

ASME B107.100-2023

(Revision of ASME B107.100-2020)

Flat Wrenches

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AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

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Mechanical Engineers**

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FOREWORD

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

In 1999 ASME initiated a project to consolidate hand tool standards by category of tool. The initial implementation included distinct standards within a single publication bearing a three-digit number corresponding to the responsible B107 subcommittee. 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 It superseded the following ASME standards: B107.6, Combination Wrenches; B107.9, Box Wrenches, Double Head; B107.39, Open End Wrenches, Double Head; and B107.40, Wrenches,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 The 2010 edition was retitled “Flat Wrenches” and incorporated and superseded ASME B107.8, Adjustable Wrenches; ASME B107.21, Wrench, Crowfoot; and ASME B107.66, Ratcheting Box Wrenches.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 the 2020 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. The 2023 edition corrects numerous table values.

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 B107.100-2023 was approved by the B107 Standards Committee on March 8, 2023, and by the Board on Standards and Testing on May 9, 2023. It was approved by the American National Standards Institute (ANSI) as an American National Standard on June 30, 2023.

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Hand Tools and Accessories

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

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In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

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(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Standard and the paragraph, figure, or table number(s)

(4) the edition(s) of the Standard to which the proposed case applies

(d) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Approved cases are posted on the committee web page.

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ASME B107.100-2023

SUMMARY OF CHANGES

Following approval by the ASME B107 Committee and ASME, and after public review, ASME B107.100-2023 was approved by the American National Standards Institute on June 30, 2023.

ASME B107.100-2023 includes the following changes identified by a margin note, **(23)**.

<i>Page</i>	<i>Location</i>	<i>Change</i>
2	3	References updated
4	Table 5.1.1-1	For $\frac{1}{2}$ -in. nominal wrench opening, maximum width of open head revised
5	Table 5.1.1-1M	For 17-mm nominal wrench opening, maximum width of open head revised
6	Table 5.1.1-2	Under "Style 1," "Long, Max." revised to "Long, Min."
7	Table 5.1.1-2M	(1) Under "Style 1," "Long, Max." revised to "Long, Min." (2) For 4-mm to 12-mm nominal wrench openings, entries under "Style 1, Long, Max." and "Style 2" revised
10	Table 5.1.2-1	For $\frac{1}{4}$ -in. nominal wrench opening, maximum outside diameter of box head revised
11	Table 5.1.2-1M	For 11-mm to 20-mm nominal wrench openings, maximum outside diameter of box head revised
17	Table 5.1.3-1	(1) For $\frac{1}{2}$ -in. nominal wrench opening, maximum width of open head under "Types I and II, Classes 1 and 2" revised (2) For $\frac{1}{16}$ -nominal wrench opening, maximum width of open head under "Type III" revised
18	Table 5.1.3-1M	For 6-mm nominal wrench opening, maximum width of open head under "Type III" revised
40	Table 5.3.2-3	Title revised
47	Table 6.2.3-1M	For 24-mm nominal wrench hex opening, proof torque under "Type II" revised

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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.

(23) 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). The American Society of Mechanical Engineers.

ASME B107.17. Gages and Mandrels for Wrench Openings. The American Society of Mechanical Engineers.

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

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

ASTM B571. Standard Practice for Qualitative Adhesion Testing of Metallic Coatings. ASTM International.

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

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

ASTM E92. Standard Test Method for Vickers Hardness of Metallic Materials. ASTM International.

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

SAE J1703. Motor Vehicle Brake Fluid. SAE International.

4 CLASSIFICATION

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

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 2: heavy duty	Flare nut	5.3.1-1, 5.3.1-2
		II	1: standard duty 2: heavy duty	Open end	5.3.2-1
39 [Note (1)]	Open end wrench, double head	II	1	Engineer's wrench, 15 deg angle	5.1.3-1
			2	Angle wrench, 30 deg and 60 deg	5.1.3-2
			3	Ignition wrench, 15 deg and 60 deg	5.1.3-3
		III	...	Angle wrench, 15 deg and 60 deg	5.1.3-4
40 [Note (1)]	Flare nut wrench	I	...	Tappet wrench, 15 deg	5.1.3-4
		II	...	Double head	5.1.4-1
66	Ratcheting box wrench	I	...	Combination: open end and 15 deg offset flare nut end	5.1.4-2
		II	...	Laminated construction	5.4-1, 5.4-2
				Nonlaminated construction	5.4-3, 5.4-4

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

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.

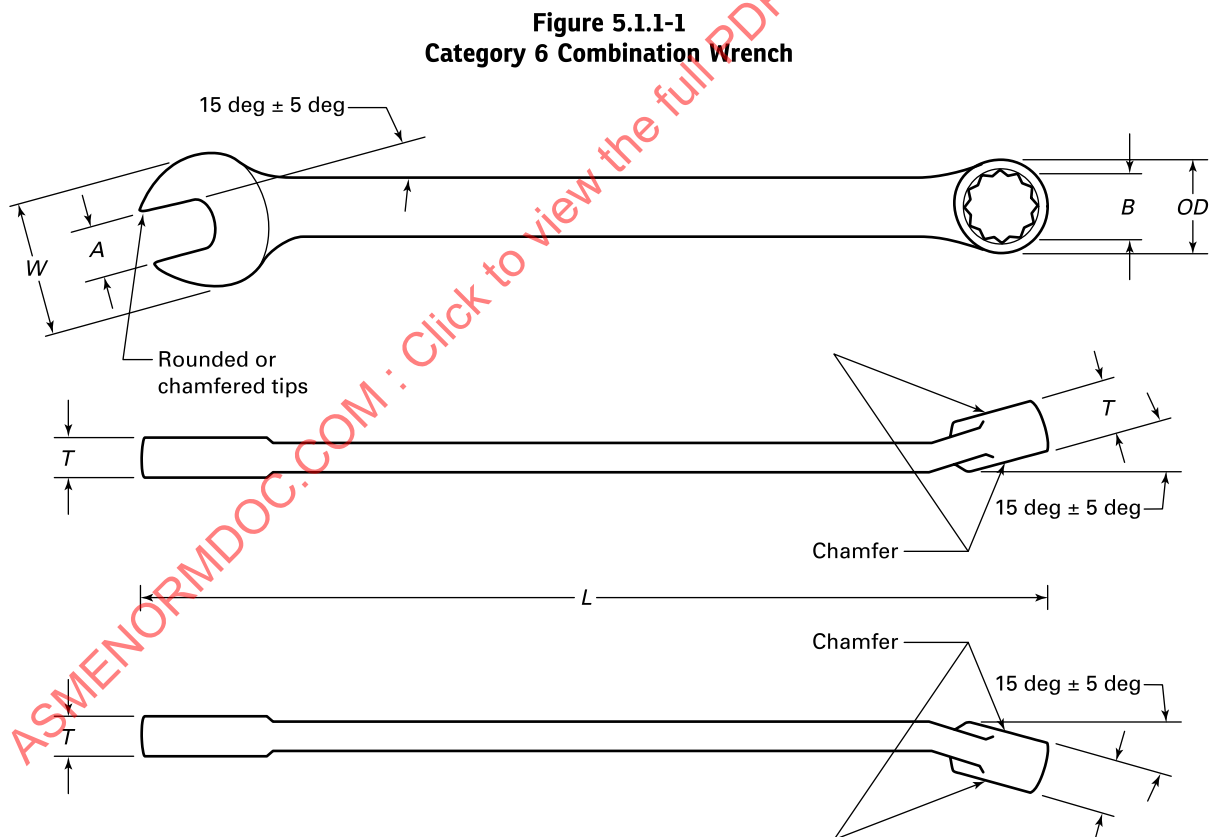
When tested as specified, wrenches shall withstand the proof torque specified in applicable tables without failure or permanent deformation (set) that might affect the durability or serviceability of the wrenches.

