16}$   | $\frac{9}{32}$  | 3.690         |
| $\frac{5}{16}$   | $\frac{5}{16}$  | 3.720         |
| $\frac{11}{32}$  | $\frac{11}{32}$ | 3.840         |
| $\frac{11}{32}$  | $\frac{3}{8}$   | 3.810         |
| $\frac{3}{8}$  | $\frac{11}{32}$ | 3.940         |
| $\frac{3}{8}$  | $\frac{3}{8}$   | 3.970         |

**Table 5.1.3-4M Category 39, Type II, Class 2 Lengths  
(Metric)**

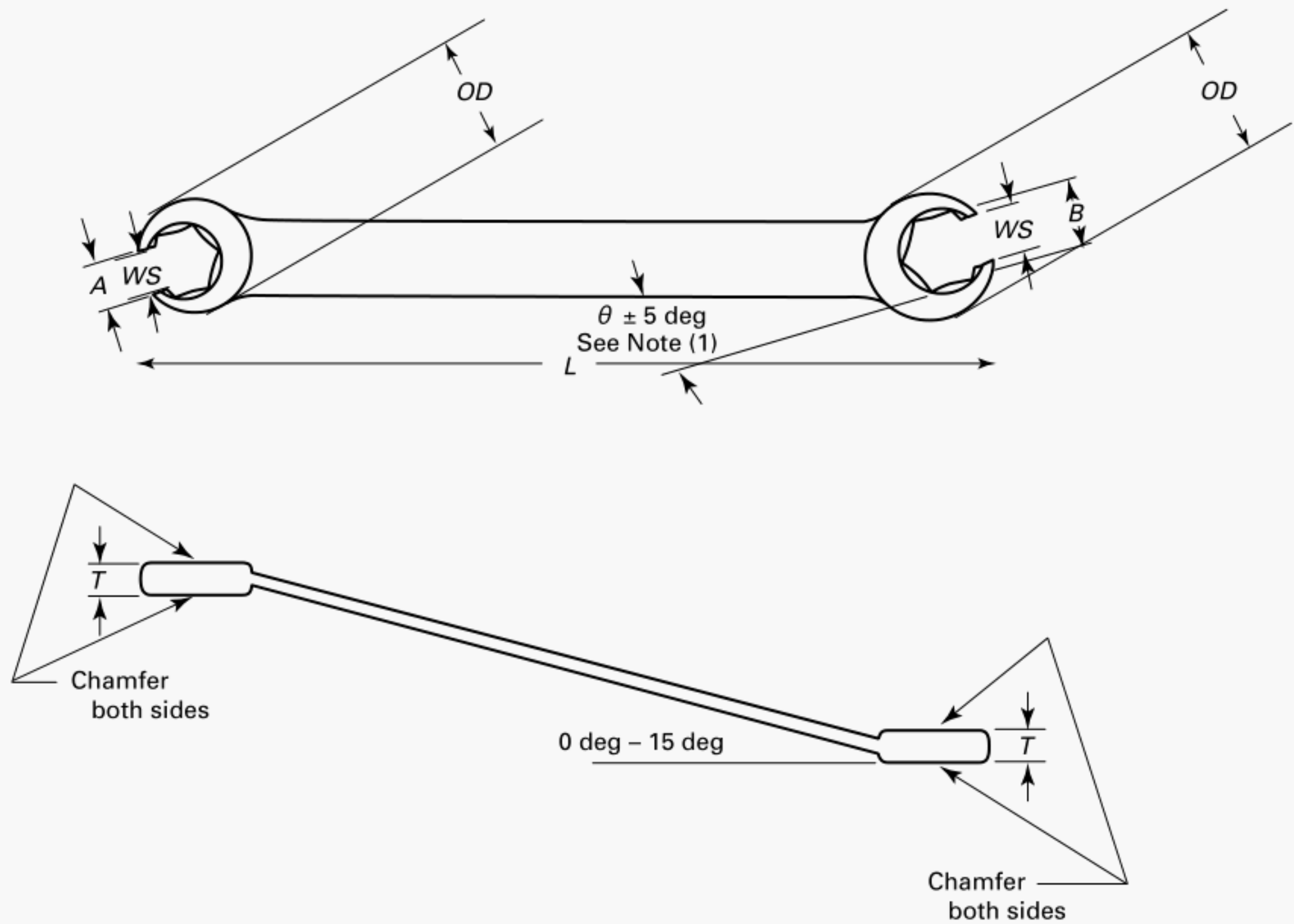
| Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i> |        |               |
|--|--------|---------------|
| 15 deg   | 60 deg | Regular, Max. |
| 3.2  | 5.5    | 75            |
| 4  | 5      | 78            |
| 5  | 4      | 82            |
| 5.5  | 3.2    | 84            |
| 6  | 7      | 86            |
| 7  | 6      | 90            |
| 8  | 9      | 94            |
| 9  | 8      | 98            |
| 10   | 11     | 102           |
| 11   | 10     | 106           |

**Table 5.1.3-5 Category 39, Type III Lengths  
(U.S. Customary)**

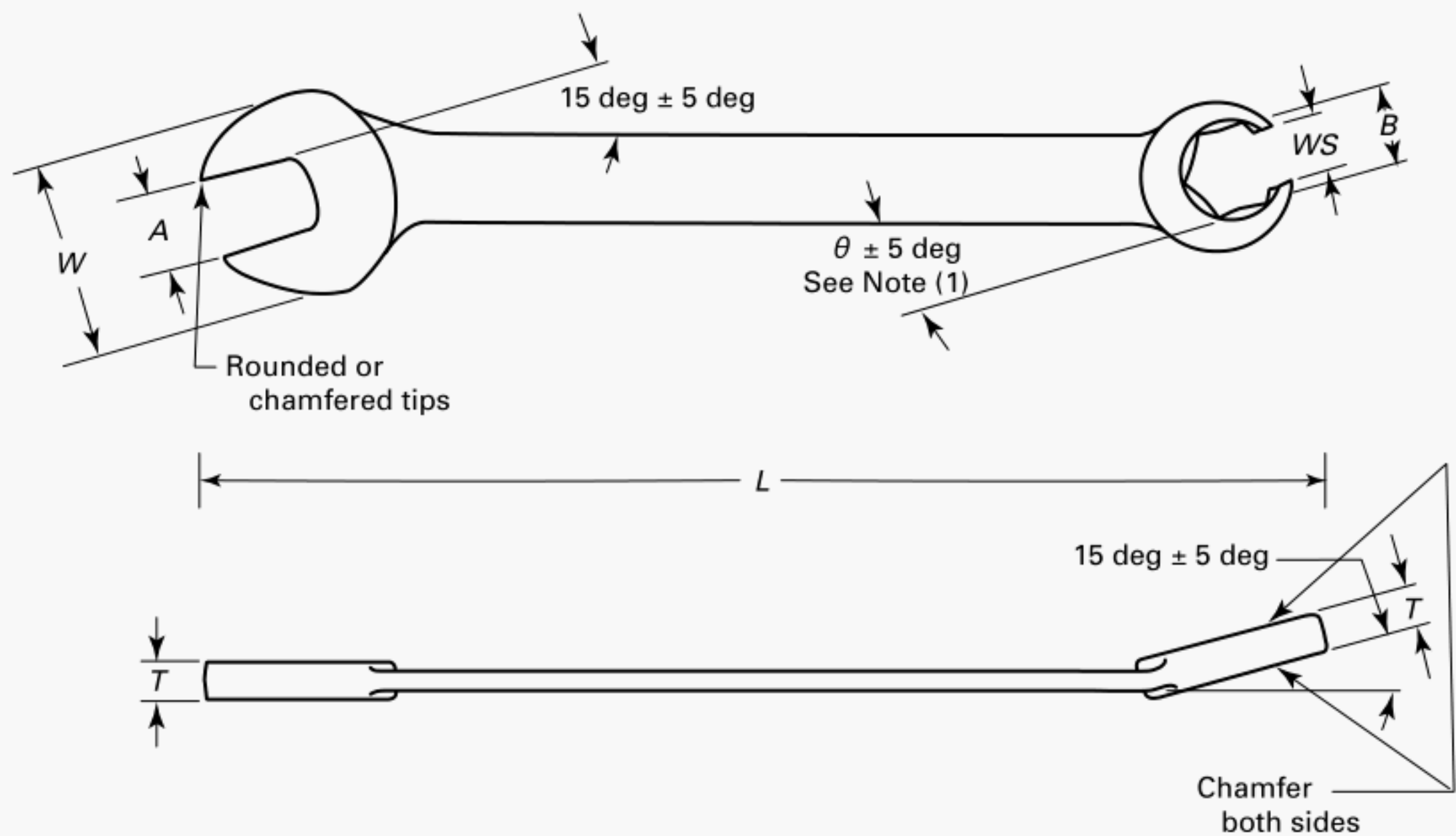
| Nominal Wrench Opening Across Flat |                 |               |
|------------------------------------|-----------------|---------------|
| <i>A</i>                           | <i>B</i>        | Regular, Max. |
| $\frac{5}{16}$                     | $\frac{3}{8}$   | 5.700         |
| $\frac{3}{8}$                      | $\frac{7}{16}$  | 5.700         |
| $\frac{7}{16}$                     | $\frac{1}{2}$   | 6.000         |
| $\frac{7}{16}$                     | $\frac{17}{32}$ | 6.000         |
| $\frac{1}{2}$                      | $\frac{9}{16}$  | 6.300         |
| $\frac{9}{16}$                     | $\frac{5}{8}$   | 6.500         |
| $\frac{5}{8}$                      | $\frac{11}{16}$ | 7.000         |
| $\frac{11}{16}$                    | $\frac{3}{4}$   | 7.500         |
| $\frac{3}{4}$                      | $\frac{7}{8}$   | 8.000         |
| $\frac{13}{16}$                    | $\frac{7}{8}$   | 8.500         |
| $\frac{15}{16}$                    | 1               | 8.700         |
| $1\frac{1}{16}$                    | $1\frac{1}{8}$  | 10.000        |
| $1\frac{1}{4}$                     | $1\frac{5}{16}$ | 11.000        |
| $1\frac{3}{8}$                     | $1\frac{7}{16}$ | 12.000        |
| $1\frac{1}{2}$                     | $1\frac{5}{8}$  | 13.000        |
| $1\frac{11}{16}$                   | $1\frac{7}{8}$  | 14.000        |

**Table 5.1.3-5M Category 39, Type III Lengths  
(Metric)**

| Nominal Wrench Opening Across Flat |          |               |
|------------------------------------|----------|---------------|
| <i>A</i>                           | <i>B</i> | Regular, Max. |
| 6                                  | 7        | 114           |
| 8                                  | 9        | 120           |
| 8                                  | 10       | 125           |
| 10                                 | 11       | 136           |
| 12                                 | 13       | 142           |
| 12                                 | 14       | 147           |
| 13                                 | 15       | 152           |
| 14                                 | 15       | 150           |
| 16                                 | 18       | 169           |
| 17                                 | 19       | 174           |
| 19                                 | 22       | 185           |
| 21                                 | 24       | 196           |
| 27                                 | 30       | 300           |

**Figure 5.1.4-1 Category 40, Type I Flare Nut Wrench**


NOTE: (1)  $\theta$  to be  $0 \text{ deg}$  or an increment of  $7\frac{1}{2} \text{ deg}$ .

**Figure 5.1.4-2 Category 40, Type II Flare Nut Combination Wrench**


NOTE: (1)  $\theta$  to be  $0 \text{ deg}$  or an increment of  $7\frac{1}{2} \text{ deg}$ .



**Table 5.1.4-1 Category 40, Type I Flare Nut Wrench  
(U.S. Customary)**

| Nominal<br>Opening<br>Across Flat,<br><i>A</i> or <i>B</i> | Maximum<br>Outside<br>Diameter of<br>Head, <i>OD</i> | Minimum<br>Width of<br>Slot in<br>Head, <i>WS</i> | Maximum<br>Thickness<br>of Head, <i>T</i> | Proof<br>Torque,<br>lbf-in. |
|--|--|---|---|-----------------------------|
| $\frac{1}{4}$  | 0.656  | 0.109   | 0.291                                     | 110                         |
| $\frac{5}{16}$   | 0.750  | 0.141   | 0.344                                     | 170                         |
| $\frac{3}{8}$  | 0.875  | 0.188   | 0.406                                     | 240                         |
| $\frac{7}{16}$   | 0.938  | 0.250   | 0.453                                     | 320                         |
| $\frac{1}{2}$  | 1.156  | 0.313   | 0.484                                     | 400                         |
| $\frac{9}{16}$   | 1.188  | 0.344   | 0.484                                     | 510                         |
| $\frac{5}{8}$  | 1.281  | 0.406   | 0.625                                     | 625                         |
| $\frac{11}{16}$  | 1.438  | 0.438   | 0.625                                     | 750                         |
| $\frac{3}{4}$  | 1.438  | 0.438   | 0.625                                     | 880                         |
| $\frac{13}{16}$  | 1.500  | 0.531   | 0.625                                     | 1,025                       |
| $\frac{7}{8}$  | 1.641  | 0.531   | 0.625                                     | 1,180                       |
| $\frac{15}{16}$  | 1.750  | 0.578   | 0.813                                     | 1,340                       |
| 1  | 1.750  | 0.656   | 0.813                                     | 1,510                       |
| $1\frac{1}{16}$  | 1.813  | 0.656   | 0.813                                     | 1,700                       |
| $1\frac{1}{8}$   | 1.938  | 0.750   | 0.875                                     | 1,880                       |

**Table 5.1.4-1M Category 40, Type I Flare Nut Wrench  
(Metric)**

| Nominal<br>Opening<br>Across Flat,<br><i>A</i> or <i>B</i> | Maximum<br>Outside<br>Diameter of<br>Head, <i>OD</i> | Minimum<br>Width of<br>Slot in<br>Head, <i>WS</i> | Maximum<br>Thickness<br>of Head, <i>T</i> | Proof<br>Torque,<br>N·m |
|--|--|---|---|-------------------------|
| 7  | 17.3   | 4.5   | 7.6                                       | 15                      |
| 8  | 19.0   | 4.5   | 8.5                                       | 20                      |
| 9  | 22.0   | 4.7   | 10.0                                      | 25                      |
| 10   | 23.5   | 5.5   | 10.5                                      | 30                      |
| 11   | 24.0   | 6.4   | 10.5                                      | 35                      |
| 12   | 25.5   | 7.0   | 11.1                                      | 40                      |
| 13   | 27.0   | 8.5   | 11.1                                      | 45                      |
| 14   | 28.0   | 9.5   | 12.0                                      | 55                      |
| 15   | 30.2   | 10.3  | 12.0                                      | 65                      |
| 16   | 31.2   | 10.3  | 12.0                                      | 75                      |
| 17   | 32.2   | 12.0  | 13.5                                      | 85                      |
| 18   | 33.6   | 12.5  | 14.0                                      | 95                      |
| 19   | 35.9   | 13.0  | 14.7                                      | 105                     |
| 20   | 37.5   | 14.0  | 14.7                                      | 120                     |
| 21   | 41.3   | 15.1  | 15.2                                      | 130                     |
| 22   | 41.3   | 15.9  | 15.2                                      | 145                     |

