

ASME B107.100-2002

WRENCHES

**Incorporating ASME B107.6, ASME B107.9, ASME B107.39,
and ASME B107.40**

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**



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Mechanical Engineers

A N A M E R I C A N N A T I O N A L S T A N D A R D

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INCORPORATING ASME B107.6, ASME B107.9, ASME B107.39,
and ASME B107.40

ASME B107.100-2002

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FOREWORD

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

The purpose of this Standard is to define general and dimensional data specifically applicable to combination, box, open end, and flare nut wrenches and to specify test methods to evaluate performance relating to the defined requirements.

This Standard includes revisions of B107.6-1994 Combination Wrenches (Inch Series) and B107.9M-1994 Combination Wrenches (Metric Series). Further, information from B107.6-1994 and B107.9M-1994 has been moved to new Standards B107.39 and B107.40, and some configurations discontinued (refer to the table on page vii). A principal change in this edition of the Standard is the use of Type designations in place of Class and Style designations, in accordance with other B107 Standards. Updated references, finish requirements, and dimensional data are included.

The format of this Standard is in accordance with *The ASME Codes & Standards Writing Guide 2000*. Requests for interpretations of the technical requirements of this Standard should be expressed in writing to the Secretary, B107 Committee, at the address below.

Suggestions for the improvement of this Standard are welcome. They should be addressed to the Secretary, ASME B107 Committee, Three Park Avenue, New York, NY 10016-5990.

The requirements of this Standard become effective at the time of publication.

This revision was approved as an American National Standard on May 13, 2002.

ASME STANDARDS COMMITTEE B107

Hand Tools and Accessories

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

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

Secretary, B107 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
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Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

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

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

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

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

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Flat Wrench Designations

Description	Length	Series	Designation before 1997				Designation after 1997		
			Std	Type	Class	Style	Std	Type	Class
Box Wrench, Double Head, 15 deg offset each end	Reg	Inch	B107.6	I	1	1	B107.9	I	1
Box Wrench, Double Head, modified offset each end	Reg	Inch	B107.6	I	2	1	B107.9	II	1
Box Wrench, Double Head, Deep offset each end	Reg	Inch	B107.6	I	2	1	B107.9	III	1
Box Wrench, Double Head, 15 deg offset each end	Short	Inch	B107.6	I	1	2	B107.9	I	2
Box Wrench, Double Head, modified offset each end	Short	Inch	B107.6	I	2	2	B107.9	II	2
Box Wrench, Double Head, Deep offset each end	Short	Inch	B107.6	I	2	2	B107.9	III	2
Engineer's wrench, double head, open end, 15 deg	Reg	Inch	B107.6	II			B107.39	I	1
Engineer's wrench, double head, open end, 15 deg	Short	Inch	B107.6	II			B107.39	I	2
Combination Wrench, open end, 15 deg box opening	Reg	Inch	B107.6	III	1		B107.6	I	
Combination Wrench, open end, 15 deg box opening	Short	Inch	B107.6	III	2		B107.6	II	
Combination Wrench, open end, 15 deg box opening	Long	Inch	B107.6	III	3		B107.6	III	
Flare Nut wrench, double head, open end		Inch	B107.6	IV			B107.40	I	
Flare Nut Comb. wrench, open end and 15 deg Offset box opening		Inch	B107.6	V			B107.40	II	
Wrench, double head, open end, 15 / 60 deg Open end		Inch	B107.6	VI	1		B107.39	II	2
Angle Wrench, double head, open end, 30 / 60 deg Open end		Inch	B107.6	VI	2		B107.39	II	1
Angle Wrench, double head, open end, 15 / 75 deg Open end		Inch	B107.6	VI	3		Discontinued		
Tappet Wrench, double head, open end		Inch	B107.6	VII			B107.39	III	
Tappet Wrench, single head, open end		Inch	B107.6	VIII			Discontinued		
Box Wrench, Double Head, 15 deg offset each end	Reg	Metric	B107.9M	I	1	1	B107.9	I	
Box Wrench Double Head, modified offset each end	Reg	Metric	B107.9M	I	2	1	B107.9	II	1
Box Wrench, Double Head, Deep offset each end	Reg	Metric	B107.9M	I	2	1	B107.9	III	1
Box Wrench, Double Head, 15 deg offset each end	Short	Metric					B107.9	I	2
Box Wrench, Double Head, modified offset each end	Short	Metric	B107.9M	I	2	2	B107.9	II	2
Box Wrench, Double Head, Deep offset each end	Short	Metric	B107.9M	I					
Engineer's wrench, double head, open end, 15 deg	Reg	Metric	B107.9M	II	1				
Engineer's wrench, double head, open end, 15 deg	Short	Metric	B107.9M	II			B107.39	I	2
Combination Wrench, open end, 15 deg box opening	Reg	Metric	B107.9M	III	1		B107.6	I	
Combination Wrench, open end, 15 deg box opening	Short	Metric	B107.9M	III					
Combination Wrench, open end, 15 deg box opening	Long	Metric	B107.9M	III	3		B107.6	III	
Flare Nut wrench, double head, open end		Metric	B107.9M	IV			B107.40	I	
Flare Nut Comb. wrench, open end and 15 deg Offset box opening		Metric	B107.9M	V			B107.40	II	
Angle Wrench, double head, open end, 15 / 60 deg Open end		Metric	B107.9M	VI	1		B107.39	II	2
Angle Wrench, double head, open end, 30 / 60 deg Open end		Metric	B107.9M	VI	2		B107.39	II	1
Angle Wrench, double head, open end, 15 / 75 deg Open end		Metric	B107.9M	VI	3		Discontinued		
Tappet Wrench, double head, open end		Metric	B107.9M	VII			B107.39	III	
Tappet Wrench, single head, open end		Metric	B107.9M	VIII			Discontinued		