U.S. Customary table values are in inches unless otherwise specified. SI 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 (see [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](#)).



(23)

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

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Width of Open Head, <i>W</i>	Maximum Outside Diameter of Box Head, <i>OD</i>	Maximum Permitted Eccentricity of Box Head Opening to Outside Diameter	Maximum Thickness of Heads, <i>T</i>		Minimum Proof Torque, lbf-in.	
				Open Head	Box Head	Open Head	Box 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
$\frac{1}{2}$	1.192	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 (SI)

(23)

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Width of Open Head, <i>W</i>	Maximum Outside Diameter of Box Head, <i>OD</i>	Maximum Permitted Eccentricity of Box Head Opening to Outside Diameter	Maximum Thickness of Heads, <i>T</i>		Minimum Proof Torque, N·m	
				Open Head	Box Head	Open Head	Box 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	39.7	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	1165
41	88.9	62.9	0.70	19.3	25.3	1154	1579
46	95.3	68.0	0.70	22.4	25.8	1453	2067
50	103.2	76.0	0.70	25.0	27.6	1716	2512

(23)

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

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Style 1				Style 2			
	Short, Max.	Regular		Long, Min.	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 (SI)

(23)

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Style 1				Style 2			
	Short, Max.	Regular		Long, Min.	Short, Max.	Regular		Long, Min.
		Min.	Max.			Min.	Max.	
4	75	...	...	...	75	...	...	...
5	79	...	...	...	79	...	...	...
5.5	82	83	130	131	82	70	130	120
6	85	86	135	136	85	76	135	125
7	88	89	145	146	88	84	145	129
8	93	94	161	162	93	92	161	137
9	100	101	170	171	100	100	170	143
10	109	110	177	178	115	115	185	163
11	119	120	193	194	125	125	195	177
12	124	125	205	206	135	130	205	190
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

5.1.2 Category 9 — Box Wrench. Wrenches shall have two box ends (see 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 5.1.2-1
Category 9, Type I Box Wrench

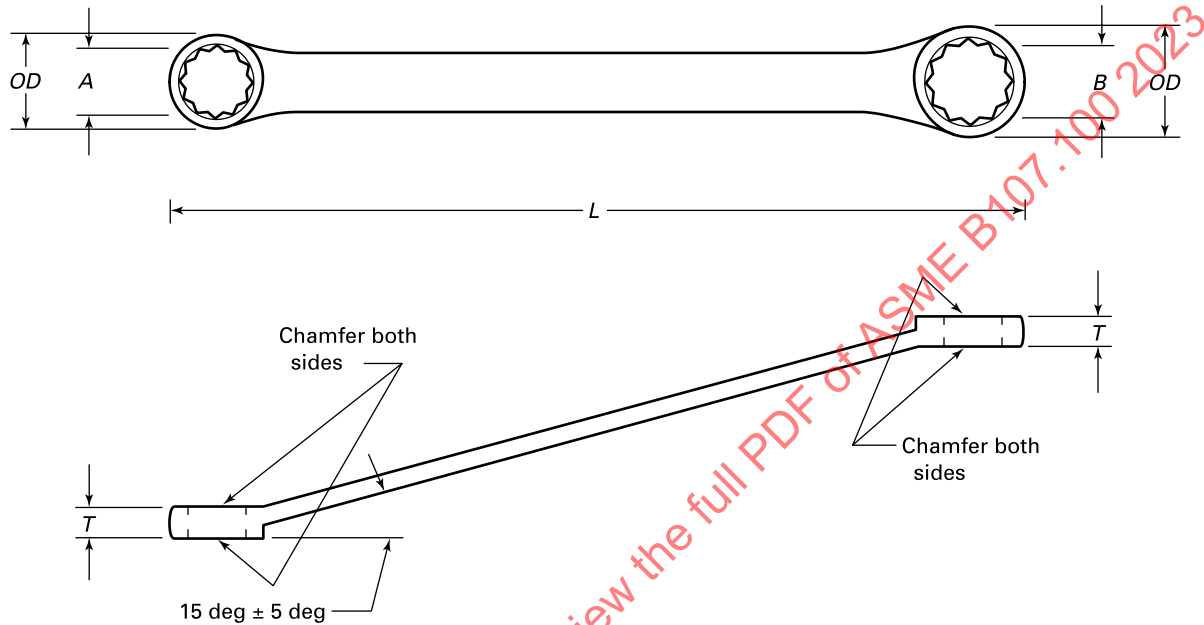


Figure 5.1.2-2
Category 9, Type I Box Wrench (Alternate Construction)