**Table 5.1.4-2 Category 40, Type II Flare Nut Combination Wrench (U.S. Customary)**

| Nominal<br>Opening Across<br>Flat, <i>A</i> or <i>B</i> | Maximum<br>Width of Open<br>Head, <i>W</i> | Maximum<br>Thickness of<br>Open Head, <i>T</i> | Maximum<br>Outside Diameter<br>of Flare Head, <i>OD</i> | Minimum Width<br>of Slot in Flare<br>Head, <i>WS</i> | Maximum<br>Thickness of<br>Flare Head, <i>T</i> | Proof Torque, lbf-in. |                     |
|---|--|--|---|--|---|-----------------------|---------------------|
|   |  |  |   |  |   | Open<br>Head, Min.    | Flare<br>Head, Min. |
| $\frac{15}{16}$   | 0.811                                      | 0.344  | 0.750   | 0.141  | 0.344   | 138                   | 170                 |
| $\frac{3}{8}$   | 0.906                                      | 0.406  | 0.875   | 0.188  | 0.406   | 275                   | 240                 |
| $\frac{7}{16}$  | 1.031                                      | 0.453  | 0.938   | 0.250  | 0.453   | 413                   | 320                 |
| $\frac{1}{2}$   | 1.219                                      | 0.484  | 1.156   | 0.313  | 0.484   | 550                   | 400                 |
| $\frac{9}{16}$  | 1.281                                      | 0.484  | 1.188   | 0.344  | 0.484   | 770                   | 510                 |
| $\frac{5}{8}$   | 1.406                                      | 0.484  | 1.281   | 0.406  | 0.625   | 1,100                 | 625                 |
| $\frac{11}{16}$   | 1.563                                      | 0.563  | 1.438   | 0.438  | 0.625   | 1,375                 | 750                 |
| $\frac{3}{4}$   | 1.672                                      | 0.563  | 1.438   | 0.438  | 0.625   | 1,650                 | 880                 |
| $\frac{13}{16}$   | 1.828                                      | 0.594  | 1.500   | 0.531  | 0.625   | 2,200                 | 1,025               |
| $\frac{7}{8}$   | 1.938                                      | 0.625  | 1.641   | 0.531  | 0.625   | 2,475                 | 1,180               |
| $\frac{15}{16}$   | 2.094                                      | 0.656  | 1.750   | 0.578  | 0.813   | 3,025                 | 1,340               |
| 1   | 2.250                                      | 0.750  | 1.750   | 0.656  | 0.813   | 3,575                 | 1,510               |

**Table 5.1.4-2M Category 40, Type II Flare Nut Combination Wrench (Metric)**

| Nominal<br>Opening Across<br>Flat, <i>A</i> or <i>B</i> | Maximum<br>Width of Open<br>Head, <i>W</i> | Maximum<br>Thickness of<br>Open Head, <i>T</i> | Maximum Outside<br>Diameter of Flare<br>Head, <i>OD</i> | Minimum Width<br>of Slot in Flare<br>Head, <i>WS</i> | Maximum<br>Thickness of<br>Flare Head, <i>T</i> | Proof Torque, N·m     |                        |
|---|--|--|---|--|---|-----------------------|------------------------|
|   |  |  |   |  |   | Open<br>Head,<br>Min. | Flare<br>Head,<br>Min. |
| 8   | 21.4                                       | 8.5  | 19.0  | 4.5  | 8.5   | 15                    | 20                     |
| 9   | 21.8                                       | 10.0   | 22.0  | 4.7  | 10.0  | 21                    | 25                     |
| 10  | 26.0                                       | 10.0   | 23.5  | 5.5  | 10.5  | 31                    | 30                     |
| 11  | 26.0                                       | 10.0   | 24.0  | 6.4  | 10.5  | 46                    | 35                     |
| 12  | 27.7                                       | 10.0   | 25.5  | 7.0  | 11.1  | 49                    | 40                     |
| 13  | 30.2                                       | 11.0   | 27.0  | 8.5  | 11.1  | 62                    | 45                     |
| 14  | 32.8                                       | 12.0   | 28.0  | 9.5  | 12.0  | 86                    | 55                     |
| 15  | 34.8                                       | 12.0   | 30.2  | 10.3   | 12.0  | 104                   | 65                     |
| 16  | 36.4                                       | 12.0   | 31.2  | 10.3   | 12.0  | 124                   | 75                     |
| 17  | 39.7                                       | 13.5   | 32.2  | 12.0   | 13.5  | 139                   | 85                     |
| 18  | 41.0                                       | 13.5   | 33.6  | 12.5   | 14.0  | 155                   | 95                     |
| 19  | 42.7                                       | 14.0   | 35.9  | 13.0   | 14.7  | 186                   | 105                    |

**Table 5.1.4-3 Category 40, Type I Lengths  
(U.S. Customary)**

| Nominal Wrench Opening Across Flat |                 |               |
|------------------------------------|-----------------|---------------|
| <i>A</i>                           | <i>B</i>        | Regular, Min. |
| $\frac{1}{4}$                      | $\frac{5}{16}$  | 3.750         |
| $\frac{5}{16}$                     | $\frac{3}{8}$   | 4.500         |
| $\frac{3}{8}$                      | $\frac{7}{16}$  | 4.875         |
| $\frac{7}{16}$                     | $\frac{1}{2}$   | 5.500         |
| $\frac{1}{2}$                      | $\frac{9}{16}$  | 5.625         |
| $\frac{5}{8}$                      | $\frac{11}{16}$ | 6.250         |
| $\frac{5}{8}$                      | $\frac{3}{4}$   | 6.750         |
| $\frac{5}{8}$                      | $\frac{13}{16}$ | 7.000         |
| $\frac{3}{4}$                      | $\frac{13}{16}$ | 7.000         |
| $\frac{3}{4}$                      | $\frac{7}{8}$   | 7.000         |
| $\frac{3}{4}$                      | 1               | 8.000         |
| $\frac{7}{8}$                      | $\frac{15}{16}$ | 8.000         |
| $\frac{7}{8}$                      | 1               | 8.000         |
| $\frac{7}{8}$                      | $1\frac{1}{8}$  | 8.000         |
| $1\frac{15}{16}$                   | $1\frac{1}{16}$ | 8.000         |
| 1                                  | $1\frac{1}{16}$ | 9.000         |

**Table 5.1.4-3M Category 40, Type I Lengths (Metric)**

| Nominal Wrench Opening Across Flat |          |               |
|------------------------------------|----------|---------------|
| <i>A</i>                           | <i>B</i> | Regular, Min. |
| 7                                  | 8        | 101           |
| 7                                  | 9        | 109           |
| 8                                  | 10       | 116           |
| 9                                  | 11       | 123           |
| 10                                 | 12       | 135           |
| 11                                 | 13       | 140           |
| 12                                 | 14       | 140           |
| 13                                 | 14       | 150           |
| 15                                 | 17       | 170           |
| 16                                 | 17       | 170           |
| 16                                 | 18       | 177           |
| 18                                 | 20       | 180           |
| 19                                 | 21       | 184           |
| 19                                 | 22       | 190           |

**Table 5.1.4-4 Category 40, Type II Lengths  
(U.S. Customary)**

| Nominal Wrench Opening Across<br>Flat, <i>A</i> or <i>B</i> |  | Regular, Min. |
|---|--|---------------|
| $\frac{5}{16}$  |  | 4.500         |
| $\frac{3}{8}$   |  | 4.875         |
| $\frac{7}{16}$  |  | 5.375         |
| $\frac{1}{2}$   |  | 5.625         |
| $\frac{9}{16}$  |  | 5.750         |
| $\frac{5}{8}$   |  | 6.250         |
| $\frac{11}{16}$   |  | 7.000         |
| $\frac{3}{4}$   |  | 7.500         |
| $\frac{13}{16}$   |  | 8.000         |
| $\frac{7}{8}$   |  | 8.300         |
| $\frac{15}{16}$   |  | 9.000         |
| 1   |  | 10.000        |

**Table 5.1.4-4M Category 40, Type II Lengths  
(Metric)**

| Nominal Wrench Opening Across<br>Flat, <i>A</i> or <i>B</i> |  | Regular, Min. |
|---|--|---------------|
| 8   |  | 100           |
| 9   |  | 103           |
| 10  |  | 119           |
| 11  |  | 124           |
| 12  |  | 140           |
| 13  |  | 143           |
| 14  |  | 150           |
| 15  |  | 153           |
| 16  |  | 156           |
| 17  |  | 162           |
| 18  |  | 170           |
| 19  |  | 180           |



Figure 5.2-1 Category 8 Adjustable Wrench

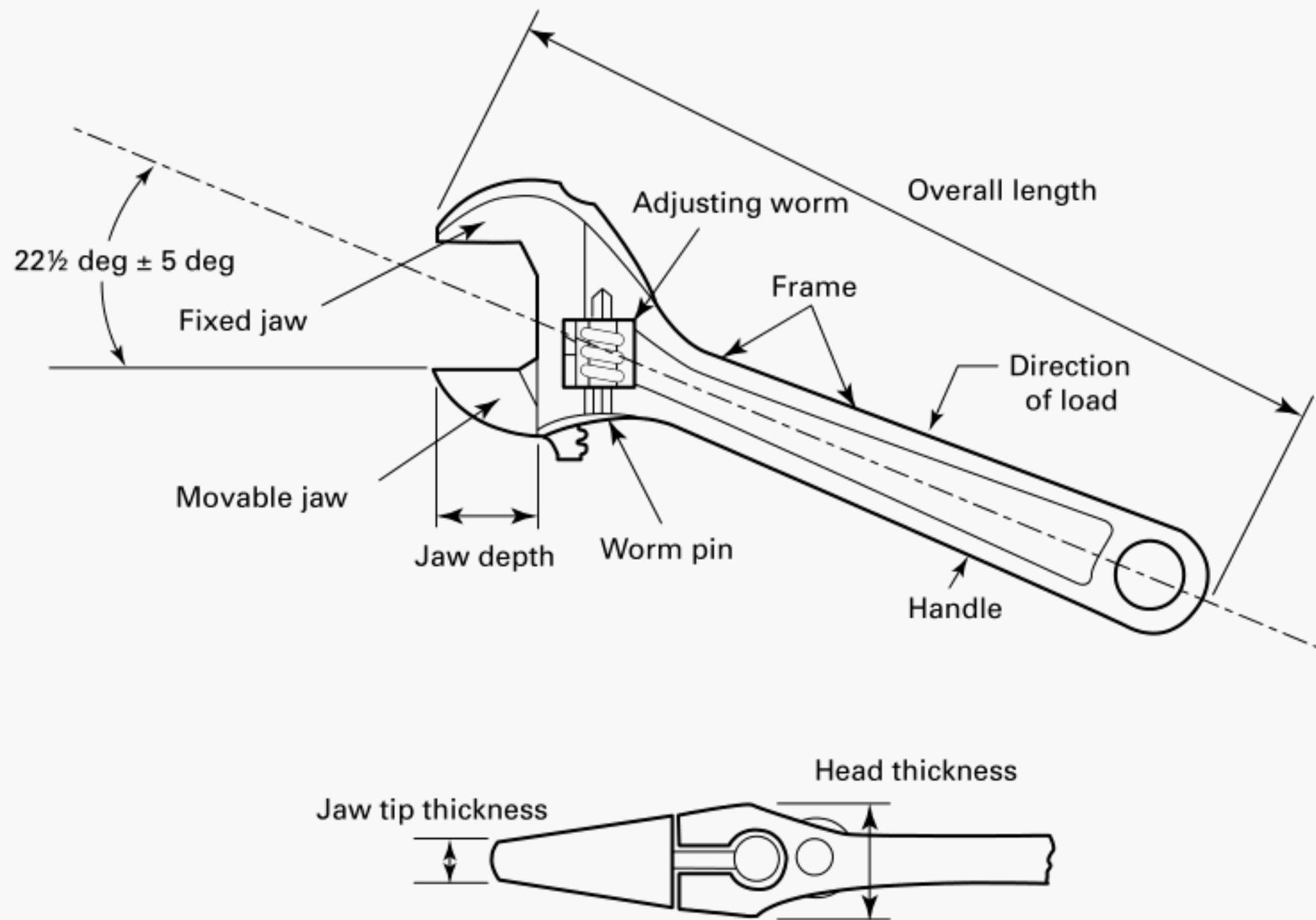


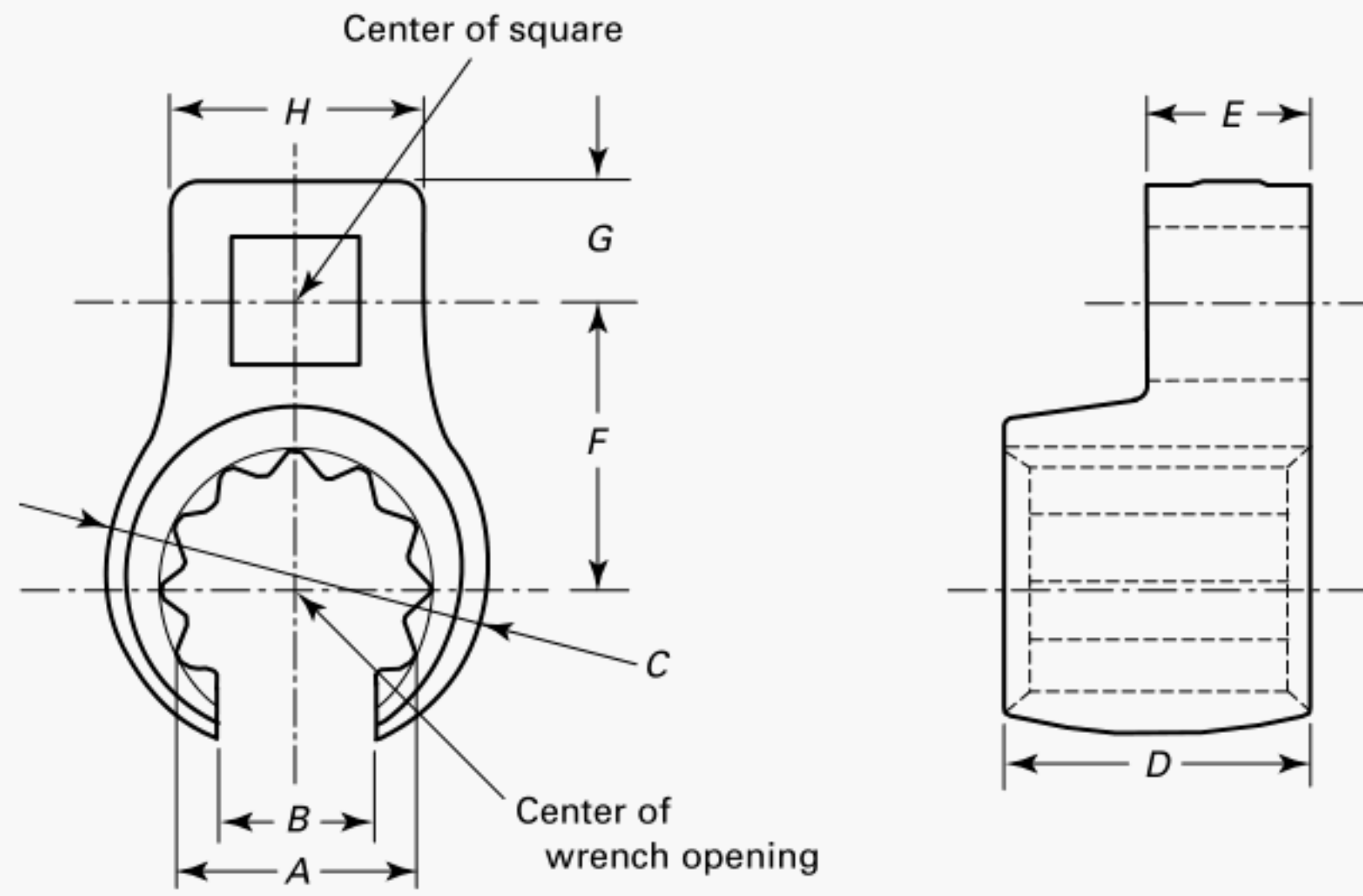
Table 5.2-1 Category 8 Adjustable Wrench (U.S. Customary)