ASME B107.6

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COMBINATION WRENCHES (INCH AND METRIC SERIES)

1 SCOPE

This Standard provides the general, dimensional, performance, and safety requirements for combination wrenches. Inclusion of dimensional data in this Standard is not intended to imply that all of the products described herein are stock production sizes. Consumers are requested to consult with manufacturers concerning lists of stock production sizes.

2 CLASSIFICATION

Combination wrench, open end, and 15 deg offset box opening

Type I Regular length

Type II Short length

Type III Long length

3 NORMATIVE REFERENCES

The following documents form a part of this Standard to the extent specified herein. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

ASME B107.17M-1997 (R2002) Gages, Wrench Openings, Reference

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

ASTM E 18-97 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM B 117-97 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B 537-70 Standard Practice for Rating of Electroplated Panels Subjected to Atmospheric Exposure

ASTM B 571-97 Standard Test Methods for Adhesion of Metallic Materials

ASTM D 968-93 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

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

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

4 REQUIREMENTS

4.1 Illustrations

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

4.2 Materials

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

4.3 Markings

Each wrench shall be marked on one of the faces or on the handle, as close to each head as is practical, in a legible and permanent manner with the respective nominal wrench opening as shown in the first column of the applicable table. In addition to size markings, each wrench shall be marked in a legible and permanent manner with manufacturer's name or trademark of such known character that the source of manufacture and country of origin may be readily determined.

4.4 Hardness

Wrenches shall be heat treated to a hardness of 38 HRC to 55 HRC when tested as specified in para. 5.1.