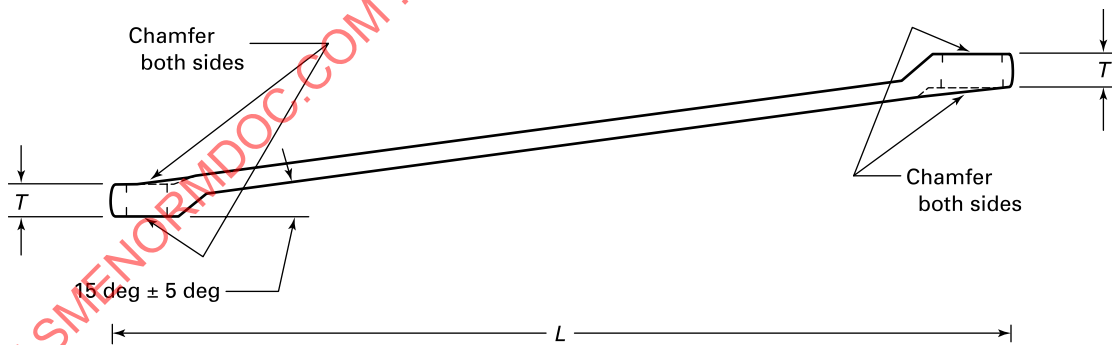


Figure 5.1.2-3
Category 9, Type II Box Wrench

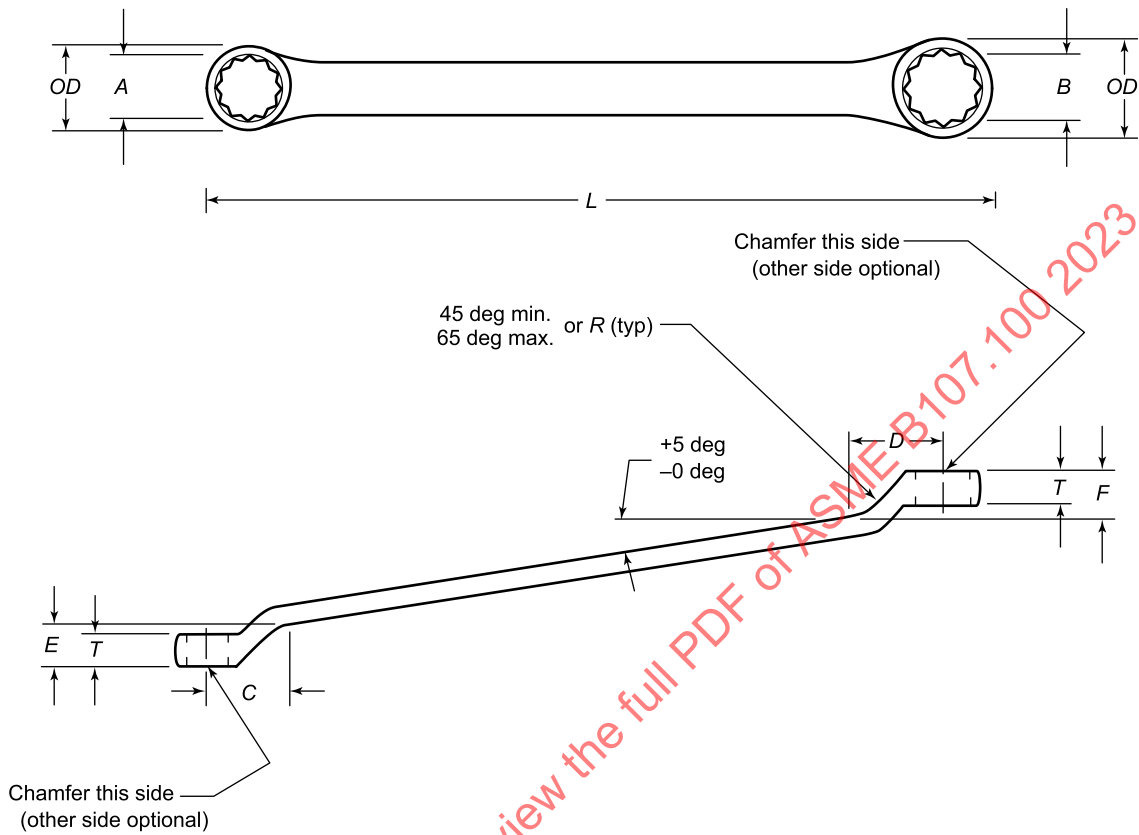


Figure 5.1.2-4
Category 9, Type III Box Wrench

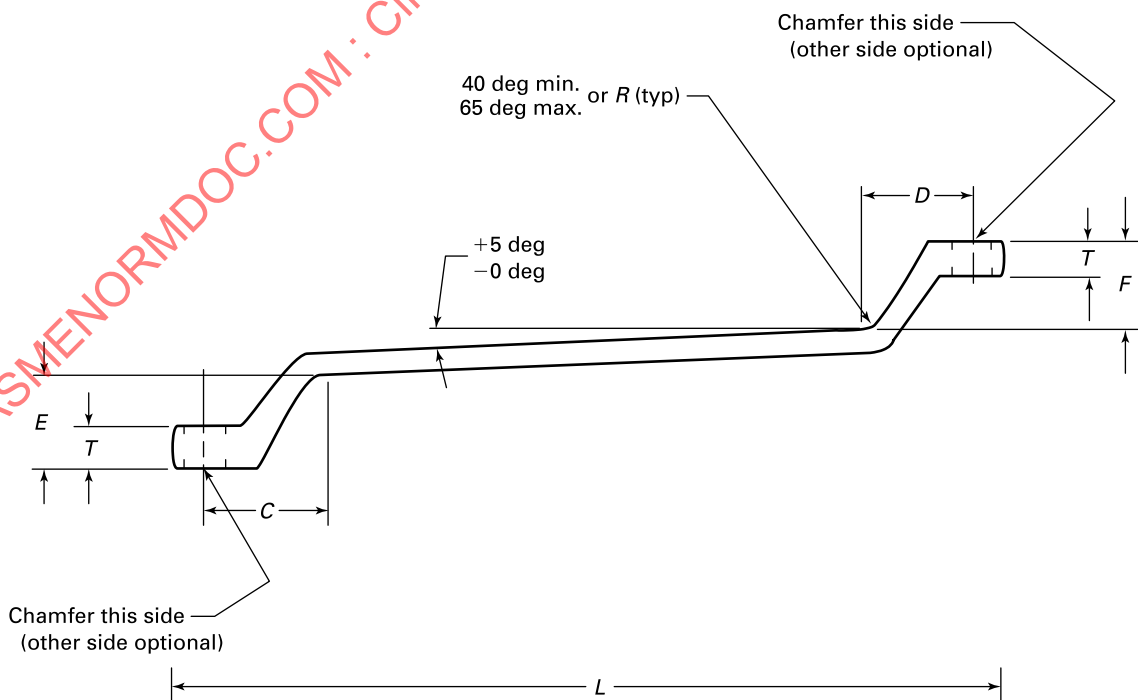


Table 5.1.2-1
Category 9 Box Wrench (U.S. Customary)

(23)

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Outside Diameter of Box Head, <i>OD</i>	Maximum Permitted Eccentricity of Box Head Opening to Outside Diameter	Maximum Thickness of Box Head, <i>T</i>	Maximum Centerline of Opening to Point Where Offset Blends With Handles, <i>C</i> and <i>D</i>		Minimum Height From Opening to Point Where Offset Blends With Handles, <i>E</i> and <i>F</i>		Minimum Proof Torque, lbf-in.
				Type II	Type III	Type II	Type 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
$\frac{1}{4}$	0.478	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 (SI)

(23)

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Outside Diameter of Box Head, <i>OD</i>	Maximum Permitted Eccentricity of Box Head Opening to Outside Diameter	Maximum Thickness of Box Head, <i>T</i>	Maximum Centerline of Opening to Point Where Offset Blends With Handles, <i>C</i> and <i>D</i>		Minimum Height From Opening to Point Where Offset Blends With Handles, <i>E</i> and <i>F</i>		Minimum Proof Torque, N·m
				Type II	Type III	Type II	Type 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	19.9	0.38	10.0	35.3	29.6	7.3	8.5	80
12	21.4	0.46	10.0	35.6	30.0	7.5	9.5	91
13	23.1	0.46	10.5	41.3	30.6	7.5	10.0	115
14	24.4	0.46	11.5	41.6	30.6	9.5	10.2	158
15	26.0	0.46	11.5	...	33.5	...	10.8	200
16	27.0	0.46	12.1	52.1	34.0	12.7	11.4	248
17	29.3	0.46	12.7	54.0	35.8	12.7	11.4	267
18	29.3	0.46	12.7	...	37.0	...	12.7	304
19	31.2	0.46	14.8	57.8	41.7	12.7	13.3	323
20	32.9	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	
A	B	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 (SI)

Nominal Wrench Opening Across Flat		Type II			Type III	
<i>A</i>	<i>B</i>	Type I, Regular, Min.	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	...	...