| Nominal<br>Size | Overall<br>Length<br>[Note (1)] |      | Minimum<br>Jaw<br>Depth,<br>Types<br>I and II | Full Opening of<br>Jaw Not Less<br>Than |         | Thickness           |               |                 | Maximum<br>Clearance<br>of Movable<br>Jaw | Maximum<br>Parallelism<br>of Movable<br>Jaw, Y | Minimum<br>Proof<br>Torque,<br>lbf-in. | Mandrel Sizes,<br>X, Across Flats,<br>+0.000/<br>−0.005 |
|-----------------|---------------------------------|------|---|---|---------|---------------------|---------------|-----------------|---|--|--|---|
|                 | Min.                            | Max. |   | Type I                                  | Type II | Jaw<br>Tip,<br>Max. | Head,<br>Max. | Handle,<br>Max. |   |  |  |   |
|                 |                                 |      |   |   |         |                     |               |                 |   |  |  |   |
| 4               | 3.5                             | 4.5  | 0.43  | 0.504                                   | ...     | 0.250               | 0.375         | 0.350           | 0.012                                     | 0.007  | 600                                    | 0.500   |
| 6               | 5.5                             | 6.5  | 0.65  | 0.756                                   | 0.938   | 0.281               | 0.455         | 0.420           | 0.012                                     | 0.008  | 1,450                                  | 0.750   |
| 8               | 7.5                             | 8.5  | 0.81  | 0.947                                   | 1.125   | 0.343               | 0.575         | 0.470           | 0.015                                     | 0.008  | 2,700                                  | 0.938   |
| 10              | 9.5                             | 10.5 | 0.98  | 1.133                                   | 1.290   | 0.437               | 0.665         | 0.570           | 0.015                                     | 0.009  | 4,500                                  | 1.125   |
| 12              | 11.5                            | 12.5 | 1.14  | 1.321                                   | 1.500   | 0.531               | 0.805         | 0.600           | 0.015                                     | 0.010  | 7,650                                  | 1.312   |
| 15              | 14.5                            | 15.5 | 1.46  | 1.698                                   | ...     | 0.625               | 1.000         | 0.688           | 0.015                                     | 0.012  | 15,000                                 | 1.688   |
| 16              | 15.7                            | 16.7 | 1.62  | 1.875                                   | ...     | 0.656               | 1.031         | 0.688           | 0.015                                     | 0.012  | 15,000                                 | 1.875   |
| 18              | 17.5                            | 19.0 | 1.78  | 2.062                                   | ...     | 0.718               | 1.281         | 0.750           | 0.015                                     | 0.015  | 20,000                                 | 2.062   |
| 20              | 19.5                            | 21.0 | 2.06  | 2.375                                   | ...     | 0.781               | 1.312         | 0.750           | 0.015                                     | 0.015  | 20,000                                 | 2.375   |
| 24              | 23.5                            | 25.0 | 2.11  | 2.438                                   | ...     | 0.906               | 1.438         | 0.875           | 0.018                                     | 0.018  | 25,000                                 | 2.438   |

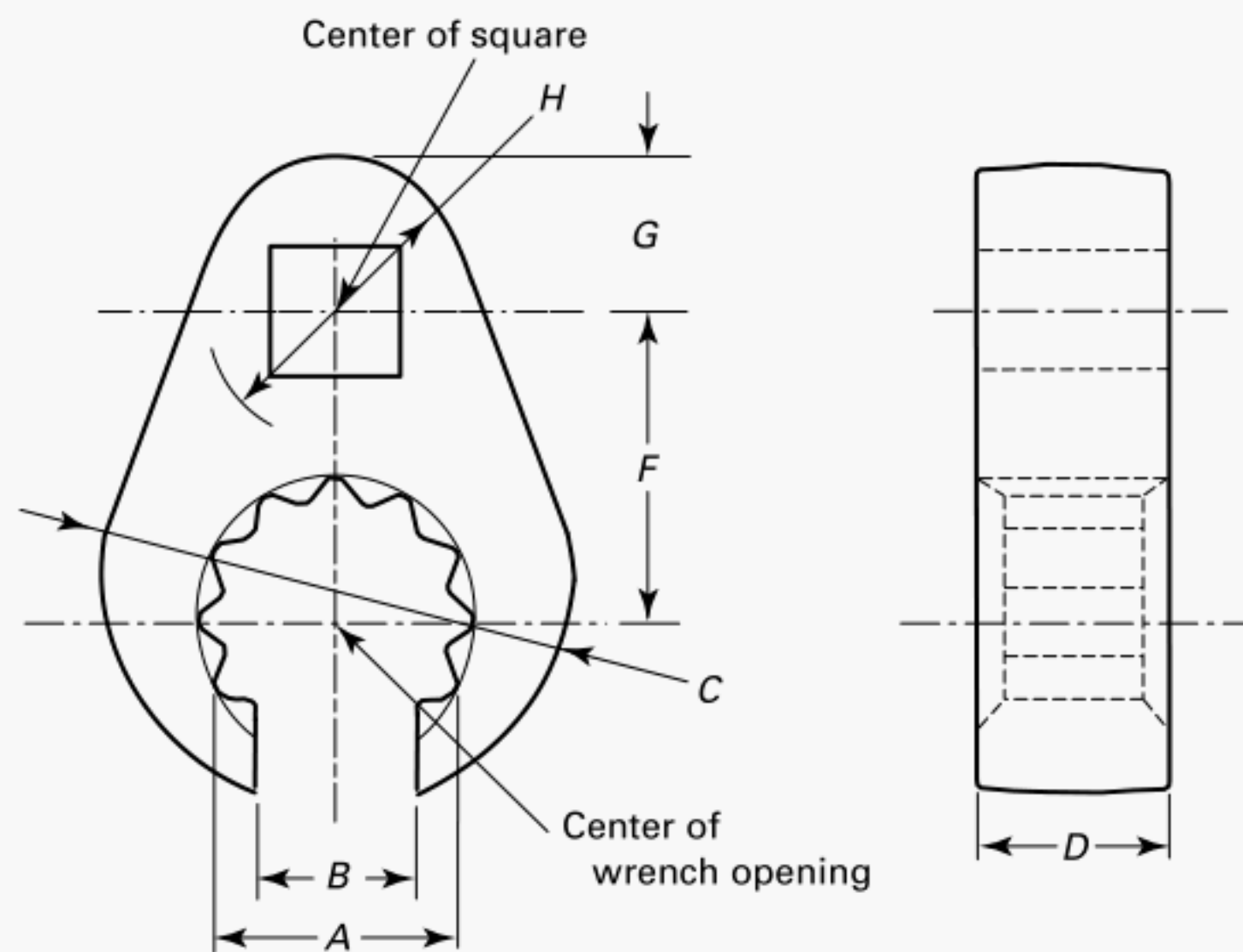
NOTE:

(1) Overall length is to be measured with comfort grips removed.

**Figure 5.3.1-1 Category 21, Type I, Class 1 Crowfoot Wrench, Flare Nut, Standard Duty**



**Figure 5.3.1-2 Category 21, Type I, Class 2 Crowfoot Wrench, Flare Nut, Heavy Duty**



**Table 5.3.1-1 Category 21, Type I, Class 1 Flare Nut,  $\frac{1}{4}$  in. Square Drive, Standard Duty (U.S. Customary)**

| Nominal Wrench Opening, <i>A</i> | Minimum Slot Opening, <i>B</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Drive End Thickness, <i>E</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Width, <i>H</i> | Minimum Proof Torque, lbf-in. |
|----------------------------------|--------------------------------|------------------------------|----------------------------------|---------------------------------------|-----------------------------------|---|-----------------------------------|-------------------------------|
| $\frac{3}{16}$                   | 0.105                          | 0.437                        | 0.312                            | 0.250                                 | 0.593                             | 0.265                                   | 0.515                             | 50                            |
| $\frac{7}{32}$                   | 0.105                          | 0.437                        | 0.312                            | 0.250                                 | 0.608                             | 0.265                                   | 0.515                             | 50                            |
| $\frac{1}{4}$                    | 0.117                          | 0.500                        | 0.312                            | 0.250                                 | 0.624                             | 0.265                                   | 0.515                             | 60                            |
| $\frac{9}{32}$                   | 0.117                          | 0.500                        | 0.312                            | 0.250                                 | 0.639                             | 0.265                                   | 0.515                             | 60                            |
| $\frac{5}{16}$                   | 0.142                          | 0.535                        | 0.344                            | 0.282                                 | 0.654                             | 0.265                                   | 0.515                             | 75                            |
| $\frac{11}{32}$                  | 0.142                          | 0.562                        | 0.344                            | 0.282                                 | 0.670                             | 0.265                                   | 0.515                             | 75                            |
| $\frac{3}{8}$                    | 0.193                          | 0.625                        | 0.531                            | 0.312                                 | 0.685                             | 0.265                                   | 0.515                             | 75                            |
| $\frac{7}{16}$                   | 0.255                          | 0.719                        | 0.593                            | 0.312                                 | 0.716                             | 0.265                                   | 0.515                             | 200                           |
| $\frac{1}{2}$                    | 0.317                          | 0.812                        | 0.593                            | 0.312                                 | 0.747                             | 0.265                                   | 0.515                             | 200                           |
| $\frac{9}{16}$                   | 0.343                          | 0.875                        | 0.593                            | 0.312                                 | 0.778                             | 0.265                                   | 0.515                             | 225                           |

**Table 5.3.1-2 Category 21, Type I, Class 1 Flare Nut,  $\frac{3}{8}$  in. Square Drive, Standard Duty (U.S. Customary)**

| Nominal Wrench Opening, <i>A</i> | Minimum Slot Opening, <i>B</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Drive End Thickness, <i>E</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Width, <i>H</i> | Minimum Proof Torque, lbf-in. |
|----------------------------------|--------------------------------|------------------------------|----------------------------------|---------------------------------------|-----------------------------------|---|-----------------------------------|-------------------------------|
| $\frac{3}{8}$                    | 0.193                          | 0.625                        | 0.624                            | 0.406                                 | 0.843                             | 0.328                                   | 0.656                             | 150                           |
| $\frac{7}{16}$                   | 0.255                          | 0.719                        | 0.624                            | 0.406                                 | 0.898                             | 0.328                                   | 0.656                             | 175                           |
| $\frac{1}{2}$                    | 0.317                          | 0.812                        | 0.624                            | 0.406                                 | 0.935                             | 0.328                                   | 0.656                             | 200                           |
| $\frac{9}{16}$                   | 0.343                          | 0.875                        | 0.624                            | 0.406                                 | 0.980                             | 0.328                                   | 0.656                             | 225                           |
| $\frac{5}{8}$                    | 0.406                          | 0.998                        | 0.750                            | 0.406                                 | 1.026                             | 0.328                                   | 0.656                             | 250                           |
| $\frac{11}{16}$                  | 0.442                          | 1.091                        | 0.750                            | 0.406                                 | 1.117                             | 0.328                                   | 0.656                             | 310                           |
| $\frac{3}{4}$                    | 0.443                          | 1.185                        | 0.781                            | 0.406                                 | 1.125                             | 0.328                                   | 0.656                             | 450                           |
| $\frac{13}{16}$                  | 0.531                          | 1.263                        | 0.781                            | 0.406                                 | 1.176                             | 0.328                                   | 0.656                             | 450                           |
| $\frac{7}{8}$                    | 0.531                          | 1.357                        | 0.812                            | 0.406                                 | 1.274                             | 0.328                                   | 0.656                             | 625                           |
| $\frac{15}{16}$                  | 0.578                          | 1.435                        | 0.812                            | 0.406                                 | 1.254                             | 0.328                                   | 0.656                             | 625                           |
| 1                                | 0.656                          | 1.513                        | 0.843                            | 0.406                                 | 1.409                             | 0.328                                   | 0.656                             | 625                           |
| $1\frac{1}{16}$                  | 0.656                          | 1.590                        | 0.843                            | 0.406                                 | 1.345                             | 0.328                                   | 0.656                             | 625                           |

**Table 5.3.1-3 Category 21, Type I, Class 1 Flare Nut,  $\frac{1}{2}$  in. Square Drive, Standard Duty (U.S. Customary)**

| Nominal<br>Wrench<br>Opening, <i>A</i> | Minimum<br>Slot Opening,<br><i>B</i> | Maximum<br>Head Width,<br><i>C</i> | Maximum<br>Head<br>Thickness, <i>D</i> | Maximum<br>Drive End<br>Thickness, <i>E</i> | Maximum<br>Center<br>Distance, <i>F</i> | Maximum<br>Drive Square<br>Location, <i>G</i> | Maximum<br>Drive End<br>Width, <i>H</i> | Minimum<br>Proof<br>Torque,<br>lbf-in. |
|--|--------------------------------------|------------------------------------|--|---|---|---|---|--|
| $1\frac{1}{8}$                         | 0.755                                | 1.688                              | 0.937                                  | 0.531                                       | 1.923                                   | 0.438   | 0.875                                   | 825                                    |
| $1\frac{3}{16}$                        | 0.812                                | 1.750                              | 0.937                                  | 0.531                                       | 1.963                                   | 0.438   | 0.875                                   | 825                                    |
| $1\frac{1}{4}$                         | 0.890                                | 1.844                              | 0.937                                  | 0.531                                       | 2.045                                   | 0.438   | 0.875                                   | 825                                    |
| $1\frac{5}{16}$                        | 0.916                                | 1.906                              | 0.937                                  | 0.531                                       | 2.045                                   | 0.438   | 0.875                                   | 900                                    |
| $1\frac{3}{8}$                         | 1.015                                | 2.000                              | 1.000                                  | 0.531                                       | 2.084                                   | 0.438   | 0.875                                   | 900                                    |
| $1\frac{7}{16}$                        | 1.015                                | 2.062                              | 1.000                                  | 0.531                                       | 2.125                                   | 0.438   | 0.875                                   | 900                                    |
| $1\frac{1}{2}$                         | 1.015                                | 2.125                              | 1.000                                  | 0.531                                       | 2.165                                   | 0.438   | 0.875                                   | 900                                    |
| $1\frac{9}{16}$                        | 1.063                                | 2.188                              | 1.000                                  | 0.531                                       | 2.205                                   | 0.438   | 0.875                                   | 1,100                                  |
| $1\frac{5}{8}$                         | 1.130                                | 2.281                              | 1.000                                  | 0.531                                       | 2.246                                   | 0.438   | 0.875                                   | 1,100                                  |
| $1\frac{11}{16}$                       | 1.265                                | 2.375                              | 1.062                                  | 0.531                                       | 2.295                                   | 0.438   | 0.875                                   | 1,100                                  |
| $1\frac{3}{4}$                         | 1.265                                | 2.438                              | 1.062                                  | 0.531                                       | 2.327                                   | 0.438   | 0.875                                   | 1,150                                  |
| $1\frac{13}{16}$                       | 1.265                                | 2.531                              | 1.062                                  | 0.531                                       | 2.367                                   | 0.438   | 0.875                                   | 1,200                                  |
| $1\frac{7}{8}$                         | 1.265                                | 2.625                              | 1.124                                  | 0.531                                       | 2.408                                   | 0.438   | 0.875                                   | 1,200                                  |
| $1\frac{15}{16}$                       | 1.265                                | 2.688                              | 1.124                                  | 0.531                                       | 2.448                                   | 0.438   | 0.875                                   | 1,200                                  |
| 2                                      | 1.515                                | 2.781                              | 1.124                                  | 0.531                                       | 2.488                                   | 0.453   | 0.906                                   | 1,400                                  |
| $2\frac{1}{16}$                        | 1.515                                | 2.844                              | 1.187                                  | 0.531                                       | 2.529                                   | 0.453   | 0.906                                   | 1,450                                  |
| $2\frac{1}{8}$                         | 1.515                                | 2.904                              | 1.187                                  | 0.531                                       | 2.569                                   | 0.453   | 0.906                                   | 1,450                                  |
| $2\frac{3}{16}$                        | 1.515                                | 3.000                              | 1.187                                  | 0.531                                       | 2.610                                   | 0.453   | 0.906                                   | 1,500                                  |
| $2\frac{1}{4}$                         | 1.515                                | 3.094                              | 1.187                                  | 0.531                                       | 2.650                                   | 0.453   | 0.906                                   | 1,500                                  |
| $2\frac{5}{16}$                        | 1.515                                | 3.156                              | 1.250                                  | 0.531                                       | 2.690                                   | 0.453   | 0.906                                   | 1,500                                  |
| $2\frac{3}{8}$                         | 1.630                                | 3.250                              | 1.250                                  | 0.531                                       | 2.731                                   | 0.469   | 0.938                                   | 1,600                                  |
| $2\frac{7}{16}$                        | 1.630                                | 3.312                              | 1.250                                  | 0.531                                       | 2.771                                   | 0.469   | 0.938                                   | 1,650                                  |
| $2\frac{1}{2}$                         | 1.630                                | 3.609                              | 1.250                                  | 0.531                                       | 2.812                                   | 0.469   | 0.938                                   | 1,700                                  |
| $2\frac{9}{16}$                        | 1.755                                | 3.500                              | 1.312                                  | 0.531                                       | 2.852                                   | 0.469   | 0.938                                   | 1,750                                  |
| $2\frac{5}{8}$                         | 2.015                                | 3.562                              | 1.312                                  | 0.531                                       | 2.893                                   | 0.469   | 0.938                                   | 1,800                                  |
| $2\frac{11}{16}$                       | 2.015                                | 3.625                              | 1.312                                  | 0.531                                       | 2.933                                   | 0.469   | 0.938                                   | 1,800                                  |
| $2\frac{3}{4}$                         | 2.015                                | 3.719                              | 1.312                                  | 0.531                                       | 2.973                                   | 0.484   | 0.969                                   | 1,850                                  |
| $2\frac{13}{16}$                       | 2.015                                | 3.781                              | 1.374                                  | 0.531                                       | 3.014                                   | 0.484   | 0.969                                   | 1,900                                  |
| $2\frac{15}{16}$                       | 2.015                                | 3.938                              | 1.374                                  | 0.531                                       | 3.095                                   | 0.484   | 0.969                                   | 1,950                                  |
| $3\frac{1}{8}$                         | 2.015                                | 4.188                              | 1.374                                  | 0.531                                       | 3.216                                   | 0.484   | 0.969                                   | 2,000                                  |