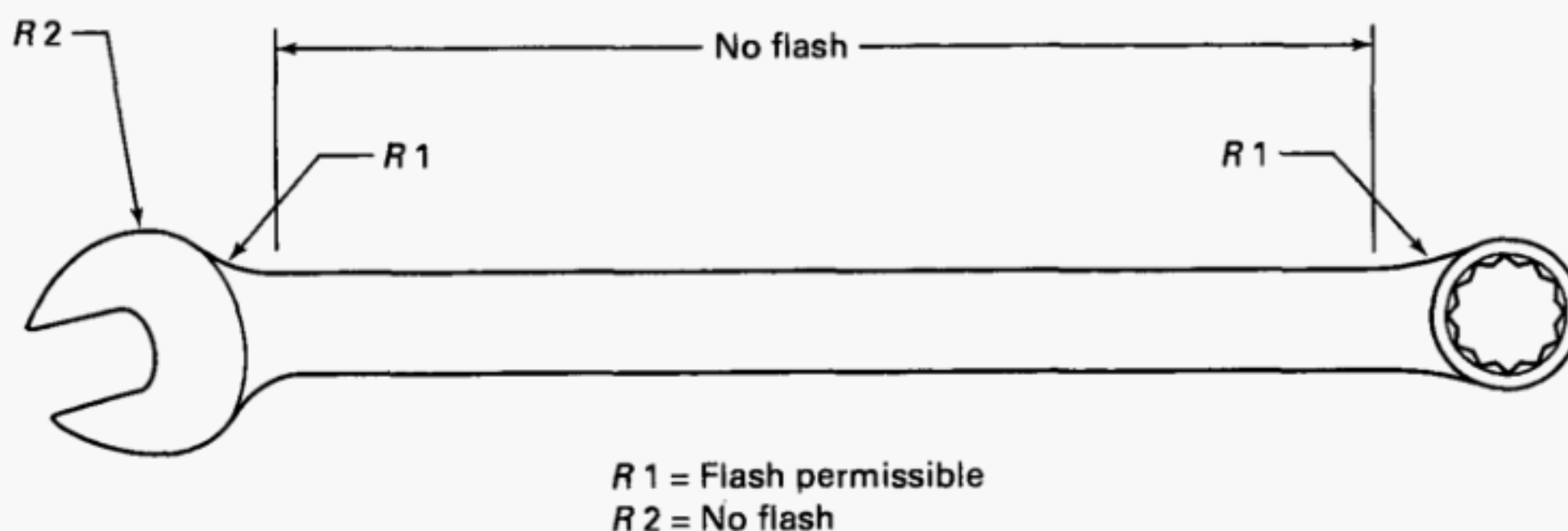


FIG. 1 FINISH REQUIREMENTS

4.5 Proof Torque

When tested as specified, wrenches shall withstand the proof torque specified in the applicable tables without failure or permanent deformation (set), which might affect the durability or serviceability of the wrenches. Proof torque is a predetermined test torque to which a sample is subjected before acceptance.

4.6 Wrench Openings

Wrench openings shall be such as to ensure acceptance when gaged with gages conforming to ASME B107.17M.

4.7 Finish

4.7.1 Surface Finish. See Fig. 1. All surfaces shall be thoroughly cleaned, free from cracks, and essentially free from burrs, pits, nodules, and other detrimental conditions.

(a) *Minimum Area of Surface Finish.* A minimum of 180 deg of the outer periphery of the box ends (90 deg on each side of the longitudinal axis of the wrench) and both faces of the open end shall be bright and shall have a maximum roughness height value of 30 microinches (0.76 micrometers) (arithmetic average using a 0.03 in. cutoff on the surface measuring instrument). Wrenches with phosphate or oxide coatings are excluded from this requirement.

(b) *Flash.* 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 which shall be essentially straight and uniform in sectional dimensions, as shown in Fig 1. Any remaining flash on any surface shall blend smoothly with adjacent surfaces; external sharp edges shall be broken to 0.016 in. (0.38 mm) radius minimum, and

shall not project more than 0.016 in. (0.38 mm) from adjacent surfaces.

4.7.2 Coatings. The coating shall be adherent, smooth, continuous, and free from uncoated areas, pits, blisters, nodules, and any other conditions, which would interfere with their protective value and serviceability. Plating contact marks should be kept to a minimum. The wrench shall be coated with one of the coatings in accordance with (a), (b), (c), or (d) below. The customer may specify the type of coating required.

(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.

(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) *Alternative Coatings.* Wrenches not falling within one of the coating types listed above shall be finished in accordance with predetermined requirements between manufacturer and customer. Alternative coatings may be used in lieu of Nickel-Chromium and shall be subjected to the Coating Process Qualification Test as specified in para. 5.3.