5.1.3 Category 39 — Open End Wrench. Wrenches shall have two open ends (see 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).

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

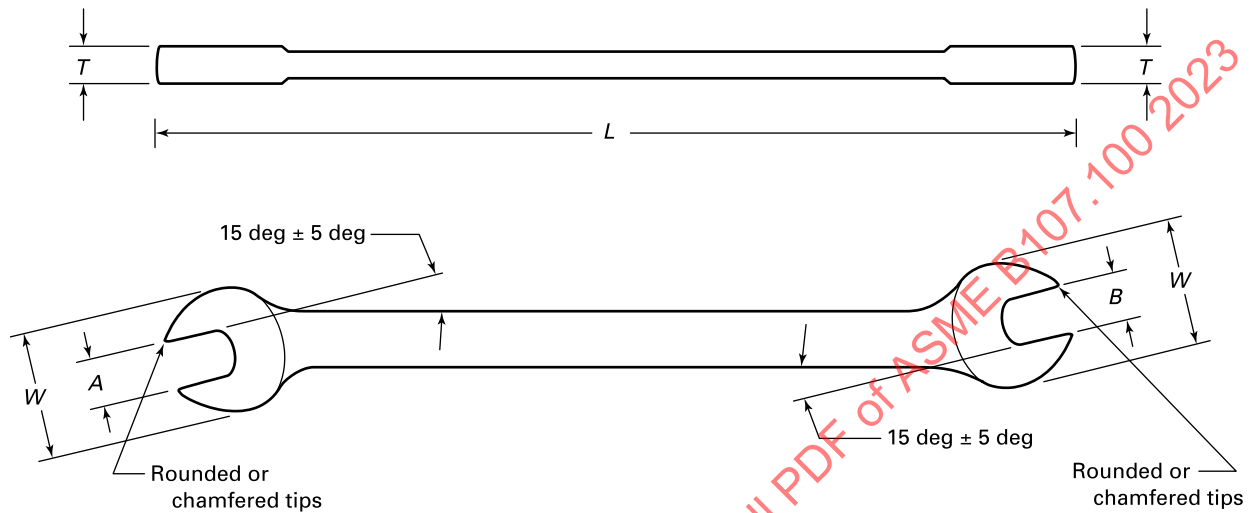


Figure 5.1.3-2
Category 39, Type II, Class 1 Angle Wrench

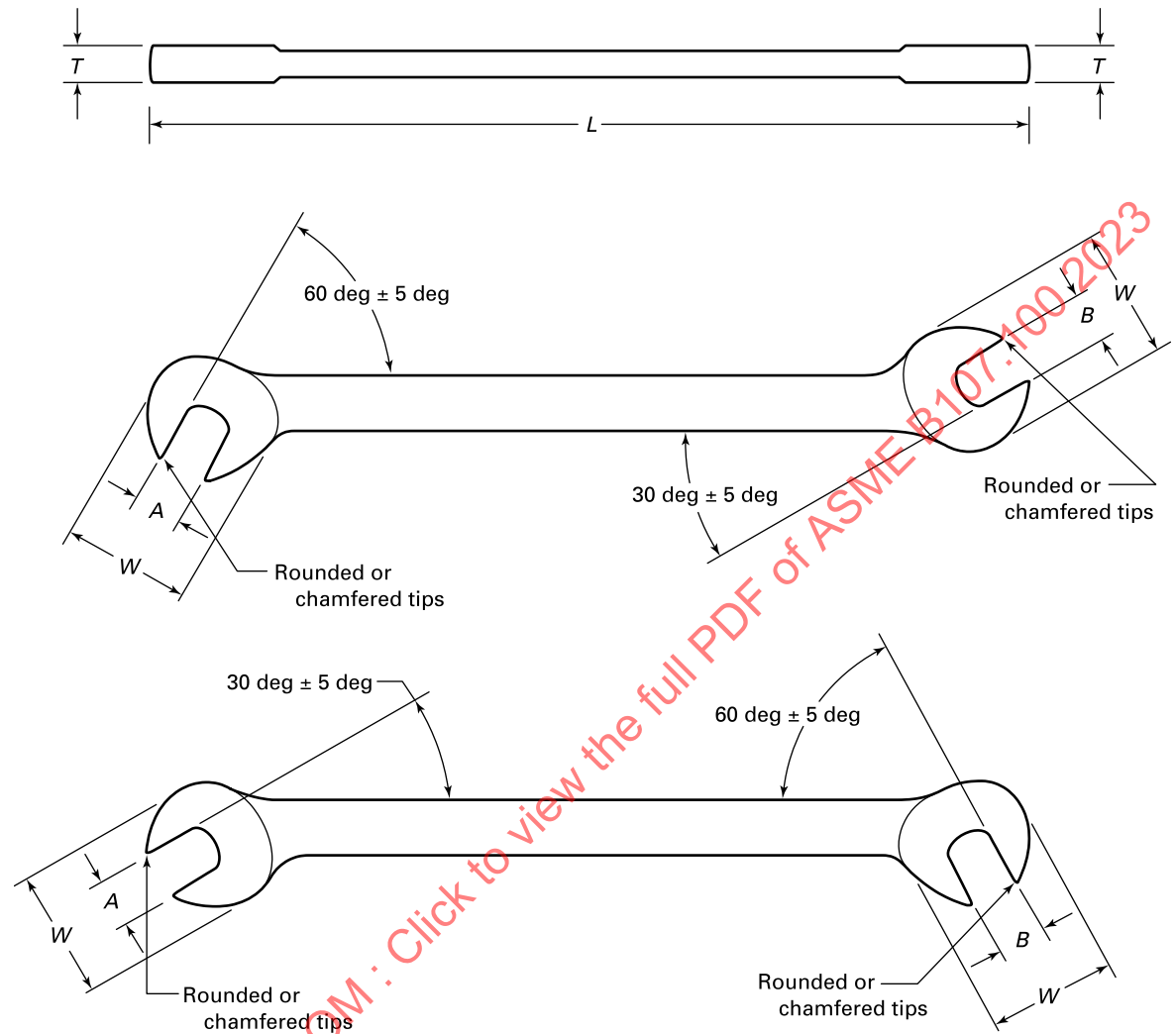


Figure 5.1.3-3
Category 39, Type II, Classes 2 and 3 Angle Wrench

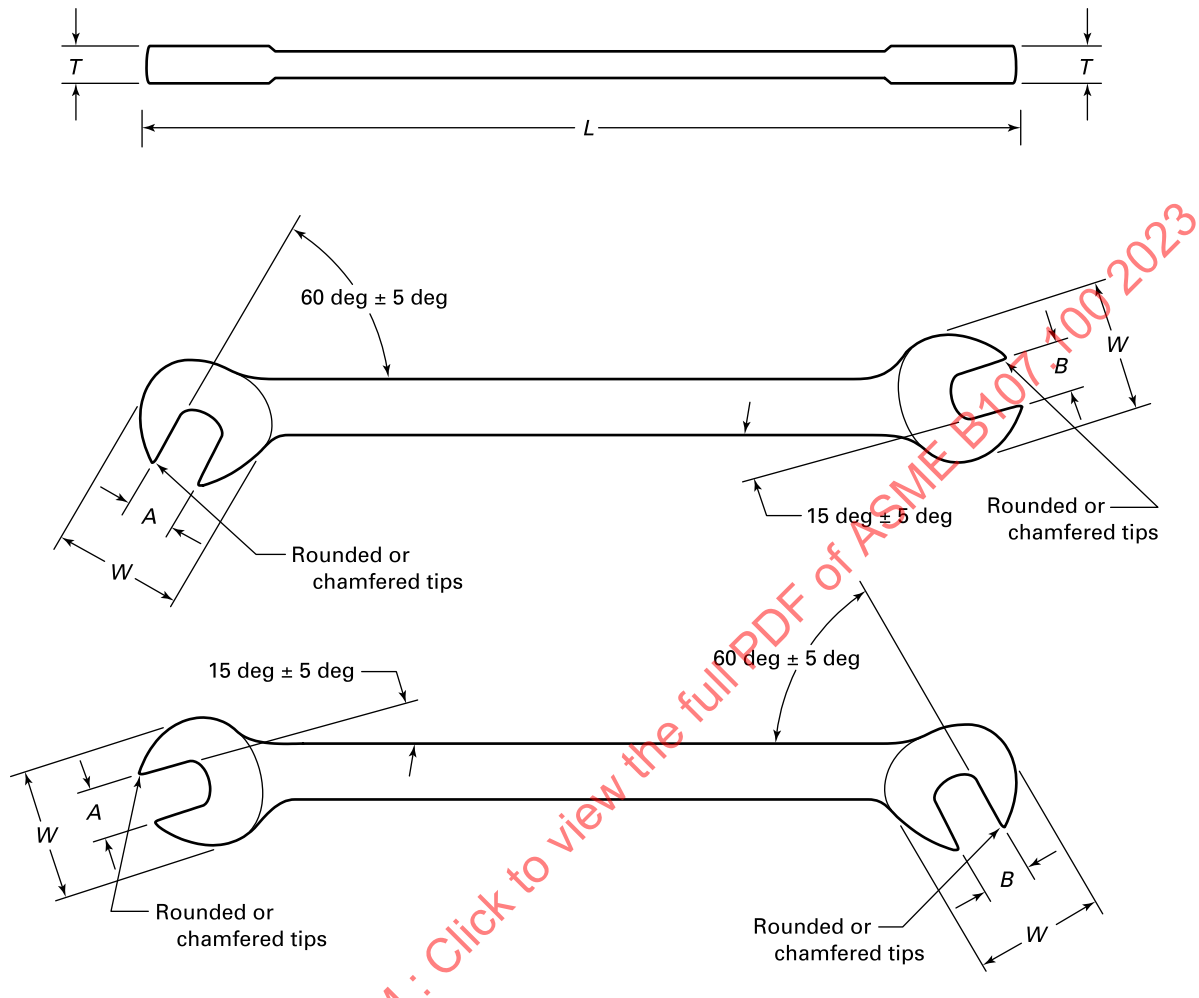


Figure 5.1.3-4
Category 39, Type III Tappet Wrench

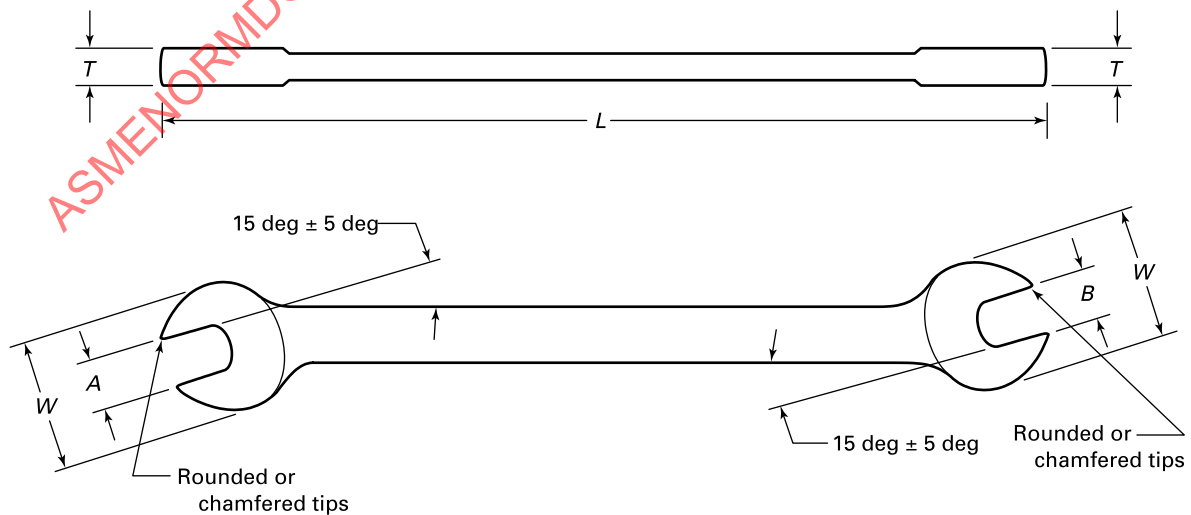


Table 5.1.3-1
Category 39 Open-End Wrench (U.S. Customary)

(23)

Nominal Wrench Opening Across Flat, A or B	Types I and II, Classes 1 and 2		Type II, Class 3		Type III		Minimum Proof Torque, lbf-in.				
	Max. Width of Open Head, W	Max. Thickness of Open Head, T	Max. Width of Open Head, W	Max. Thickness of Open Head, T	Max. Width of Open Head, W	Max. Thickness of Open Head, T	Type II				
							Type I	Class 1	Class 2	Class 3	Type 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
$\frac{1}{2}$	1.192	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	1.598	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.