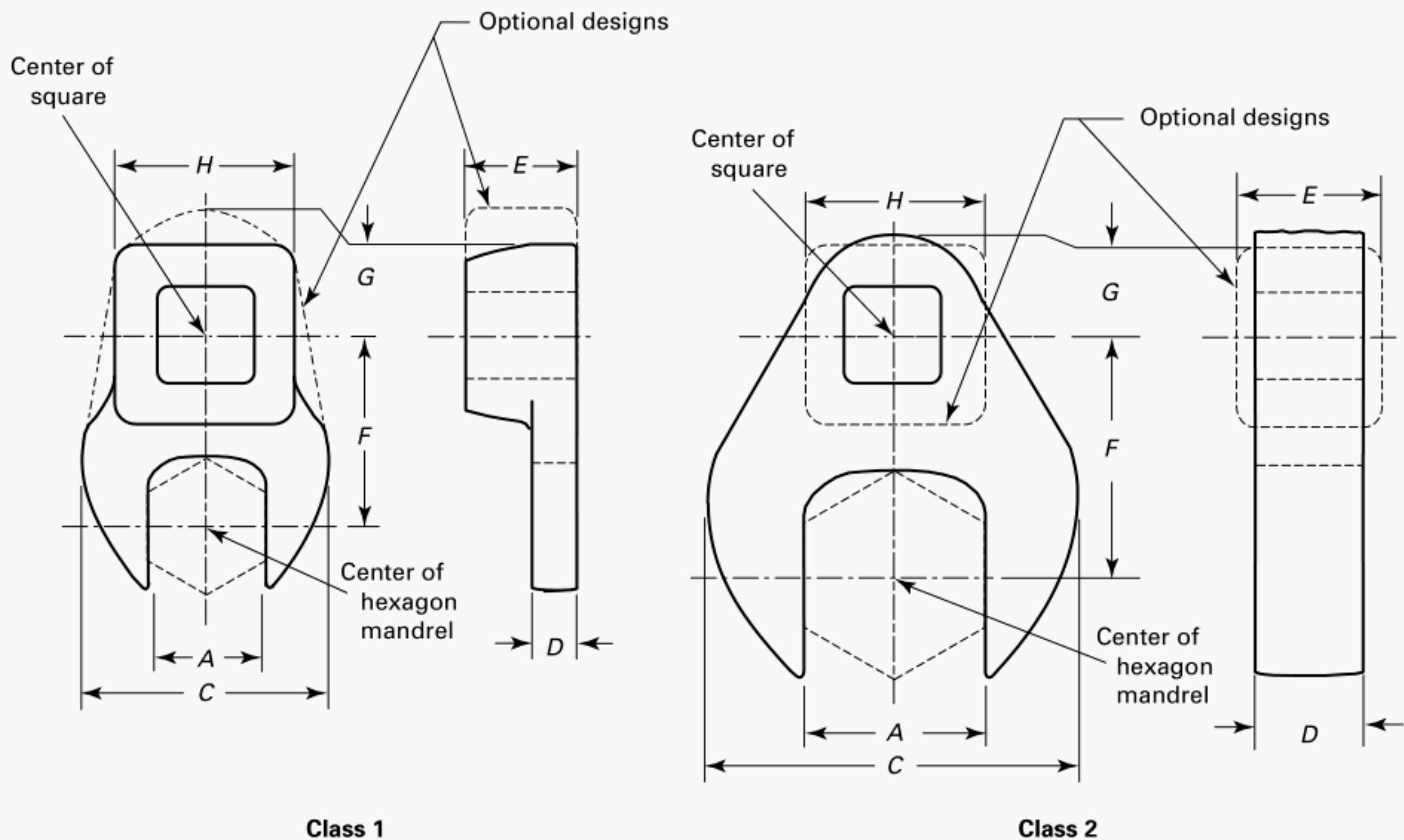
**Table 5.3.1-4 Category 21, Type I, Class 2 Flare Nut,  $\frac{3}{8}$  in. Square Drive, Heavy Duty (U.S. Customary)**

| Nominal Wrench Opening, <i>A</i> | Minimum Slot Opening, <i>B</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Diameter, <i>H</i> | Minimum Proof Torque, lbf-in. |
|----------------------------------|--------------------------------|------------------------------|----------------------------------|-----------------------------------|---|--------------------------------------|-------------------------------|
| $\frac{3}{8}$                    | 0.193                          | 0.891                        | 0.406                            | 0.843                             | 0.470                                   | 0.938                                | 240                           |
| $\frac{7}{16}$                   | 0.255                          | 1.000                        | 0.406                            | 0.889                             | 0.470                                   | 0.938                                | 320                           |
| $\frac{1}{2}$                    | 0.317                          | 1.094                        | 0.468                            | 0.935                             | 0.470                                   | 0.938                                | 400                           |
| $\frac{9}{16}$                   | 0.343                          | 1.219                        | 0.468                            | 0.980                             | 0.470                                   | 0.938                                | 510                           |
| $\frac{5}{8}$                    | 0.406                          | 1.296                        | 0.468                            | 1.026                             | 0.470                                   | 0.938                                | 625                           |
| $\frac{11}{16}$                  | 0.442                          | 1.406                        | 0.562                            | 1.117                             | 0.470                                   | 1.060                                | 750                           |
| $\frac{3}{4}$                    | 0.442                          | 1.515                        | 0.562                            | 1.125                             | 0.470                                   | 1.060                                | 880                           |
| $\frac{13}{16}$                  | 0.531                          | 1.719                        | 0.593                            | 1.176                             | 0.470                                   | 1.190                                | 1,025                         |
| $\frac{7}{8}$                    | 0.531                          | 1.719                        | 0.593                            | 1.274                             | 0.470                                   | 1.190                                | 1,180                         |
| $\frac{15}{16}$                  | 0.578                          | 1.984                        | 0.641                            | 1.254                             | 0.470                                   | 1.190                                | 1,280                         |
| 1                                | 0.656                          | 1.984                        | 0.641                            | 1.409                             | 0.470                                   | 1.190                                | 1,480                         |

**Table 5.3.1-4M Category 21, Type I, Class 2 Flare Nut,  $\frac{3}{8}$  in. Square Drive, Heavy Duty (Metric)**

| Nominal Wrench Opening, <i>A</i> | Minimum Slot Opening, <i>B</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Diameter, <i>H</i> | Minimum Proof Torque, N·m |
|----------------------------------|--------------------------------|------------------------------|----------------------------------|-----------------------------------|---|--------------------------------------|---------------------------|
| 9                                | 4.5                            | 22.9                         | 10.3                             | 21.0                              | 11.9                                    | 23.8                                 | 25                        |
| 10                               | 4.8                            | 24.0                         | 10.3                             | 21.8                              | 11.9                                    | 23.8                                 | 30                        |
| 11                               | 6.4                            | 25.4                         | 10.3                             | 22.5                              | 11.9                                    | 23.8                                 | 35                        |
| 12                               | 7.0                            | 27.0                         | 10.3                             | 23.2                              | 11.9                                    | 23.8                                 | 40                        |
| 13                               | 8.0                            | 27.8                         | 11.9                             | 24.0                              | 11.9                                    | 23.8                                 | 45                        |
| 14                               | 8.7                            | 31.0                         | 11.9                             | 24.7                              | 11.9                                    | 23.8                                 | 55                        |
| 15                               | 10.3                           | 32.1                         | 11.9                             | 25.4                              | 11.9                                    | 23.8                                 | 65                        |
| 16                               | 10.3                           | 32.9                         | 11.9                             | 26.1                              | 11.9                                    | 23.8                                 | 75                        |
| 17                               | 11.1                           | 35.7                         | 14.3                             | 26.9                              | 11.9                                    | 26.9                                 | 85                        |
| 18                               | 11.1                           | 36.1                         | 14.3                             | 27.6                              | 11.9                                    | 26.9                                 | 95                        |
| 19                               | 11.1                           | 36.1                         | 14.3                             | 28.3                              | 11.9                                    | 26.9                                 | 105                       |
| 20                               | 12.0                           | 43.7                         | 16.3                             | 29.1                              | 11.9                                    | 30.2                                 | 120                       |
| 21                               | 13.5                           | 43.7                         | 16.3                             | 29.8                              | 11.9                                    | 30.2                                 | 130                       |
| 22                               | 13.5                           | 43.7                         | 16.3                             | 30.5                              | 11.9                                    | 30.2                                 | 145                       |

Figure 5.3.2-1 Category 21, Type II Crowfoot Wrench, Open End



sharp edges shall be broken to 0.016 in. (0.41 mm) radius minimum and shall not project more than 0.016 in. (0.41 mm) from adjacent surfaces.

**5.9.2 Coatings.** The coating shall be adherent, smooth, continuous, and free from uncoated areas, pits, blisters, nodules, and any other conditions that would interfere with their protective value and serviceability. Plating contact marks should be kept to a minimum.

Category 6, 9, 21, 39, and 40 wrenches shall be coated with one of the coatings in accordance with (a), (b), or (c) below. The customer may specify the type of coating required.

The frame and the movable jaw of Category 8 wrenches shall have one or more of the coatings described below, with the exception of zinc. Adjusting mechanisms consisting of a worm and worm pin, when provided, shall have any of the following coatings:

(a) *Nickel-Chromium.* Wrenches shall have a protective-decorative nickel-chromium plating. The nickel thickness shall be a minimum of 0.000150 in. (0.0038 mm). The chromium thickness shall be a minimum of 0.000003 in. (0.000076 mm). A nickel-iron undercoating (16% iron max.) may be substituted for nickel. Alternative coatings may be used in lieu of nickel-chromium and shall be subjected to the Alternative Coating Test as specified in para. 6.3.

(b) *Phosphate.* Wrenches shall have a chemically produced phosphate coating followed by a coating of rust preventative.

(c) *Oxide.* Oxide-coated wrenches shall have a coating consisting of a chemically produced oxide followed by a coating of rust preventative.

(d) *Zinc.* Adjusting worms and worm pins may have a coating of electrodeposited zinc of 0.0003 in. (0.0076 mm) minimum thickness.

**5.9.3 Category 66.** Surfaces shall have a rust-preventive treatment and be essentially free from burrs, pits, cracks, nodules, and other conditions (including flash) that would adversely affect the performance or safety of the wrench. When provided, coatings shall be adherent, smooth, continuous, and free from any conditions that would interfere with their protective value, safety, and function. Plated surfaces shall be subjected to the tests detailed in paras. 6.3.2 and 6.3.3.

## 5.10 Comfort Grips

When comfort grips are furnished on handles, they shall be made of rubber, plastic, or other suitable material capable of normal use without deteriorating or rubbing off, and shall pass the solvent test specified in para. 6.6. The comfort grips shall remain permanently attached under normal use of the tool. Unless specifically

**Table 5.3.2-1 Category 21, Type II, Class 1 Open End,  $\frac{3}{8}$  in. Square Drive, Standard Duty (U.S. Customary)**