4.8 Design

The wrench shall have one open end and one box end of identical nominal size. The open end shall be suitable for use on hexagonal and square-headed bolts and nuts. The box opening shall have either a 6 or 12 point opening as specified. The wrench shall conform

to Tables 1 or 2 for the applicable style and shall be similar to Fig. 2.

Wrenches shall be so designed as to afford 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. The corners and serrations in the box end openings shall be clearly defined (not smeared or torn). Wrenches that have a box end design shall be chamfered on both sides to provide a lead for the working surfaces. The tips (working ends) of all open ends shall also be chamfered or rounded to eliminate burrs (see Fig. 2).

5 TEST PROCEDURES

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

5.1 Hardness

Hardness shall be tested in accordance with ASTM E 18. When surface preparation is necessary, the amount of material removed shall not exceed 0.007 in. (0.18 mm) in the area contacted by the indenter.

5.2 Proof Torque Test

Proof Torque Test shall be conducted to determine conformance with the applicable proof torque requirement specified in para. 4.5.

5.2.1 Wrench Preparation. In order 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.

5.2.2 Mandrels for Wrench Openings. Suitable mandrels shall be used to fit into the wrench opening and provide proper support and necessary strength for the proof torque applied. The wrenches shall be tested on hexagonal mandrels. Mandrels shall conform to the dimensions and tolerances of Tables 3 and 4. Mandrels shall be hardened to not less than 55 HRC and smoothly finished on the wrench engaging surfaces.

5.2.3 Application of Proof Torque. The proof torque specified in the applicable table is the torque applied to the test mandrel, which tends to rotate the mandrel about its longitudinal axis. Wrench openings shall be gaged prior to testing. The torque shall be applied to mandrels which 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.* Box ends shall be torqued to the proof torque. Following the removal of the proof torque, they shall be regaged. Any box end which does not sustain the proof torque, cracks, fractures, slips on 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 which do not sustain the proof torque, 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 B107.17M size by more than the following:

(1) 0.002 in. (0.05 mm) for wrench opening sizes $\frac{5}{32}$ in. (4 mm) through 1 in. (25 mm).

(2) 0.003 in. (0.08 mm) for wrench opening sizes $1\frac{1}{16}$ in. (26 mm) through $2\frac{1}{4}$ in. (50 mm).

5.3 Coating Process Qualification Test

Alternative coatings shall be subjected to testing in order to certify the manufacturer's production coating process. The Coating Process Test consists of an adhesion, abrasion, and corrosion test specified in paras. 5.3.2, 5.3.3, and 5.3.4. The Coating Process Qualification Test may also be performed to certify the manufacturer's Nickel-Chromium coating process. Passing the Coating Process Qualification tests, when agreed to by the customer, exempts the manufacturer from the Nickel-Chromium thickness requirement of para. 4.7.2(a). Re-testing may be required when a significant change occurs in the process, when there is a change in the materials, or when contractually required by the customer.

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

5.3.2 Coating Process Adhesion Test. Sample wrenches shall pass the file or grind-saw test of ASTM B 571.

TABLE 1 TYPE I, II, AND III COMBINATION WRENCH (CUSTOMARY UNITS)