(23)

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

Nominal Wrench Opening Across Flat, <i>A</i> or <i>B</i>	Types I and II, Classes 1 and 2		Type II, Class 3		Type III		Minimum Proof Torque, N·m				
	Max. Width of Open Head, <i>W</i>	Max. Thickness of Open Head, <i>T</i>	Max. Width of Open Head, <i>W</i>	Max. Thickness of Open Head, <i>T</i>	Max. Width of Open Head, <i>W</i>	Max. Thickness of Open Head, <i>T</i>	Type II				
							Type I	Class 1	Class 2	Class 3	Type 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	...	...	16.4	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 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 (SI)

Nominal Wrench Opening 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 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 (SI)

Nominal Wrench Opening 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 (SI)

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		Regular, Max.
A	B	
$\frac{5}{16}$	$\frac{3}{8}$	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

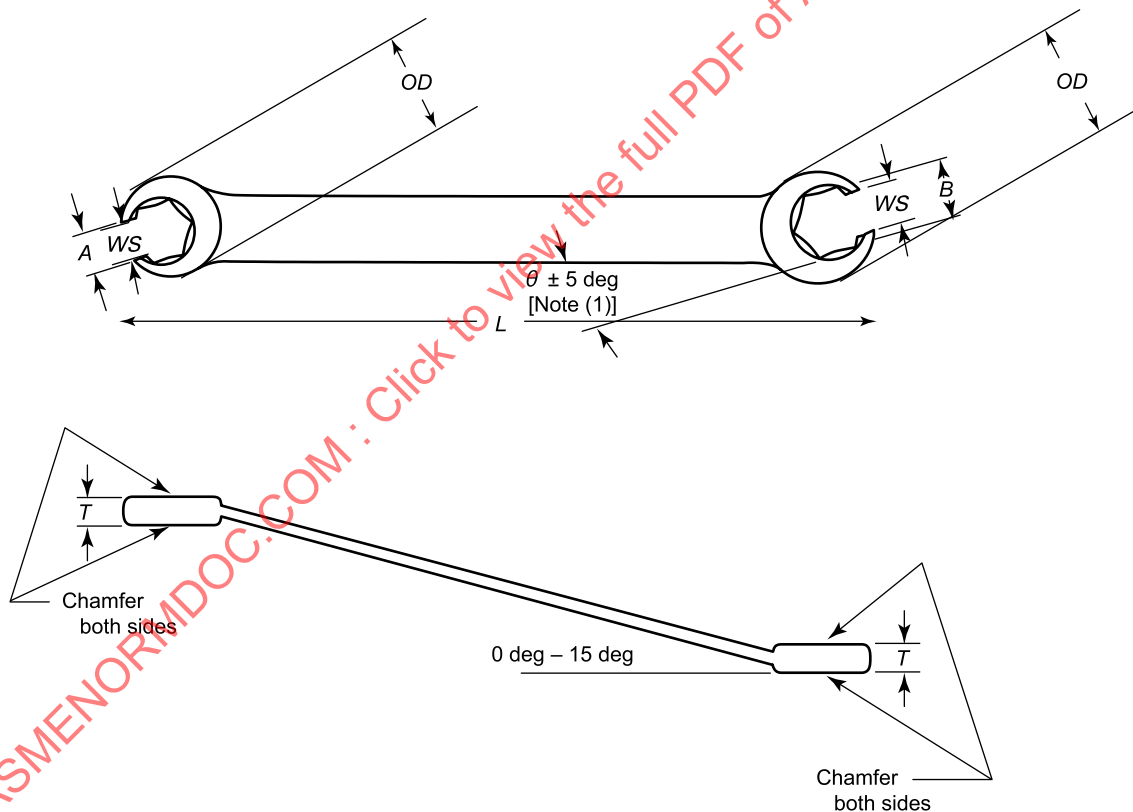
Table 5.1.3-5M
Category 39, Type III Lengths (SI)

Nominal Wrench Opening Across Flat		Regular, Max.
A	B	
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

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.

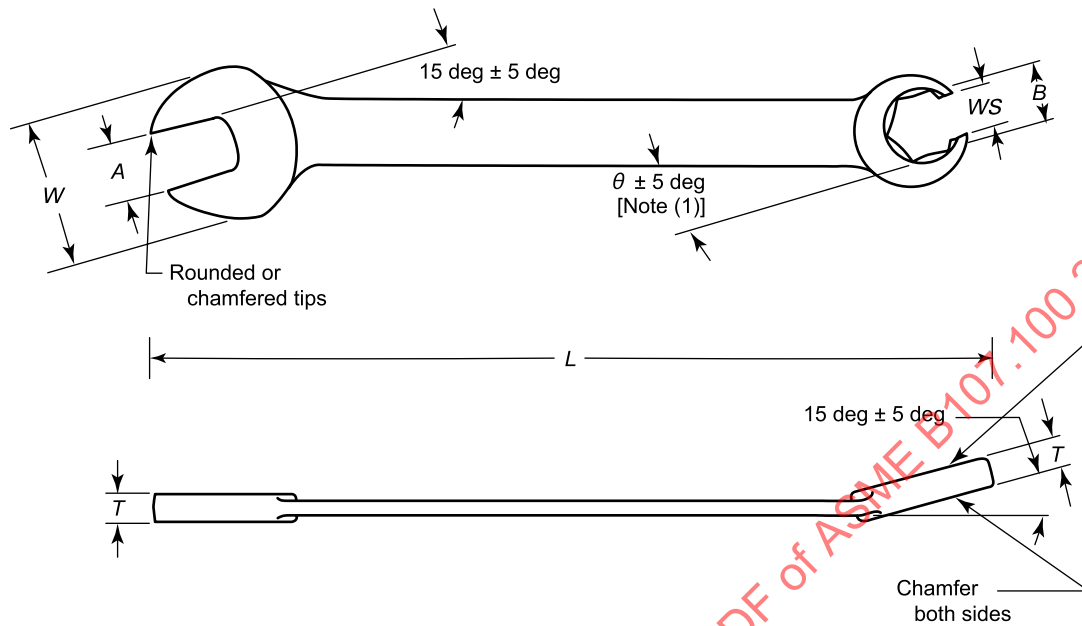
NOTE: Typical lengths are shown in Tables 5.1.4-3 and 5.1.4-4 (Tables 5.1.4-3M and 5.1.4-4M).

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



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

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



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

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

Nominal Opening Across Flat, A or B	Maximum Outside Diameter of Head, OD	Minimum Width of Slot in Head, WS	Maximum Thickness of Head, T	Proof Torque, 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 (SI)

Nominal Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Outside Diameter of Head, <i>OD</i>	Minimum Width of Slot in Head, <i>WS</i>	Maximum Thickness of Head, <i>T</i>	Proof Torque, 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 Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Width of Open Head, <i>W</i>	Maximum Thickness of Open Head, <i>T</i>	Maximum Outside Diameter of Flare Head, <i>OD</i>	Minimum Width of Slot in Flare Head, <i>WS</i>	Maximum Thickness of Flare Head, <i>T</i>	Proof Torque, lbf·in.	
						Open Head, Min.	Flare 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 (SI)

Nominal Opening Across Flat, <i>A</i> or <i>B</i>	Maximum Width of Open Head, <i>W</i>	Maximum Thickness of Open Head, <i>T</i>	Maximum Outside Diameter of Flare Head, <i>OD</i>	Minimum Width of Slot in Flare Head, <i>WS</i>	Maximum Thickness of Flare Head, <i>T</i>	Proof Torque, N·m	
						Open Head, Min.	Flare Head, 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		Regular, Min.
<i>A</i>	<i>B</i>	
$\frac{1}{4}$	$\frac{5}{16}$	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
$\frac{15}{16}$	$1\frac{1}{16}$	8.000
1	$1\frac{1}{16}$	9.000

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

Nominal Wrench Opening Across Flat		Regular, Min.
<i>A</i>	<i>B</i>	
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 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 (SI)

Nominal Wrench Opening Across	
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

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).