| Nominal<br>Wrench<br>Opening, <i>A</i> | Maximum<br>Head Width,<br><i>C</i> | Maximum Head<br>Thickness, <i>D</i> | Maximum Drive<br>End Thickness,<br><i>E</i> | Maximum<br>Center<br>Distance, <i>F</i> | Maximum Drive<br>Square Location,<br><i>G</i> | Maximum<br>Drive End<br>Width, <i>H</i> | Minimum<br>Proof Torque,<br>lbf-in. |
|--|------------------------------------|-------------------------------------|---|---|---|---|-------------------------------------|
| $\frac{3}{8}$                          | 0.951                              | 0.250                               | 0.656                                       | 0.843                                   | 0.375   | 0.750                                   | 105                                 |
| $\frac{7}{16}$                         | 0.951                              | 0.250                               | 0.656                                       | 0.889                                   | 0.375   | 0.750                                   | 140                                 |
| $\frac{1}{2}$                          | 1.137                              | 0.270                               | 0.656                                       | 0.935                                   | 0.375   | 0.750                                   | 175                                 |
| $\frac{9}{16}$                         | 1.270                              | 0.270                               | 0.656                                       | 0.980                                   | 0.375   | 0.750                                   | 210                                 |
| $\frac{5}{8}$                          | 1.387                              | 0.350                               | 0.656                                       | 1.026                                   | 0.375   | 0.750                                   | 263                                 |
| $\frac{11}{16}$                        | 1.570                              | 0.350                               | 0.656                                       | 1.117                                   | 0.438   | 1.000                                   | 315                                 |
| $\frac{3}{4}$                          | 1.625                              | 0.350                               | 0.719                                       | 1.125                                   | 0.438   | 1.000                                   | 368                                 |
| $\frac{13}{16}$                        | 1.750                              | 0.350                               | 0.719                                       | 1.176                                   | 0.438   | 1.000                                   | 420                                 |
| $\frac{7}{8}$                          | 1.812                              | 0.370                               | 0.719                                       | 1.274                                   | 0.438   | 1.000                                   | 473                                 |
| $\frac{15}{16}$                        | 2.010                              | 0.370                               | 0.719                                       | 1.254                                   | 0.438   | 1.000                                   | 525                                 |
| 1                                      | 2.078                              | 0.375                               | 0.719                                       | 1.409                                   | 0.438   | 1.000                                   | 578                                 |
| $1\frac{1}{16}$                        | 2.125                              | 0.375                               | 0.719                                       | 1.345                                   | 0.438   | 1.000                                   | 630                                 |
| $1\frac{1}{8}$                         | 2.125                              | 0.375                               | 0.719                                       | 1.390                                   | 0.438   | 1.000                                   | 700                                 |
| $1\frac{3}{16}$                        | 2.156                              | 0.375                               | 0.719                                       | 1.436                                   | 0.438   | 1.000                                   | 770                                 |
| $1\frac{1}{4}$                         | 2.188                              | 0.375                               | 0.719                                       | 1.481                                   | 0.438   | 1.000                                   | 840                                 |
| $1\frac{5}{16}$                        | 2.188                              | 0.375                               | 0.719                                       | 1.527                                   | 0.438   | 1.000                                   | 910                                 |
| $1\frac{3}{8}$                         | 2.438                              | 0.375                               | 0.719                                       | 1.573                                   | 0.438   | 1.000                                   | 980                                 |
| $1\frac{7}{16}$                        | 2.438                              | 0.375                               | 0.719                                       | 1.618                                   | 0.438   | 1.000                                   | 1,050                               |
| $1\frac{1}{2}$                         | 2.625                              | 0.375                               | 0.719                                       | 1.664                                   | 0.438   | 1.125                                   | 1,120                               |
| $1\frac{9}{16}$                        | 2.625                              | 0.375                               | 0.719                                       | 1.709                                   | 0.438   | 1.125                                   | 1,190                               |
| $1\frac{5}{8}$                         | 2.750                              | 0.375                               | 0.719                                       | 1.755                                   | 0.438   | 1.125                                   | 1,260                               |
| $1\frac{11}{16}$                       | 2.750                              | 0.375                               | 0.719                                       | 1.800                                   | 0.438   | 1.125                                   | 1,330                               |
| $1\frac{3}{4}$                         | 2.938                              | 0.375                               | 0.719                                       | 1.846                                   | 0.438   | 1.125                                   | 1,400                               |
| $1\frac{13}{16}$                       | 2.938                              | 0.375                               | 0.719                                       | 1.891                                   | 0.438   | 1.125                                   | 1,470                               |
| $1\frac{7}{8}$                         | 3.250                              | 0.375                               | 0.719                                       | 1.937                                   | 0.438   | 1.125                                   | 1,540                               |
| $1\frac{15}{16}$                       | 3.375                              | 0.375                               | 0.719                                       | 1.983                                   | 0.438   | 1.125                                   | 1,540                               |
| 2                                      | 3.500                              | 0.500                               | 0.812                                       | 2.028                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{1}{16}$                        | 3.500                              | 0.500                               | 0.812                                       | 2.074                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{1}{8}$                         | 3.625                              | 0.500                               | 0.812                                       | 2.119                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{3}{16}$                        | 3.688                              | 0.500                               | 0.812                                       | 2.165                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{1}{4}$                         | 3.938                              | 0.500                               | 0.812                                       | 2.210                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{5}{16}$                        | 4.000                              | 0.500                               | 0.812                                       | 2.256                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{3}{8}$                         | 4.188                              | 0.500                               | 0.812                                       | 2.302                                   | 0.520   | 1.125                                   | 1,540                               |
| $2\frac{7}{16}$                        | 4.188                              | 0.500                               | 0.812                                       | 2.347                                   | 0.520   | 1.125                                   | 1,555                               |
| $2\frac{1}{2}$                         | 4.312                              | 0.500                               | 0.812                                       | 2.393                                   | 0.580   | 1.125                                   | 1,600                               |
| $2\frac{9}{16}$                        | 4.375                              | 0.500                               | 0.812                                       | 2.438                                   | 0.580   | 1.125                                   | 1,660                               |
| $2\frac{5}{8}$                         | 4.625                              | 0.500                               | 0.812                                       | 2.484                                   | 0.580   | 1.125                                   | 1,760                               |
| $2\frac{11}{16}$                       | 4.750                              | 0.500                               | 0.812                                       | 2.529                                   | 0.580   | 1.125                                   | 1,830                               |
| $2\frac{3}{4}$                         | 4.812                              | 0.500                               | 0.812                                       | 2.575                                   | 0.640   | 1.285                                   | 1,900                               |
| $2\frac{13}{16}$                       | 4.812                              | 0.500                               | 0.812                                       | 2.656                                   | 0.640   | 1.285                                   | 2,075                               |
| $2\frac{7}{8}$                         | 5.125                              | 0.500                               | 0.812                                       | 2.688                                   | 0.640   | 1.285                                   | 2,135                               |
| $2\frac{15}{16}$                       | 5.188                              | 0.500                               | 0.812                                       | 2.719                                   | 0.640   | 1.285                                   | 2,200                               |
| 3                                      | 5.188                              | 0.500                               | 0.812                                       | 2.757                                   | 0.640   | 1.285                                   | 2,200                               |



**Table 5.3.2-1M Category 21, Type II, Class 1 Open End,  $\frac{3}{8}$  in. Square Drive, Standard Duty (Metric)**

| Nominal Wrench Opening, <i>A</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Drive End Thickness, <i>E</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Width, <i>H</i> | Minimum Proof Torque, N·m |
|----------------------------------|------------------------------|----------------------------------|---------------------------------------|-----------------------------------|---|-----------------------------------|---------------------------|
| 9                                | 23.7                         | 6.5                              | 16.7                                  | 21.0                              | 9.5                                     | 19.5                              | 12                        |
| 10                               | 24.2                         | 6.5                              | 16.7                                  | 21.8                              | 9.5                                     | 19.5                              | 16                        |
| 11                               | 24.2                         | 6.5                              | 16.7                                  | 22.5                              | 9.5                                     | 19.5                              | 18                        |
| 12                               | 28.5                         | 7.0                              | 16.7                                  | 23.2                              | 9.5                                     | 19.5                              | 20                        |
| 13                               | 28.5                         | 7.0                              | 16.7                                  | 24.0                              | 9.5                                     | 19.5                              | 24                        |
| 14                               | 30.5                         | 7.0                              | 16.7                                  | 24.7                              | 9.5                                     | 19.5                              | 30                        |
| 15                               | 35.0                         | 9.0                              | 16.7                                  | 25.4                              | 9.5                                     | 19.5                              | 33                        |
| 16                               | 35.0                         | 9.0                              | 16.7                                  | 26.1                              | 9.5                                     | 19.5                              | 36                        |
| 17                               | 36.5                         | 9.0                              | 16.7                                  | 26.9                              | 9.5                                     | 19.5                              | 39                        |
| 18                               | 41.6                         | 9.0                              | 16.7                                  | 27.6                              | 11.0                                    | 25.5                              | 41                        |
| 19                               | 41.6                         | 9.0                              | 18.3                                  | 28.3                              | 11.0                                    | 25.5                              | 45                        |
| 20                               | 41.6                         | 9.0                              | 18.3                                  | 29.1                              | 11.0                                    | 25.5                              | 48                        |
| 21                               | 44.5                         | 9.5                              | 18.3                                  | 29.8                              | 11.0                                    | 25.5                              | 53                        |
| 22                               | 44.5                         | 9.5                              | 18.3                                  | 30.5                              | 11.0                                    | 25.5                              | 57                        |
| 23                               | 52.0                         | 10.0                             | 18.3                                  | 36.0                              | 11.0                                    | 25.5                              | 60                        |
| 24                               | 52.0                         | 10.0                             | 18.3                                  | 37.0                              | 11.0                                    | 25.5                              | 65                        |

**Table 5.3.2-2 Category 21, Type II, Class 1 Open End,  $\frac{1}{2}$  in. Square Drive, Standard Duty (U.S. Customary)**

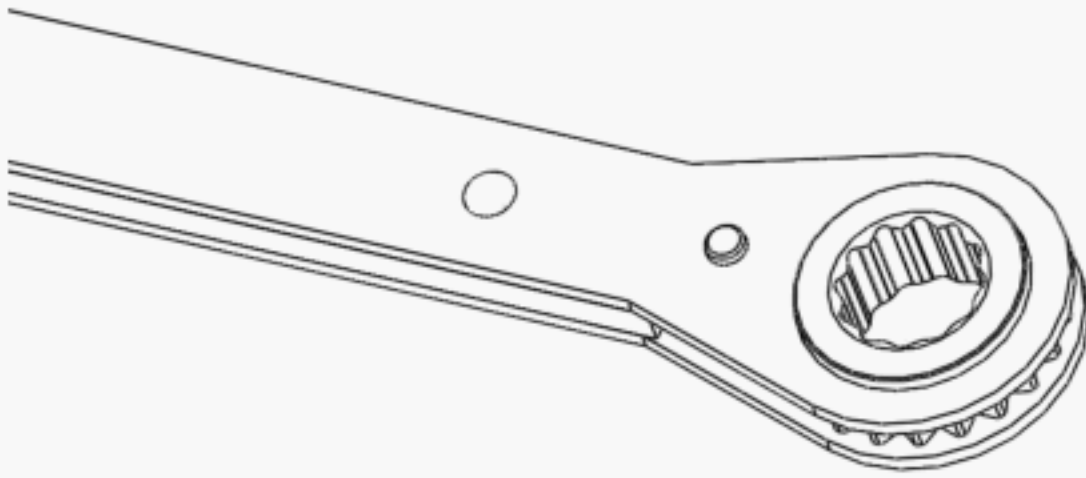
| Nominal Wrench Opening, <i>A</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Drive End Thickness, <i>E</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Width, <i>H</i> | Minimum Proof Torque, lbf-in. |
|----------------------------------|------------------------------|----------------------------------|---------------------------------------|-----------------------------------|---|-----------------------------------|-------------------------------|
| $\frac{15}{16}$                  | 1.968                        | 0.656                            | 0.656                                 | 1.801                             | 0.531                                   | 1.031                             | 2,800                         |
| 1                                | 1.968                        | 0.656                            | 0.656                                 | 1.842                             | 0.531                                   | 1.031                             | 2,900                         |
| $1\frac{1}{16}$                  | 2.156                        | 0.656                            | 0.656                                 | 1.882                             | 0.562                                   | 1.031                             | 3,000                         |
| $1\frac{1}{8}$                   | 2.250                        | 0.656                            | 0.656                                 | 1.923                             | 0.594                                   | 1.031                             | 3,100                         |
| $1\frac{3}{16}$                  | 2.380                        | 0.656                            | 0.656                                 | 1.963                             | 0.594                                   | 1.031                             | 3,200                         |
| $1\frac{1}{4}$                   | 2.500                        | 0.656                            | 0.656                                 | 2.045                             | 0.594                                   | 1.031                             | 3,300                         |
| $1\frac{5}{16}$                  | 2.620                        | 0.656                            | 0.656                                 | 2.045                             | 0.594                                   | 1.031                             | 3,400                         |
| $1\frac{3}{8}$                   | 2.750                        | 0.656                            | 0.656                                 | 2.084                             | 0.594                                   | 1.031                             | 3,500                         |
| $1\frac{7}{16}$                  | 2.880                        | 0.656                            | 0.656                                 | 2.125                             | 0.594                                   | 1.031                             | 3,600                         |
| $1\frac{1}{2}$                   | 3.000                        | 0.656                            | 0.656                                 | 2.165                             | 0.594                                   | 1.031                             | 3,700                         |
| $1\frac{9}{16}$                  | 3.130                        | 0.656                            | 0.656                                 | 2.205                             | 0.594                                   | 1.031                             | 3,800                         |
| $1\frac{5}{8}$                   | 3.250                        | 0.656                            | 0.656                                 | 2.246                             | 0.594                                   | 1.031                             | 4,000                         |
| $1\frac{11}{16}$                 | 3.380                        | 0.656                            | 0.656                                 | 2.295                             | 0.594                                   | 1.031                             | 4,200                         |
| $1\frac{3}{4}$                   | 3.500                        | 0.656                            | 0.656                                 | 2.327                             | 0.594                                   | 1.031                             | 4,400                         |
| $1\frac{13}{16}$                 | 3.620                        | 0.656                            | 0.656                                 | 2.367                             | 0.594                                   | 1.031                             | 4,600                         |
| $1\frac{7}{8}$                   | 3.750                        | 0.656                            | 0.656                                 | 2.408                             | 0.594                                   | 1.031                             | 4,800                         |
| 2                                | 4.000                        | 0.656                            | 0.656                                 | 2.488                             | 0.594                                   | 1.031                             | 5,000                         |
| $2\frac{1}{4}$                   | 4.250                        | 0.656                            | 0.656                                 | 2.650                             | 0.594                                   | 1.031                             | 5,000                         |
| $2\frac{3}{8}$                   | 4.406                        | 0.656                            | 0.656                                 | 2.731                             | 0.594                                   | 1.031                             | 5,000                         |
| $2\frac{7}{16}$                  | 4.406                        | 0.656                            | 0.656                                 | 2.771                             | 0.594                                   | 1.031                             | 5,000                         |
| $2\frac{1}{2}$                   | 4.406                        | 0.656                            | 0.656                                 | 2.812                             | 0.594                                   | 1.031                             | 5,000                         |



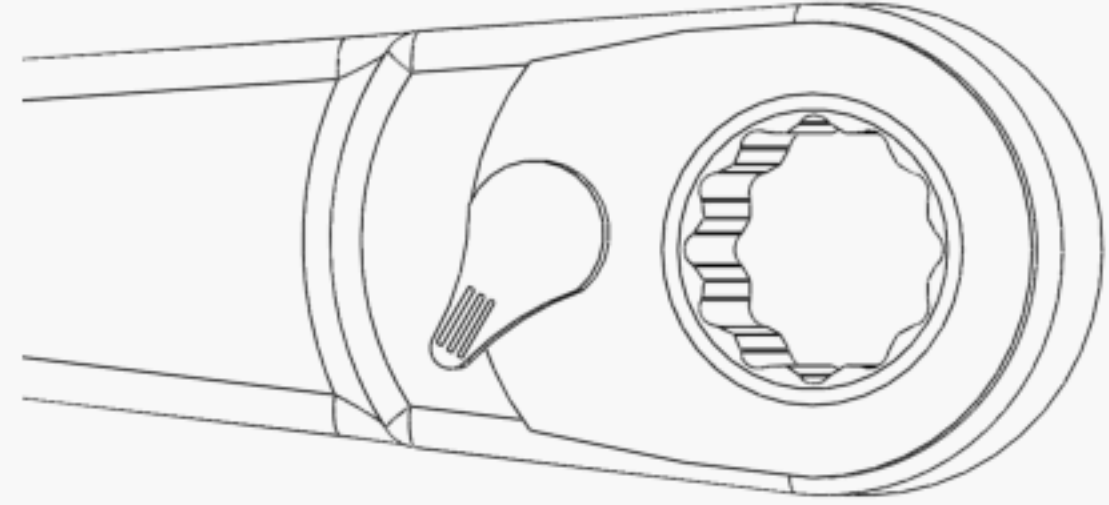
**Table 5.3.2-3 Category 21, Type II, Class 1 Open End,  $\frac{3}{8}$  in. Square Drive, Heavy Duty (U.S. Customary)**