Nominal Wrench Opening Across Flats, A or B, in.	Width of Open Head W Max., in.	Outside Diameter of Box Head, OD Max., in.	Permitted Eccentricity of Box Head Opening to Outside Diameter, Max., in.	Thickness of Heads, T		Proof Torque		Overall Length L			
				Open Head Max., in.	Box Head Max., in.	Open Head Min., lbf-in.	Box Head Min., lbf-in.	Type I		Type II	Type III
								Min., in.	Max., in.	Max., in.	Min., in.
1/8	0.359	0.297	0.015	0.141	0.172	20	60	2.500	4.625	3.125	-
5/32	0.438	0.313	0.015	0.141	0.172	35	90	2.750	4.750	3.250	-
3/16	0.500	0.375	0.015	0.172	0.203	45	150	2.875	4.875	3.375	-
7/32	0.563	0.406	0.015	0.172	0.234	50	165	3.000	5.000	3.500	-
1/4	0.654	0.478	0.015	0.205	0.295	67	220	3.000	5.125	3.625	4.250
9/32	0.688	0.500	0.015	0.215	0.280	78	248	3.250	5.500	3.750	4.500
5/16	0.811	0.572	0.015	0.223	0.330	138	275	3.250	5.875	4.250	5.000
11/32	0.813	0.612	0.015	0.237	0.335	193	275	3.250	6.250	4.500	5.500
3/8	0.906	0.663	0.015	0.250	0.344	275	605	3.500	6.625	4.750	5.938
7/16	0.996	0.730	0.015	0.281	0.391	413	715	4.500	7.312	5.750	6.375
1/2	1.192	0.824	0.015	0.344	0.394	550	1,020	5.250	8.062	6.000	6.938
9/16	1.272	0.924	0.018	0.375	0.425	770	1,500	5.750	9.000	6.375	7.500
5/8	1.402	1.000	0.018	0.380	0.500	1,100	2,200	6.000	10.000	6.625	8.125
11/16	1.536	1.094	0.020	0.400	0.535	1,375	2,640	6.500	11.000	7.126	8.938
3/4	1.672	1.175	0.020	0.406	0.594	1,650	2,860	6.750	12.000	7.250	9.750
13/16	1.828	1.344	0.020	0.516	0.609	2,200	3,300	7.125	13.000	7.500	10.250
7/8	1.938	1.375	0.023	0.516	0.688	2,475	3,630	9.625	14.000	7.750	11.500
15/16	2.078	1.469	0.023	0.594	0.701	3,025	4,510	10.500	15.000	8.125	12.500
1	2.250	1.531	0.020	0.625	0.719	3,575	5,390	11.375	15.500	8.500	13.500
1 1/16	2.344	1.688	0.023	0.625	0.790	3,850	5,940	13.000	16.250	8.750	14.500
1 1/8	2.500	1.724	0.023	0.656	0.860	4,400	6,430	14.000	17.750	9.125	15.500
1 3/16	2.630	1.813	0.023	0.688	0.890	5,200	7,200	15.000	18.250	9.400	16.310
1 1/4	2.766	1.906	0.023	0.719	0.940	5,775	7,920	15.750	19.500	9.750	16.750
1 5/16	2.938	2.063	0.027	0.719	0.940	6,600	8,400	16.500	21.000	10.125	18.500
1 3/8	3.063	2.113	0.027	0.750	0.940	7,425	8,970	17.250	21.500	10.500	19.375
1 7/16	3.188	2.227	0.027	0.813	0.953	8,250	9,240	18.000	22.250	-	20.375
1 1/2	3.375	2.395	0.027	0.813	1.008	8,500	10,365	18.750	23.000	-	21.375
1 9/16	3.563	2.438	0.027	0.813	1.031	8,750	11,495	19.500	23.500	-	22.250
1 5/8	3.625	2.641	0.031	0.813	1.063	9,000	12,800	20.250	24.500	-	22.375
1 11/16	3.750	2.790	0.031	0.813	1.063	10,500	13,570	20.750	25.000	-	23.375
1 3/4	4.000	2.938	0.031	0.875	1.125	11,100	14,300	21.750	26.500	-	24.250
1 13/16	4.188	2.938	0.037	0.875	1.125	11,750	15,100	22.500	27.500	-	25.250
1 7/8	4.344	3.125	0.037	0.938	1.125	12,400	15,900	23.250	29.000	-	26.250
2	4.469	3.125	0.037	0.938	1.125	13,650	17,400	23.875	29.000	-	27.250
2 1/16	4.594	3.313	0.037	0.938	1.234	14,300	18,200	23.938	30.250	-	-
2 1/8	5.000	3.313	0.046	0.938	1.234	14,900	19,000	24.875	30.750	-	-
2 3/16	5.000	3.313	0.046	0.938	1.234	15,500	19,700	24.875	31.250	-	-
2 1/4	5.000	3.313	0.050	0.938	1.234	16,200	20,500	24.875	31.750	-	-