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 ± 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.

Figure 5.2-1
Category 8 Adjustable Wrench

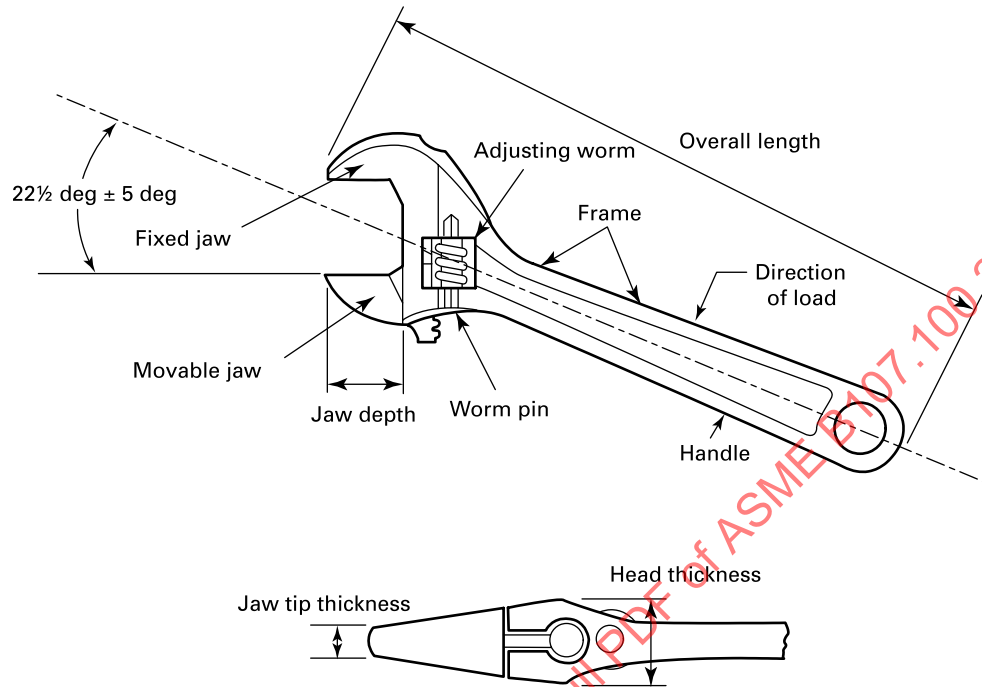


Table 5.2-1
Category 8 Adjustable Wrench (U.S. Customary)

Nominal Size	Overall Length [Note (1)]		Minimum Jaw Depth, Types I and II	Full Opening of Jaw Not Less Than		Thickness			Maximum Clearance of Movable Jaw	Maximum Parallelism of Movable Jaw, Y	Minimum Proof Torque, lbf-in.	Mandrel Sizes, X, Across Flats, +0.000/-0.005
	Min.	Max.		Type I	Type II	Jaw Tip, Max.	Head, Max.	Handle, 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.

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).

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

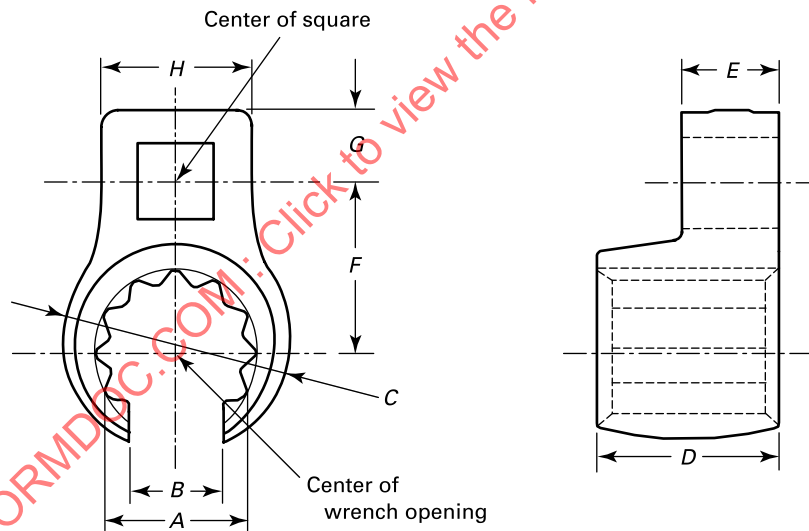


Figure 5.3.1-2
Category 21, Type I, Class 2 Crowfoot Wrench, Flare Nut, Heavy Duty

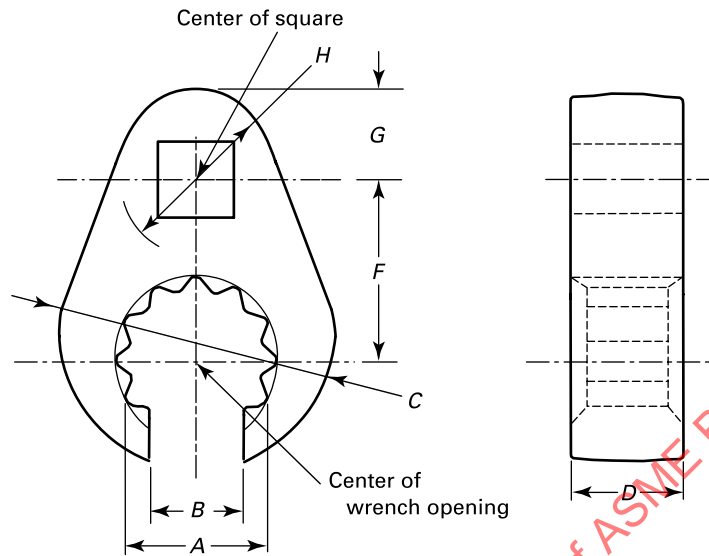


Table 5.3.1-1
Category 21, Type I, Class 1 Flare Nut, $\frac{1}{4}$ in. Square Drive, Standard Duty (U.S. Customary)