| Nominal Wrench Opening, <i>A</i> | Maximum Head Width, <i>C</i> | Maximum Head Thickness, <i>D</i> | Maximum Drive End Thickness, <i>E</i> | Maximum Center Distance, <i>F</i> | Maximum Drive Square Location, <i>G</i> | Maximum Drive End Width, <i>H</i> | Minimum Proof Torque, lbf-in. |
|----------------------------------|------------------------------|----------------------------------|---------------------------------------|-----------------------------------|---|-----------------------------------|-------------------------------|
| $\frac{3}{8}$                    | 0.937                        | 0.390                            | 0.440                                 | 0.843                             | 0.656                                   | 0.750                             | 150                           |
| $\frac{7}{16}$                   | 1.015                        | 0.405                            | 0.440                                 | 0.889                             | 0.656                                   | 0.750                             | 200                           |
| $\frac{1}{2}$                    | 1.187                        | 0.405                            | 0.440                                 | 0.935                             | 0.656                                   | 0.750                             | 250                           |
| $\frac{9}{16}$                   | 1.265                        | 0.405                            | 0.440                                 | 0.980                             | 0.656                                   | 0.750                             | 300                           |
| $\frac{5}{8}$                    | 1.375                        | 0.405                            | 0.440                                 | 1.026                             | 0.656                                   | 0.750                             | 375                           |
| $1\frac{1}{16}$                  | 1.500                        | 0.405                            | 0.440                                 | 1.117                             | 0.656                                   | 1.000                             | 450                           |
| $\frac{3}{4}$                    | 1.625                        | 0.405                            | 0.440                                 | 1.125                             | 0.719                                   | 1.000                             | 525                           |
| $1\frac{3}{16}$                  | 1.828                        | 0.425                            | 0.440                                 | 1.176                             | 0.719                                   | 1.000                             | 600                           |
| $\frac{7}{8}$                    | 1.890                        | 0.425                            | 0.440                                 | 1.274                             | 0.719                                   | 1.000                             | 675                           |
| $1\frac{5}{16}$                  | 2.015                        | 0.425                            | 0.440                                 | 1.254                             | 0.719                                   | 1.000                             | 750                           |
| 1                                | 2.110                        | 0.425                            | 0.440                                 | 1.409                             | 0.719                                   | 1.000                             | 825                           |
| $1\frac{1}{16}$                  | 2.125                        | 0.425                            | 0.440                                 | 1.345                             | 0.719                                   | 1.000                             | 900                           |
| $1\frac{1}{8}$                   | 2.125                        | 0.425                            | 0.440                                 | 1.390                             | 0.719                                   | 1.000                             | 1,000                         |
| $1\frac{3}{16}$                  | 2.188                        | 0.425                            | 0.440                                 | 1.436                             | 0.719                                   | 1.000                             | 1,100                         |
| $1\frac{1}{4}$                   | 2.203                        | 0.425                            | 0.440                                 | 1.481                             | 0.719                                   | 1.000                             | 1,200                         |
| $1\frac{5}{16}$                  | 2.203                        | 0.425                            | 0.440                                 | 1.527                             | 0.719                                   | 1.000                             | 1,300                         |
| $1\frac{3}{8}$                   | 2.422                        | 0.425                            | 0.440                                 | 1.573                             | 0.719                                   | 1.000                             | 1,400                         |
| $1\frac{7}{16}$                  | 2.422                        | 0.425                            | 0.440                                 | 1.618                             | 0.719                                   | 1.000                             | 1,500                         |
| $1\frac{1}{2}$                   | 2.594                        | 0.425                            | 0.440                                 | 1.664                             | 0.719                                   | 1.125                             | 1,600                         |
| $1\frac{9}{16}$                  | 2.594                        | 0.425                            | 0.440                                 | 1.709                             | 0.719                                   | 1.125                             | 1,700                         |
| $1\frac{5}{8}$                   | 2.734                        | 0.425                            | 0.440                                 | 1.755                             | 0.719                                   | 1.125                             | 1,800                         |
| $1\frac{11}{16}$                 | 2.734                        | 0.425                            | 0.440                                 | 1.800                             | 0.719                                   | 1.125                             | 1,900                         |
| $1\frac{3}{4}$                   | 2.922                        | 0.425                            | 0.440                                 | 1.846                             | 0.719                                   | 1.125                             | 2,000                         |
| $1\frac{13}{16}$                 | 2.922                        | 0.425                            | 0.440                                 | 1.891                             | 0.719                                   | 1.125                             | 2,100                         |
| $1\frac{7}{8}$                   | 3.234                        | 0.425                            | 0.440                                 | 1.937                             | 0.719                                   | 1.125                             | 2,200                         |
| $1\frac{15}{16}$                 | 3.234                        | 0.425                            | 0.440                                 | 1.983                             | 0.719                                   | 1.125                             | 2,200                         |
| 2                                | 3.469                        | 0.500                            | 0.562                                 | 2.028                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{1}{16}$                  | 3.469                        | 0.500                            | 0.562                                 | 2.074                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{1}{8}$                   | 3.656                        | 0.500                            | 0.562                                 | 2.119                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{3}{16}$                  | 3.656                        | 0.500                            | 0.562                                 | 2.165                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{1}{4}$                   | 3.906                        | 0.500                            | 0.562                                 | 2.210                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{5}{16}$                  | 3.906                        | 0.500                            | 0.562                                 | 2.256                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{3}{8}$                   | 4.156                        | 0.500                            | 0.562                                 | 2.302                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{7}{16}$                  | 4.156                        | 0.500                            | 0.562                                 | 2.347                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{1}{2}$                   | 4.344                        | 0.500                            | 0.625                                 | 2.393                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{9}{16}$                  | 4.344                        | 0.500                            | 0.625                                 | 2.438                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{5}{8}$                   | 4.594                        | 0.500                            | 0.625                                 | 2.484                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{11}{16}$                 | 4.594                        | 0.500                            | 0.625                                 | 2.529                             | 0.812                                   | 1.125                             | 2,200                         |
| $2\frac{3}{4}$                   | 4.781                        | 0.500                            | 0.656                                 | 2.575                             | 0.812                                   | 1.250                             | 2,200                         |
| $2\frac{13}{16}$                 | 4.781                        | 0.500                            | 0.656                                 | 2.656                             | 0.812                                   | 1.250                             | 2,200                         |
| $2\frac{7}{8}$                   | 5.141                        | 0.500                            | 0.656                                 | 2.688                             | 0.812                                   | 1.250                             | 2,200                         |
| $2\frac{15}{16}$                 | 5.141                        | 0.500                            | 0.656                                 | 2.719                             | 0.812                                   | 1.250                             | 2,200                         |
| 3                                | 5.141                        | 0.500                            | 0.656                                 | 2.757                             | 0.812                                   | 1.250                             | 2,200                         |

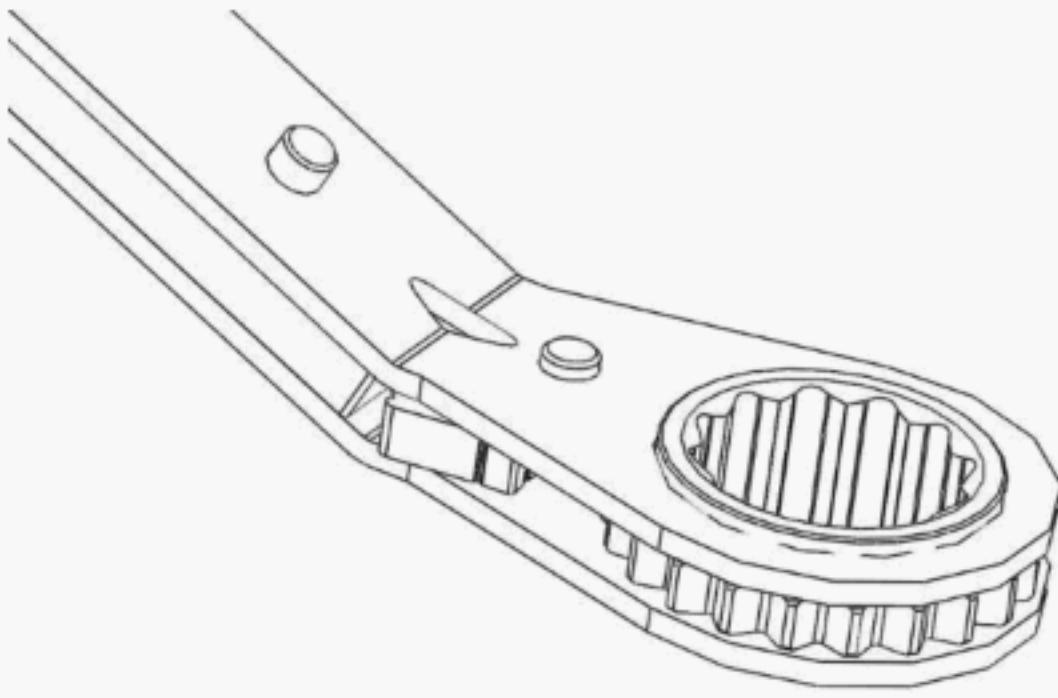
**Figure 5.4-1 Category 66 Laminated Ratcheting Box Wrench**



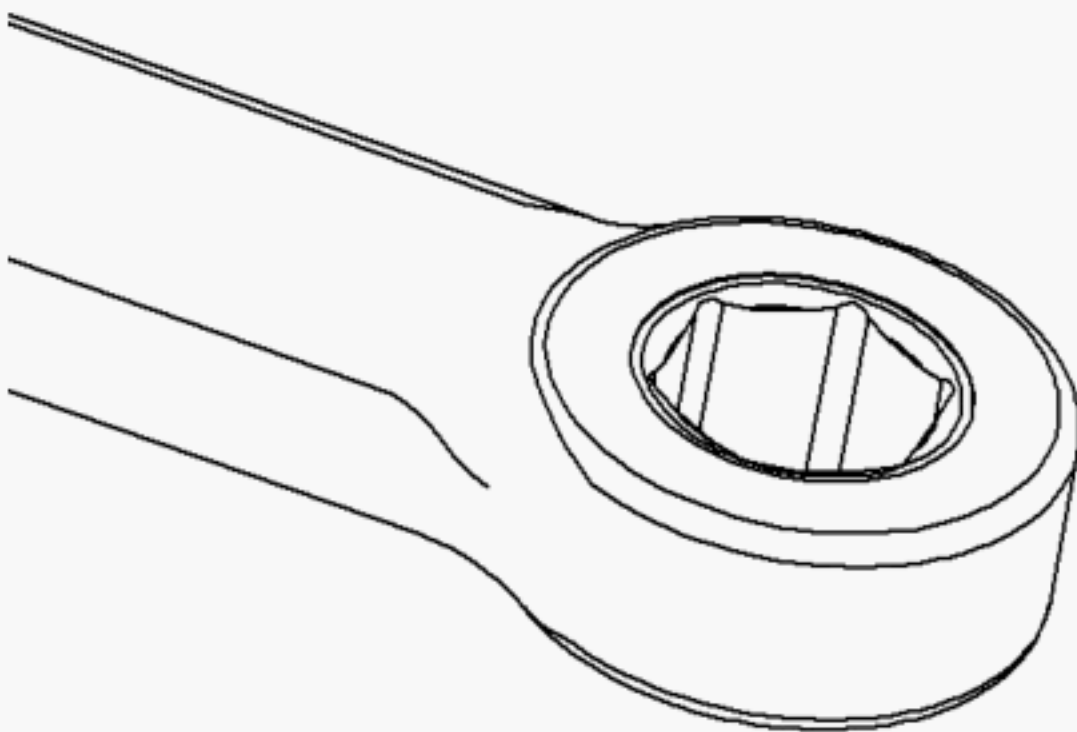
**Figure 5.4-4 Category 66 Nonlaminated Ratcheting Box Wrench (With Reversing Mechanism)**

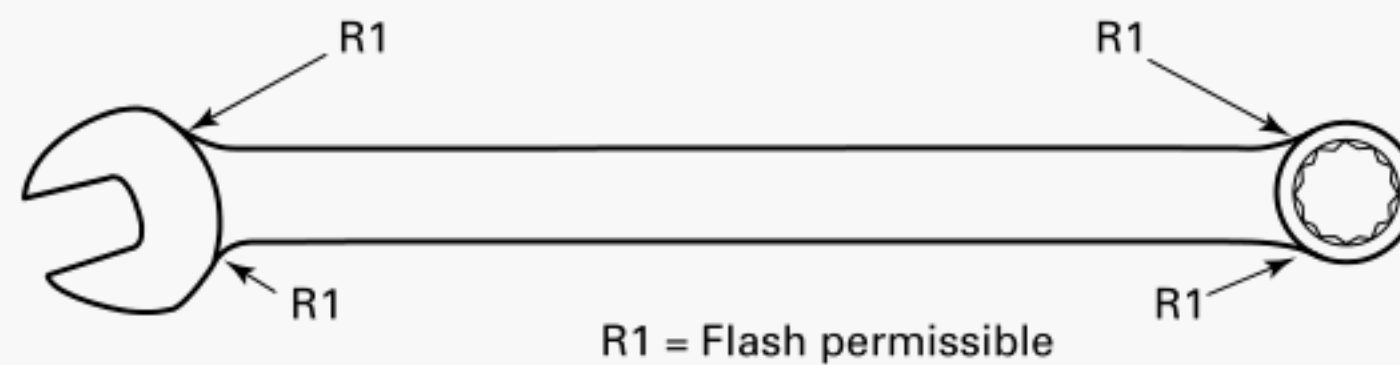


**Figure 5.4-2 Category 66 Laminated Ratcheting Box Wrench (Offset)**



**Figure 5.4-3 Category 66 Nonlaminated Ratcheting Box Wrench**



**Figure 5.9.1-1 Flash Restrictions**

designed, labeled, and tested for such use, tools with comfort grips shall not be advertised or marked as having any nonconductive or electrically insulating properties.

## 6 TESTS

Many of the tests herein are inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting these 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.

U.S. Customary table values are in inches unless otherwise specified. Metric table values are in millimeters unless otherwise specified.

### 6.1 Hardness

Hardness shall be tested in accordance with ASTM E18. Surface preparation may be necessary to ensure that the hardness of the substrate material is measured.

### 6.2 Proof Torque Test

A proof torque test shall be conducted to determine conformance with the applicable proof torque requirement specified.

**6.2.1 Wrench Preparation.** To prepare the wrench for test, suitable reference lines may be scribed on the head and handle. After application of proof torque, examination for permanent deformation shall be made.

**6.2.2 Mandrels for Wrench Openings.** Suitable mandrels shall fit into the wrench opening and provide proper support and necessary strength for the proof torque applied. Category 6, 9, 21, 39, and 40 wrenches shall be tested on hexagonal mandrels. Mandrels shall conform to ASME B107.17.

Category 8 wrenches shall be tested on a mandrel conforming to [Table 5.2-1](#) and [Figures 6.2.2-1](#) and [6.2.2-2](#) for the size of wrench indicated.

**6.2.3 Application of Proof Torque.** The proof torque specified in the applicable Table is the torque applied to the test mandrel that tends to rotate the mandrel about its longitudinal axis. Category 6, 9, 39, and 40 wrench openings shall be gaged prior to testing. The torque shall be applied to mandrels that are fully seated and extend through the wrenching surfaces. The force required to produce the torque shall be applied as far from the mandrel as practical.