TABLE 2 TYPE I, II, AND III COMBINATION WRENCH (SI UNITS)

Nominal Wrench Opening Across Flats, A or B, mm	Width of Open Head, W Max., mm	Outside Diameter of Box Head, OD Max., mm	Permitted Eccentricity of Box Head Opening to Outside Diameter Max., mm	Thickness of Heads, T		Proof Torque		Overall Length L			
				Open Head Max., mm	Box Head Max., mm	Open Head Min., N•m	Box Head Min., N•m	Type I		Type II	Type III
								Min., mm	Max., mm	Max., mm	Min., mm
4	10.8	7.6	0.38	3.7	4.0	4	12	-	-	75	-
5	12.5	9.0	0.38	3.9	4.6	5	17	-	-	79	-
5.5	15.5	11.8	0.38	5.3	6.0	5	18	70	130	82	120
6	17.3	12.7	0.38	5.8	7.4	7	20	76	135	85	125
7	18.3	14.3	0.38	6.3	7.7	8	27	84	145	88	129
8	21.4	15.0	0.38	6.3	8.2	15	30	92	155	92	137
9	21.8	17.4	0.38	6.6	9.0	21	40	100	170	100	143
10	26.0	18.8	0.38	6.9	9.0	31	71	115	185	115	163
11	26.0	19.9	0.38	7.0	10.0	46	80	125	195	125	177
12	27.7	21.4	0.46	8.0	10.0	49	91	135	205	135	190
13	30.2	23.1	0.46	8.9	10.5	62	115	140	215	140	200
14	32.8	24.4	0.46	8.9	11.5	86	158	148	229	150	214
15	34.8	26.0	0.46	8.9	11.5	104	200	153	245	155	226
16	36.4	27.0	0.46	9.4	12.1	124	248	157	260	160	231
17	39.7	29.3	0.46	9.8	12.7	139	267	163	275	165	241
18	41.3	29.3	0.46	10.0	12.7	155	304	170	290	170	250
19	42.7	31.2	0.46	10.1	14.8	186	323	182	305	185	265
20	46.4	32.9	0.51	11.4	14.8	217	347	190	335	190	275
21	47.6	33.8	0.51	11.7	16.3	248	372	195	350	195	290
22	48.3	35.6	0.51	12.0	16.3	279	408	200	365	200	305
23	52.4	37.3	0.51	12.4	16.5	310	455	205	384	205	315
24	53.5	38.1	0.51	12.5	17.8	341	509	210	396	210	330
25	55.7	40.2	0.51	12.7	17.9	372	559	259	409	-	345
26	57.2	42.2	0.58	14.0	18.0	403	608	280	415	-	367
27	60.2	44.2	0.58	14.7	19.8	432	671	300	430	-	374
28	62.3	45.3	0.58	14.9	19.8	497	710	320	445	-	387
29	65.5	45.3	0.58	14.9	19.8	514	750	340	460	-	390
30	67.0	47.5	0.58	15.2	20.0	570	795	365	475	-	395
31	68.6	48.6	0.58	15.2	20.5	610	850	395	490	-	420
32	71.0	49.8	0.58	15.7	22.0	650	905	405	505	-	425
33	73.0	50.3	0.58	15.7	22.3	700	950	425	535	-	454
34	75.0	52.0	0.58	16.0	23.2	745	994	445	565	-	-
36	76.8	56.1	0.58	19.0	25.1	894	1165	480	615	-	-
41	88.9	62.9	0.70	19.3	25.3	1154	1579	535	665	-	-
46	95.3	68.0	0.70	22.4	25.8	1453	2067	585	715	-	-
50	103.2	76.0	0.70	25.0	27.6	1716	2512	635	765	-	-