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, ½ 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.
1 ⅛	0.755	1.688	0.937	0.531	1.923	0.438	0.875	825
1 ⅜	0.812	1.750	0.937	0.531	1.963	0.438	0.875	825
1 ¼	0.890	1.844	0.937	0.531	2.045	0.438	0.875	825
1 ⅝	0.916	1.906	0.937	0.531	2.045	0.438	0.875	900
1 ¾	1.015	2.000	1.000	0.531	2.084	0.438	0.875	900
1 ⅞	1.015	2.062	1.000	0.531	2.125	0.438	0.875	900
1 ½	1.015	2.125	1.000	0.531	2.165	0.438	0.875	900
1 ⅞	1.063	2.188	1.000	0.531	2.205	0.438	0.875	1,100
1 ⅝	1.130	2.281	1.000	0.531	2.246	0.438	0.875	1,100
1 ⅞	1.265	2.375	1.062	0.531	2.295	0.438	0.875	1,100
1 ¾	1.265	2.438	1.062	0.531	2.327	0.438	0.875	1,150
1 ⅞	1.265	2.531	1.062	0.531	2.367	0.438	0.875	1,200
1 ⅞	1.265	2.625	1.124	0.531	2.408	0.438	0.875	1,200
1 ⅞	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 ⅛	1.515	2.844	1.187	0.531	2.529	0.453	0.906	1,450
2 ⅛	1.515	2.904	1.187	0.531	2.569	0.453	0.906	1,450
2 ⅞	1.515	3.000	1.187	0.531	2.610	0.453	0.906	1,500
2 ¼	1.515	3.094	1.187	0.531	2.650	0.453	0.906	1,500
2 ⅝	1.515	3.156	1.250	0.531	2.690	0.453	0.906	1,500
2 ¾	1.630	3.250	1.250	0.531	2.731	0.469	0.938	1,600
2 ⅞	1.630	3.312	1.250	0.531	2.771	0.469	0.938	1,650
2 ½	1.630	3.609	1.250	0.531	2.812	0.469	0.938	1,700
2 ⅞	1.755	3.500	1.312	0.531	2.852	0.469	0.938	1,750
2 ⅝	2.015	3.562	1.312	0.531	2.893	0.469	0.938	1,800
2 ⅞	2.015	3.625	1.312	0.531	2.933	0.469	0.938	1,800
2 ¾	2.015	3.719	1.312	0.531	2.973	0.484	0.969	1,850
2 ⅞	2.015	3.781	1.374	0.531	3.014	0.484	0.969	1,900
2 ⅞	2.015	3.938	1.374	0.531	3.095	0.484	0.969	1,950
3 ⅛	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 (SI)

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

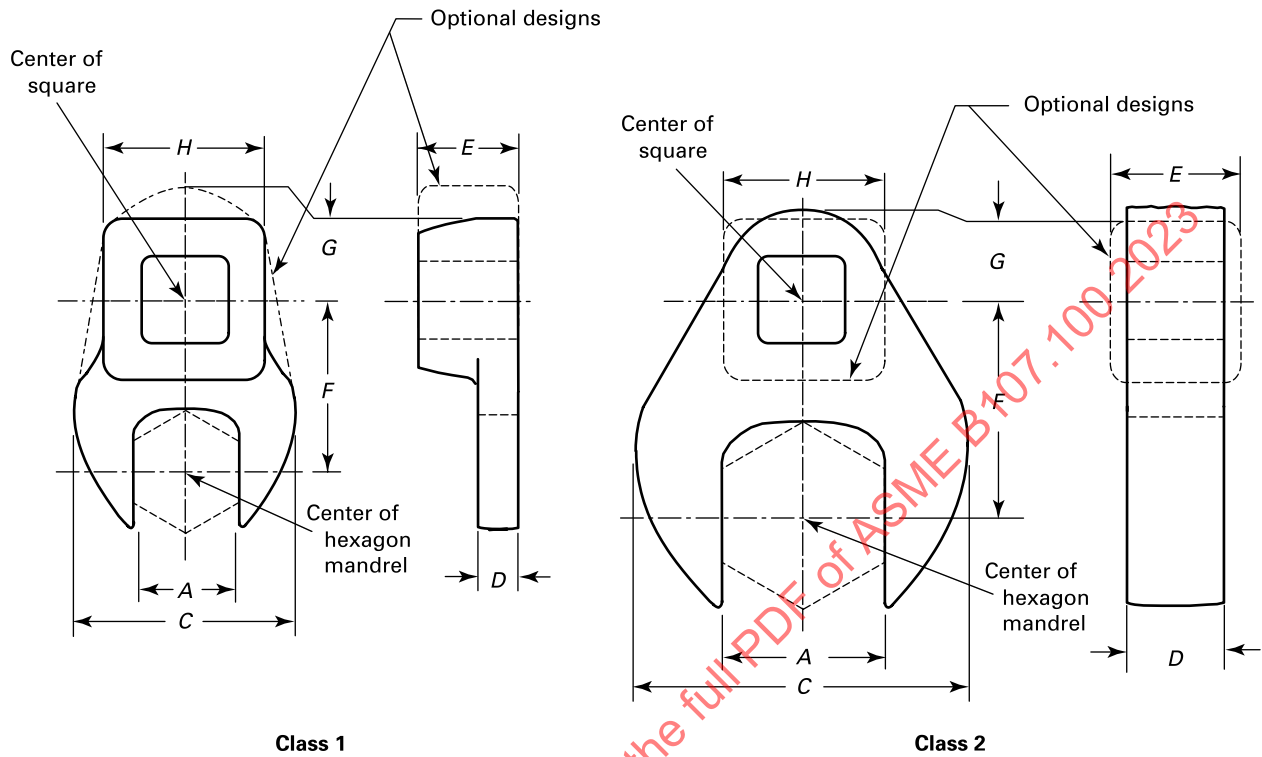


Table 5.3.2-1
Category 21, Type II, Class 1 Open End, $\frac{3}{8}$ in. Square Drive, Standard Duty (U.S. Customary)

Nominal 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.
$\frac{3}{8}$	0.951	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
$1\frac{1}{16}$	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
$1\frac{3}{16}$	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
$1\frac{5}{16}$	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 (SI)

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 2 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

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).

Figure 5.4-1
Category 66 Laminated Ratcheting Box Wrench

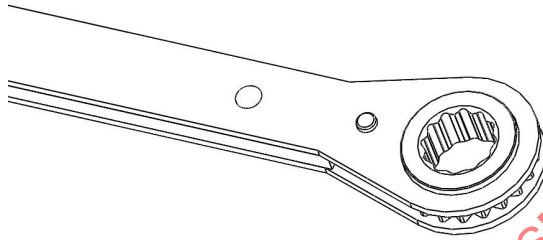


Figure 5.4-2
Category 66 Laminated Ratcheting Box Wrench (Offset)

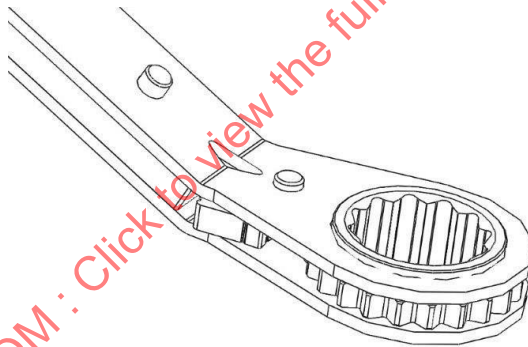


Figure 5.4-3
Category 66 Nonlaminated Ratcheting Box Wrench