(a) *Box Ends and Flare Nut Ends.* Box ends and flare nut ends shall be torqued to the proof torque. Following the removal of the proof torque, they shall be regaged. Any box

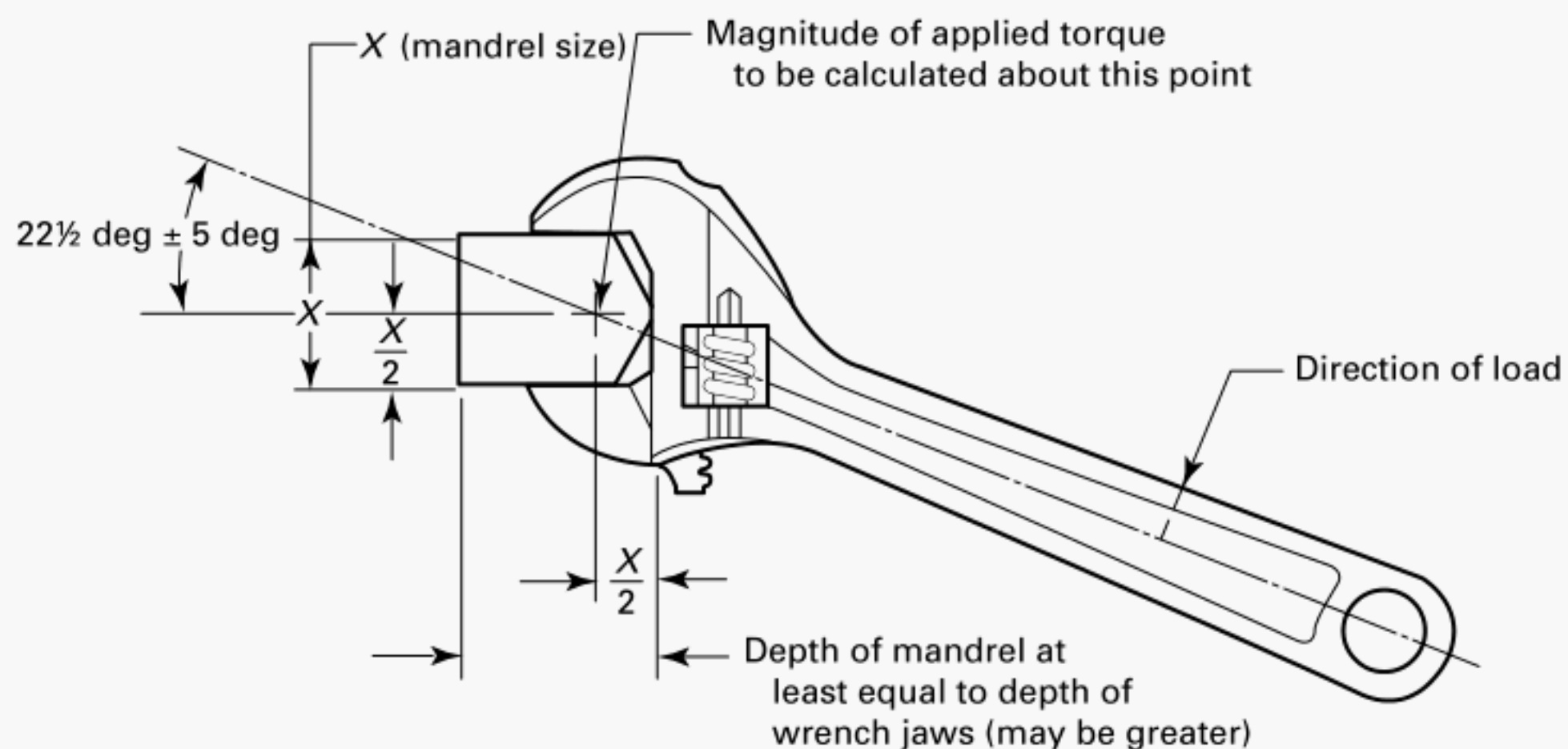
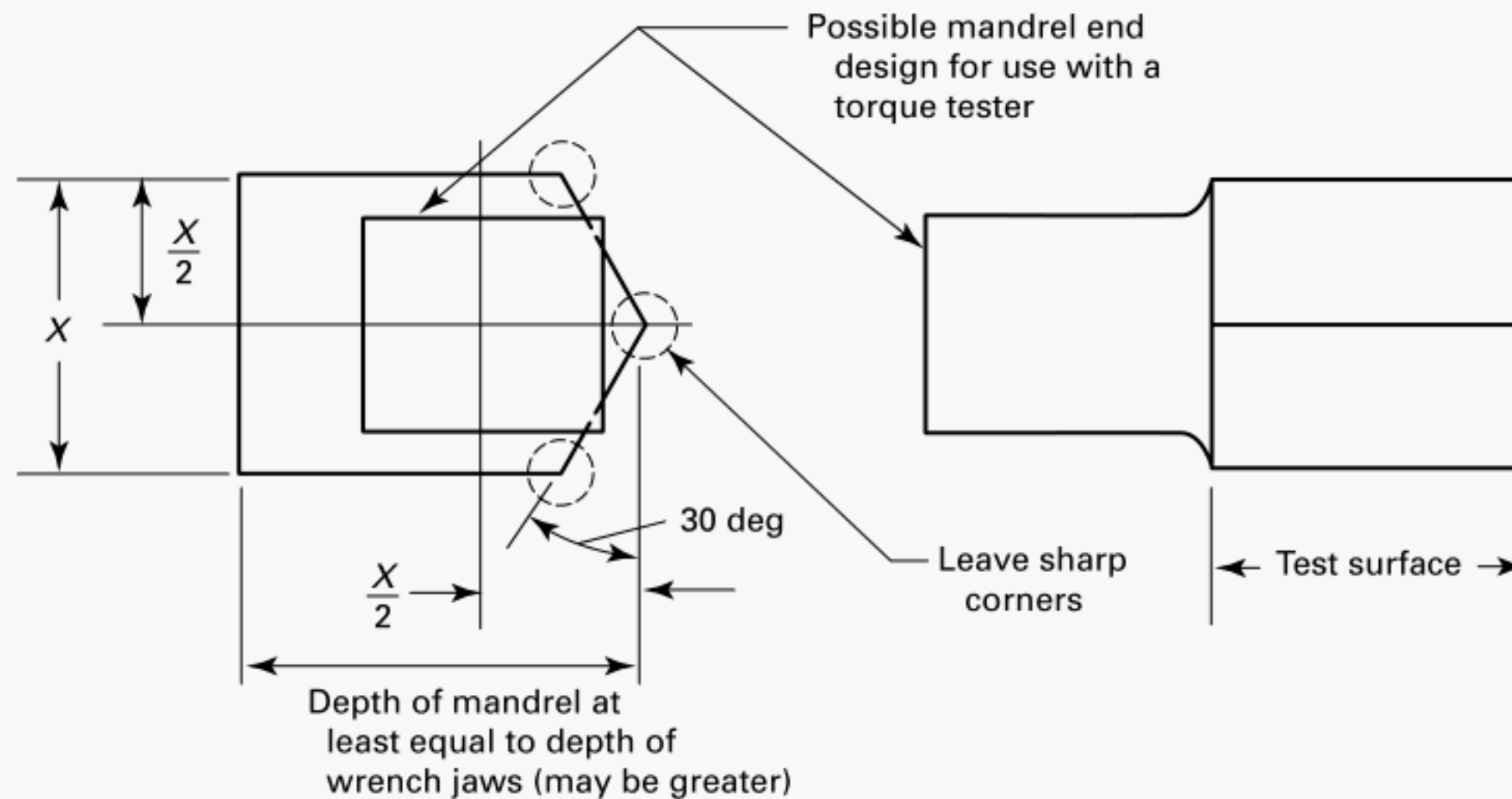
**Figure 6.2.2-1 Category 8 Test Configuration**



Figure 6.2.2-2 Category 8 Mandrel Configuration



end or flare nut end that does not sustain the proof torque or that cracks, fractures, slips on the mandrel, or does not meet gage requirements after torquing has failed the test. Wrench failure has also occurred if there is visible permanent distortion in the handle and/or permanent deformation of the box end with respect to the handle in excess of 5 deg.

(b) *Open Ends.* Open ends shall be torqued to the proof torque. Following the removal of the proof torque, they shall be regaged. Open ends that do not sustain the proof torque or that crack, fracture, slip on the mandrel, or exhibit visible handle distortion have failed the test. Wrench failure has also occurred if the open end jaws spread in excess of the "NO GO" gage as specified by ASME B107.17 size by more than the following:

(1) 0.002 in. for wrench opening sizes up to and including 1 in.

(2) 0.003 in. for wrench opening sizes larger than 1 in.

(3) 0.05 mm for wrench opening sizes up to and including 25 mm

(4) 0.08 mm for wrench opening sizes larger than 25 mm

(c) *Category 21.* Above 50% of peak value, torque shall be applied at a speed of 15 deg/min to 30 deg/min until peak value is verified, then torque shall be released. Following the removal of the proof torque, wrench openings shall be regaged. Wrenches that do not sustain the proof torque or that crack, fracture, or slip on the mandrel have failed the test. The wrench shall also be considered to have failed the test if there is permanent spreading of the open end jaw in excess of the "NO GO" gage sizes of ASME B107.17 by more than the following at the tips:

(1) 0.002 in. for nominal wrench openings  $\frac{3}{16}$  in. to 1 in.

(2) 0.003 in. for nominal wrench openings  $1\frac{1}{16}$  in. to  $2\frac{1}{4}$  in.

(3) 0.004 in. for nominal wrench openings  $2\frac{5}{16}$  in. to  $3\frac{1}{8}$  in.

(4) 0.05 mm for nominal wrench openings 9 mm to 24 mm

(d) *Category 8.* The direction of loading shall be as shown in Figure 6.2.2-1. It is important that the jaws are tight on the mandrel; otherwise, secondary stress will be introduced by the mandrel. There shall be no formation of cracks or fracture of any part of the wrench. After proof torque tests, there shall be no resultant binding or loosening of the movable jaw. Before and after the proof torque test, each wrench shall be opened and closed to verify the wrench operates over the full range of the jaw opening and shall meet para. 6.5.

(e) *Category 66.* Wrench openings shall be gaged for conformance with ASME B107.17 prior to testing. The wrench opening shall then be engaged on the end of a mandrel to a depth no greater than specified in Table 6.2.3-1 (Table 6.2.3-1M). The force required to produce the torque shall be applied as far from the mandrel as practical, so that the whole wrench is tested. Proof torque test speed shall not be faster than 30 deg/min after the torque has reach 50% of the specified proof table value. Any wrench opening that cracks, fractures, or does not gage shall have failed the test.

### 6.3 Alternative Coating Tests

The alternative coating tests consist of an adhesion test, abrasion test, and corrosion test specified in paras. 6.3.2 through 6.3.4. The alternative coating tests may also be performed to certify nickel-chromium coating. Passing the alternative coating tests, when agreed to by the



**Table 6.2.3-1 Category 66 Ratcheting Box Wrench Torque Requirements (U.S. Customary)**

| Wrench<br>Opening<br>Configuration | Nominal Wrench<br>Opening Across<br>Flats | Proof Torque, lbf-in. |         | Maximum Reversing<br>Torque, ozf-in. | Maximum Mandrel<br>Insertion Depth |
|------------------------------------|---|-----------------------|---------|--------------------------------------|------------------------------------|
|                                    |   | Type I                | Type II |                                      |                                    |
| Hex                                | $\frac{5}{32}$                            | 100                   | 100     | 10                                   | 0.178                              |
|                                    | $\frac{3}{16}$                            | 125                   | 125     | 10                                   | 0.203                              |
|                                    | $\frac{1}{4}$                             | 144                   | 144     | 10                                   | 0.295                              |
|                                    | $\frac{9}{32}$                            | 162                   | 162     | 10                                   | 0.300                              |
|                                    | $\frac{5}{16}$                            | 180                   | 180     | 10                                   | 0.330                              |
|                                    | $\frac{11}{32}$                           | 270                   | 270     | 10                                   | 0.335                              |
|                                    | $\frac{3}{8}$                             | 360                   | 360     | 25                                   | 0.344                              |
|                                    | $\frac{7}{16}$                            | 480                   | 480     | 25                                   | 0.391                              |
|                                    | $\frac{1}{2}$                             | 600                   | 600     | 25                                   | 0.413                              |
|                                    | $\frac{9}{16}$                            | 720                   | 750     | 25                                   | 0.425                              |
|                                    | $\frac{19}{32}$                           | 810                   | 935     | 40                                   | 0.438                              |
|                                    | $\frac{5}{8}$                             | 900                   | 1,100   | 40                                   | 0.531                              |
|                                    | $\frac{11}{16}$                           | 930                   | 1,320   | 40                                   | 0.535                              |
|                                    | $\frac{3}{4}$                             | 960                   | 1,430   | 40                                   | 0.594                              |
|                                    | $\frac{25}{32}$                           | 980                   | 1,540   | 50                                   | 0.602                              |
|                                    | $\frac{13}{16}$                           | 1,000                 | 1,650   | 50                                   | 0.688                              |
|                                    | $\frac{7}{8}$                             | 1,060                 | 1,815   | 50                                   | 0.609                              |
|                                    | $\frac{15}{16}$                           | 1,224                 | 2,255   | 50                                   | 0.701                              |
|                                    | 1   | 1,325                 | 2,695   | 50                                   | 0.719                              |
|                                    | $1\frac{1}{16}$                           | 1,460                 | 2,970   | 75                                   | 0.790                              |
|                                    | $1\frac{1}{8}$                            | 1,620                 | 3,215   | 75                                   | 0.860                              |
|                                    | $1\frac{1}{4}$                            | 1,820                 | 3,960   | 75                                   | 0.940                              |
|                                    | $1\frac{5}{16}$                           | 2,050                 | 4,200   | 100                                  | 0.940                              |
|                                    | $1\frac{3}{8}$                            | 2,375                 | 4,485   | 100                                  | 0.940                              |
|                                    | $1\frac{7}{16}$                           | 2,700                 | 4,620   | 100                                  | 0.953                              |
|                                    | $1\frac{1}{2}$                            | 3,100                 | 5,185   | 100                                  | 1.008                              |
| Square                             | $\frac{3}{16}$                            | 125                   | 125     | 10                                   | 0.203                              |
|                                    | $\frac{1}{4}$                             | 144                   | 144     | 10                                   | 0.295                              |
|                                    | $\frac{5}{16}$                            | 180                   | 180     | 10                                   | 0.330                              |
|                                    | $\frac{3}{8}$                             | 360                   | 360     | 25                                   | 0.344                              |
|                                    | $\frac{1}{2}$                             | 600                   | 600     | 25                                   | 0.413                              |
|                                    | $\frac{9}{16}$                            | 720                   | 750     | 25                                   | 0.425                              |

**Table 6.2.3-1M Category 66 Ratcheting Box Wrench Torque Requirements (Metric)**

| Nominal Wrench<br>Hex Opening<br>Across Flats | Proof<br>Torque, N·m |            | Maximum<br>Reversing<br>Torque, N·m | Maximum<br>Mandrel<br>Insertion<br>Depth |
|---|----------------------|------------|-------------------------------------|--|
|   | Type<br>I            | Type<br>II |                                     |  |
| 6   | 14                   | 14         | 0.07                                | 7.4                                      |
| 7   | 18                   | 18         | 0.07                                | 7.7                                      |
| 8   | 21                   | 21         | 0.07                                | 8.2                                      |
| 9   | 34                   | 34         | 0.07                                | 9.0                                      |
| 10  | 43                   | 43         | 0.07                                | 9.0                                      |
| 11  | 52                   | 52         | 0.07                                | 10.0                                     |
| 12  | 59                   | 59         | 0.18                                | 10.0                                     |
| 13  | 70                   | 70         | 0.18                                | 10.5                                     |
| 14  | 79                   | 79         | 0.18                                | 11.5                                     |
| 15  | 90                   | 100        | 0.18                                | 11.5                                     |
| 16  | 102                  | 124        | 0.28                                | 12.1                                     |
| 17  | 104                  | 134        | 0.28                                | 12.7                                     |
| 18  | 106                  | 152        | 0.28                                | 12.7                                     |
| 19  | 108                  | 162        | 0.28                                | 14.8                                     |
| 20  | 111                  | 174        | 0.35                                | 14.8                                     |
| 21  | 114                  | 186        | 0.35                                | 16.3                                     |
| 22  | 119                  | 204        | 0.35                                | 14.8                                     |
| 23  | 122                  | 228        | 0.35                                | 15.5                                     |
| 24  | 139                  | 255        | 0.35                                | 17.8                                     |
| 25  | 156                  | 208        | 0.35                                | 17.9                                     |
| 26  | 175                  | 304        | 0.35                                | 18.0                                     |
| 27  | 192                  | 366        | 0.35                                | 19.8                                     |
| 28  | 203                  | 355        | 0.35                                | 19.8                                     |
| 29  | 220                  | 375        | 0.35                                | 19.8                                     |
| 30  | 235                  | 398        | 0.35                                | 20.0                                     |
| 31  | 248                  | 425        | 0.35                                | 21.0                                     |
| 32  | 268                  | 453        | 0.35                                | 22.0                                     |

customer, exempts the manufacturer from the nickel-chromium thickness requirement of [para. 5.9.2\(a\)](#).

**6.3.1 Test Preparation.** The quantity and condition of the sample wrenches used for the following tests shall be per the manufacturer's standard practice or as mutually agreed to by the manufacturer and the customer.

**6.3.2 Coating Adhesion Test.** Sample wrenches shall pass the file or grind-saw test of ASTM B571.

**6.3.3 Coating Abrasion Test.** Sample wrenches shall have no base material exposed when subjected to the 100 L of falling sand test of ASTM D968 Method A.

**6.3.4 Coating Corrosion Test.** Sample wrenches shall be tested for corrosion resistance by exposure to a 48-hr salt spray test, as specified in ASTM B117, without falling below the ASTM B537 rating of 6.

## 6.4 Clearance of Movable Jaw — Category 8

The clearance of the movable jaw shall be measured, before proof torque testing, throughout its operating range to determine compliance with [Table 5.2-1](#). With the movable jaw pressed firmly by hand to one side, a feeler gage of the applicable size specified in [Table 5.2-1](#) shall not enter the space between one side of the movable jaw base and the slide rail of the fixed jaw (see [Figure 6.4-1](#)). The test shall then be repeated with the jaw pressed to the opposite side. Clearance between the movable jaw and the slide rail of the fixed jaw at any opening within the specified capacity shall not exceed the values shown in [Table 5.2-1](#).