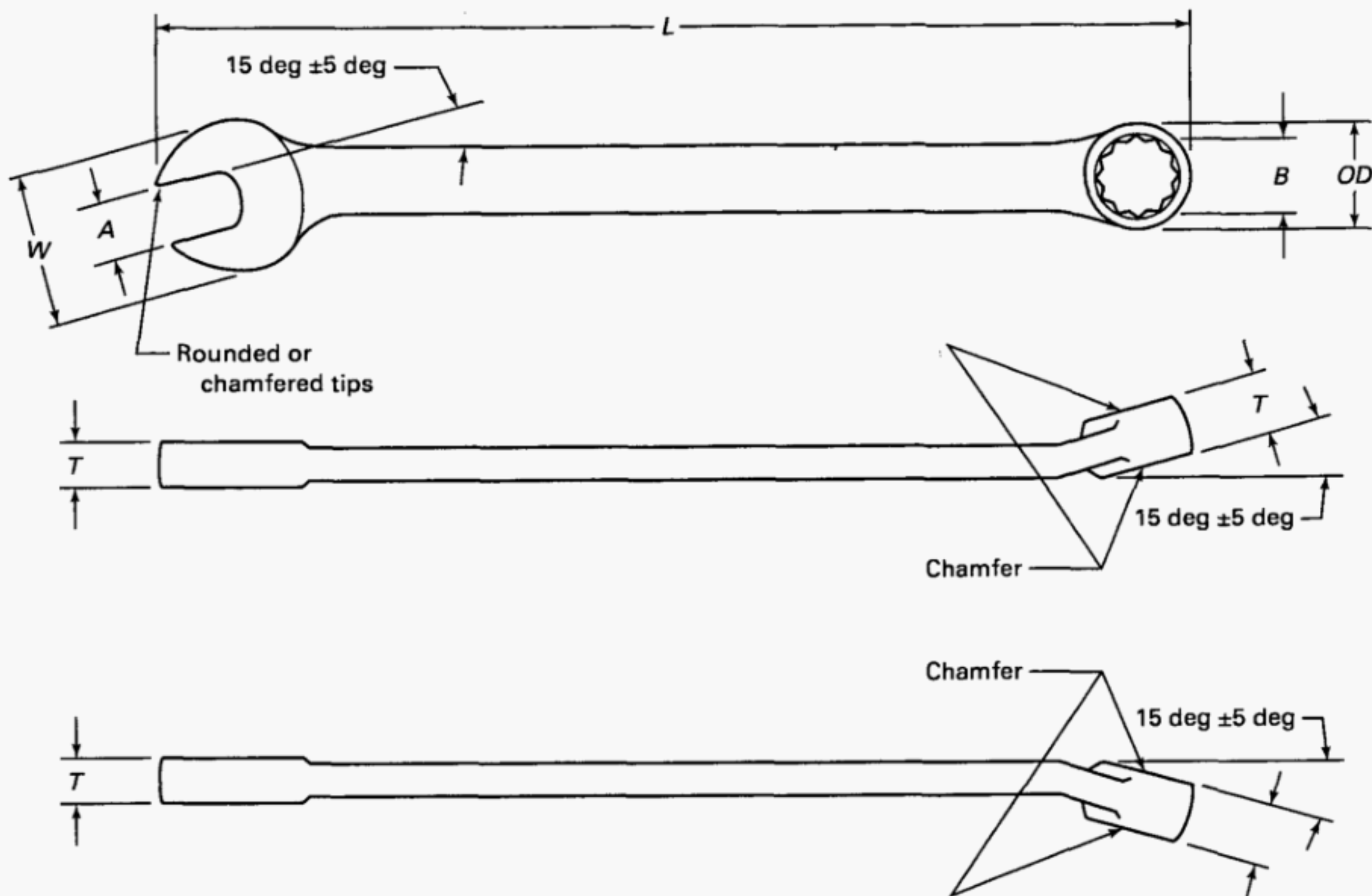


FIG. 2 TYPE I, II, AND III COMBINATION WRENCH

5.3.3 Coating Process Abrasion Test. Sample wrenches shall have no base material exposed when subjected to 100 L of falling sand test of ASTM D 968 Method A.