## 6.5 Parallelism of Jaw Surfaces — Category 8

Jaws shall be parallel within the limits of clearance for the size specified in [Table 5.2-1](#). Parallelism shall be measured before and after the test in [para. 6.2.3\(d\)](#) and shall be determined by the use of a gage block and step block conforming to the requirements shown in [Figure 6.5-1](#). With the gage block placed between the jaw faces as near to the bottom of the opening as possible, insert the step block between the jaw tip and the surface of the gage block. The "GO" portion of the step block shall enter the space between the jaw tip and the gage block and the "NO GO" portion of the step block shall not enter the space between the jaw tip and the gage block.

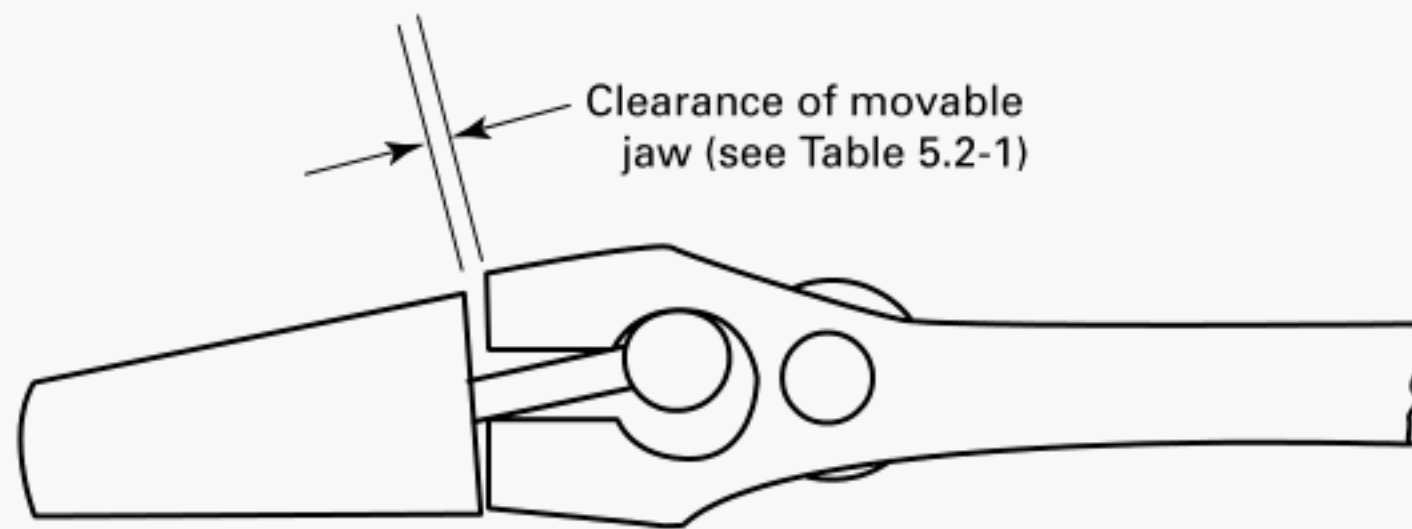
## 6.6 Comfort Grip Solvent Test

**6.6.1 Purpose.** This test is used to ensure that comfort grips have adequate resistance to solvents encountered during normal use.

**6.6.2 Apparatus.** Any suitable container for the solvent may be used. Care should be taken to provide adequate ventilation of solvent fumes.

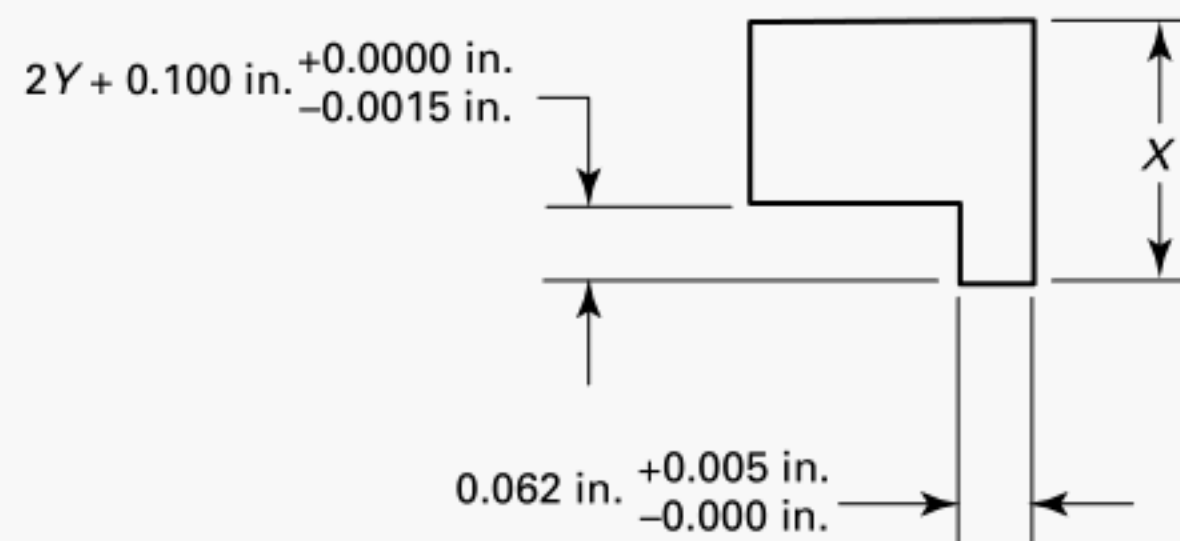
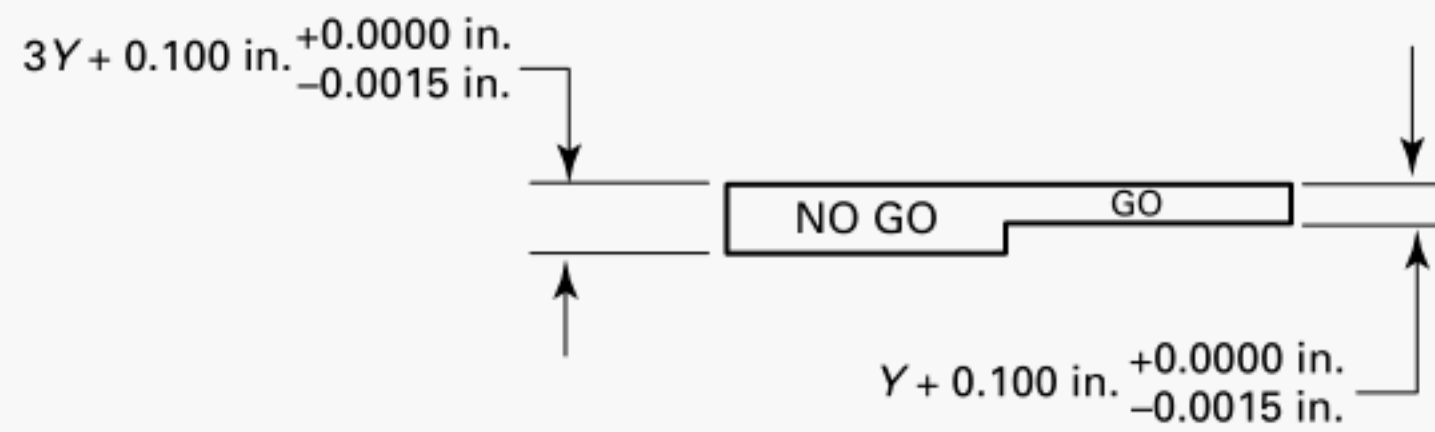
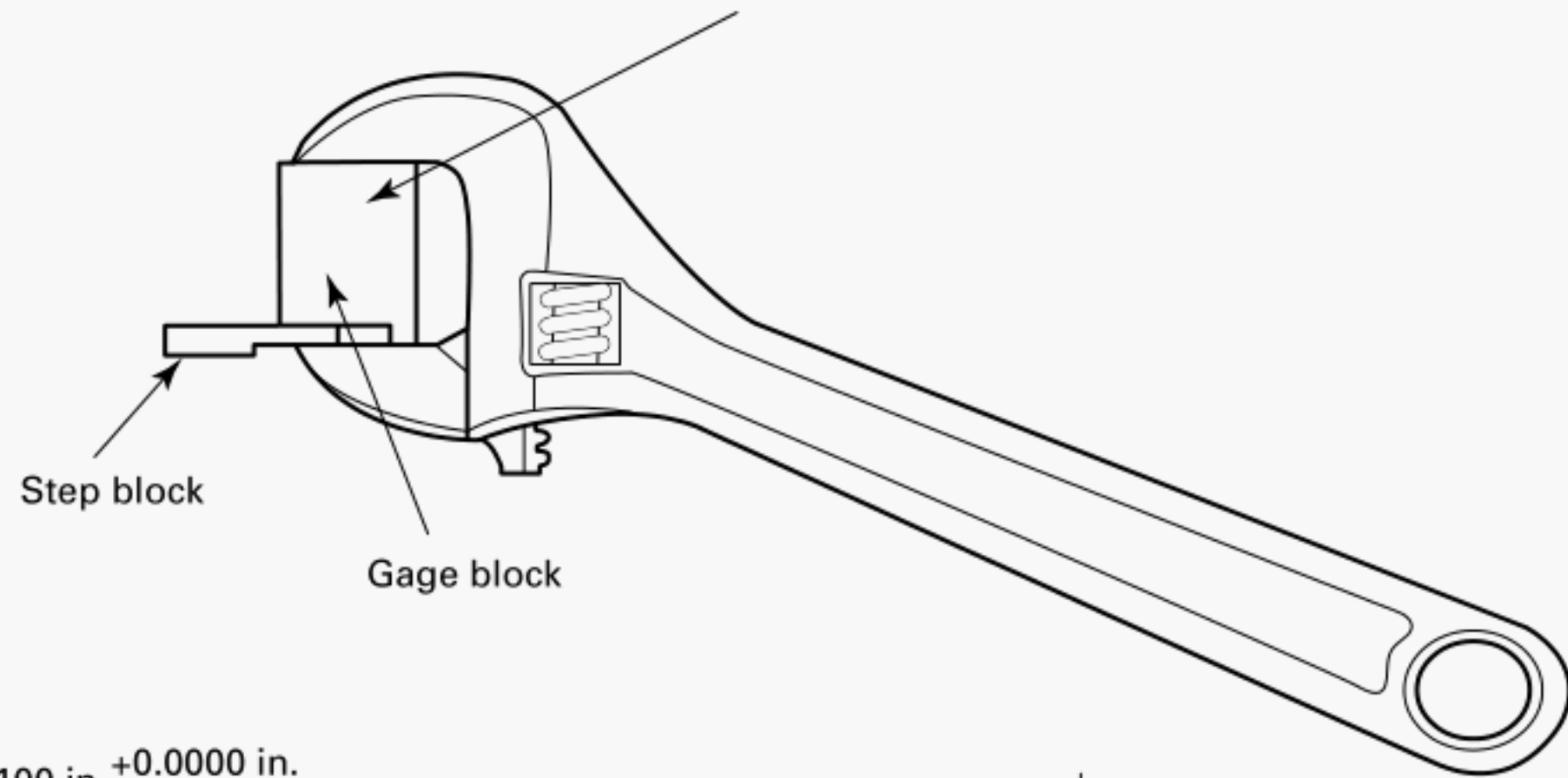
**6.6.3 Procedure.** Solvent tests shall be conducted at room temperature. The material being tested shall be fully immersed in the test fluids specified herein. New samples shall be used for each test fluid. Samples shall be immersed for 15 min to 20 min, removed, and allowed to dry for 24 hr to 28 hr. Test fluids are SAE J1703 brake fluid, gasoline, ethylene glycol, and ethyl alcohol. There shall be no significant swelling or surface attack of the material being tested. Comfort grips shall be tested while attached to the handles. Cushion grip throats, inserts, and sleeves that are not dependent on friction or adhesives for attachment may be tested separately.

**Figure 6.4-1 Category 8 Jaw Clearance Measurement**



**Figure 6.5-1 Parallelism Measurement**

Fixed and adjustable jaw flats closed against the gage block with the upper gage block surface flush against the face of the fixed jaw





### 6.7 Drop Test — Categories 8 and 66

The wrench shall be dropped from a height of 6 ft onto a concrete surface 12 times. For Category 8, the movable jaw shall be at least halfway open when dropped. After this test, all component parts shall remain properly assembled, and the movable jaw and adjustment mechanism shall work satisfactorily. For Category 66, on wrenches with protruding shifters, the tester should attempt to have the shifter strike first on the concrete at least twice during the test. There shall be no physical failure of any component, and the wrench must be fully functional after this test.

### 6.8 Reversing Torque — Category 66

Category 66, Type II wrenches shall be tested for reversing torque after they have been tested for proof torque. Each wrench shall be rotated 360 deg after the proof load test and before measuring reversing torque. The reversing torque shall not exceed the requirements in [Table 6.2.3-1](#) ([Table 6.2.3-1M](#)).

### 6.9 Cycle Test — Category 66

The applied torque for cycle testing shall be 35% of the proof torque specified in [Table 6.2.3-1](#) ([Table 6.2.3-1M](#)). Samples shall be tested at a rate not to exceed 60 cycles/min. The ratcheting gear mechanism shall withstand a cycle test of 5,000 cycles in the clockwise direction and 5,000 cycles in the counterclockwise direction.

Wrenches without a reversing feature shall be tested for 5,000 cycles in one direction only. There shall be no physical failure of any component, and the wrench must be fully functional after the test.

### 6.10 Failure Mode Test

This test shall be performed as an extension of the proof torque tests in [para. 6.2.3](#). The torque on the sample shall be increased to the point of failure or to 115% of the proof torque, whichever occurs first.

(a) If there is no failure, the sample passes the test.

(b) If there is deformation without fracture, the sample passes the test.

(c) If there is fracture with evidence of deformation prior to fracture, the sample passes the test.

(d) If there is fracture with no evidence of deformation before fracture, the sample fails the test.

## 7 SAFETY REQUIREMENTS AND LIMITATIONS OF USE

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

If using a Category 21 crowfoot wrench for torque measuring applications, consult the torque instrument manufacturer's literature for a correction formula for accessories.



# NONMANDATORY APPENDIX A DESIGNATIONS

## A-1 INTRODUCTION

This Appendix is provided to assist with specifying details needed to order the tools described in this Standard.

## A-2 SPECIFICATIONS

Wrenches may be designated by the following data in the sequence shown, as applicable:

(a) Description, e.g., ASME B107.100 Category 39 Open end wrench, double head

(b) Type

(c) Class

(d) Drive size

(e) Wrench nominal opening size(s) (pairings) and configuration(s)

(f) Length or length style

(g) Finish

EXAMPLE: ASME B107.100 Category 39, Type II, Class 1 — 30 deg and 60 deg angle wrench,  $\frac{3}{8}$  in. drive, 1 in. wrench opening, regular length, black oxide.

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# **B107 AMERICAN NATIONAL STANDARDS FOR HAND TOOLS**

|                       |   |
|-----------------------|---|
| B107.4-2019           | Driving and Spindle Ends for Portable Hand, Impact, Air, and Electric Tools (Percussion Tools Excluded) |
| B107.17-2010          | Gages and Mandrels for Wrench Openings  |
| B107.56-2018          | Body Repair Tools   |
| B107.100-2020         | Flat Wrenches   |
| B107.110-2012         | Socket Wrenches, Handles, and Attachments   |
| B107.300-2010 (R2016) | Torque Instruments  |
| B107.400-2018         | Striking Tools  |
| B107.410-2018         | Struck Tools  |
| B107.500-2010         | Pliers  |
| B107.600-2016         | Screwdrivers and Screwdriver Bits   |

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