5.3.4 Coating Process Corrosion Test. Sample wrenches shall be tested for corrosion resistance by exposure to a 48 hr salt spray test, as specified in ASTM B 117, without falling below the ASTM B 537 rating of 6.

6 DESIGNATIONS

Wrenches shall be designated by the following data in the sequence shown:

- (a) Type
- (b) Size of openings
- (c) Configuration of openings
- (d) Coating

EXAMPLE: Combination Wrench Type I, Regular Length, $\frac{1}{2}$ in. openings, 12 point openings, Nickel-chrome.

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.

**TABLE 3 HEXAGON MANDREL DIMENSIONS
(CUSTOMARY UNITS)**

Nominal Size of Wrench Opening, in.	Hexagon Mandrel Dimensions, in.		
	Across Flats Tolerance		Across Corners, Min., in. [Note (1)]
	Plus	Minus	
1/8	0.001	0.002	0.1403
5/32	0.001	0.002	0.1745
13/64	0.001	0.002	0.2095
3/16	0.001	0.002	0.2268
7/32	0.001	0.002	0.2440
15/64	0.001	0.002	0.2610
1/4	0.001	0.002	0.2780
9/32	0.001	0.002	0.3133
5/16	0.001	0.002	0.3495
11/32	0.001	0.002	0.3860
3/8	0.001	0.002	0.4225
7/16	0.001	0.002	0.4935
1/2	0.001	0.003	0.5635
9/16	0.001	0.003	0.6339
5/8	0.001	0.003	0.7055
11/16	0.001	0.003	0.7769
3/4	0.001	0.003	0.8485
13/16	0.001	0.003	0.9201
7/8	0.001	0.003	0.9917
15/16	0.001	0.003	1.0631
1	0.001	0.003	1.1297
1 1/16	0.001	0.003	1.2013
1 1/8	0.001	0.003	1.2728
1 3/16	0.001	0.003	1.343
1 1/4	0.001	0.003	1.416
1 5/16	0.001	0.003	1.487
1 3/8	0.001	0.003	1.559
1 7/16	0.001	0.003	1.631
1 1/2	0.001	0.003	1.702
1 9/16	0.001	0.007	1.770
1 5/8	0.001	0.007	1.841
1 11/16	0.001	0.007	1.912
1 3/4	0.001	0.007	1.983
1 13/16	0.001	0.007	2.054
1 7/8	0.001	0.007	2.124
1 15/16	0.001	0.007	2.195
2	0.001	0.007	2.266
2 1/16	0.001	0.007	2.337
2 1/8	0.001	0.007	2.408
2 3/16	0.001	0.007	2.479
2 1/4	0.001	0.007	2.549

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 1 1/2 in. nominal size.

**TABLE 4 HEXAGON MANDREL DIMENSIONS
(SI UNITS)**

Nominal Size of Wrench Opening, mm	Hexagon Mandrel Dimensions, mm		
	Across Flats Tolerance		Across Corners, Min., mm [Note (1)]
	Plus	Minus	
3.2	0.025	0.050	3.57
4	0.025	0.050	4.46
5	0.025	0.050	5.58
5.5	0.025	0.050	6.13
6	0.025	0.050	6.68
6.3	0.025	0.050	7.02
7	0.025	0.050	7.79
8	0.025	0.050	8.95
9	0.025	0.050	10.11
10	0.025	0.050	11.27
11	0.025	0.050	12.40
12	0.025	0.076	13.53
13	0.025	0.076	14.67
14	0.025	0.076	15.80
15	0.025	0.076	16.92
16	0.025	0.076	18.06
17	0.025	0.076	19.20
18	0.025	0.076	20.35
19	0.025	0.076	21.49
20	0.025	0.076	22.64
21	0.025	0.076	23.78
22	0.025	0.076	24.93
23	0.025	0.076	26.07
24	0.025	0.076	27.20
25	0.025	0.076	28.27
26	0.025	0.076	29.38
27	0.025	0.076	30.53
28	0.025	0.076	31.67
29	0.025	0.076	32.81
30	0.025	0.076	33.96
31	0.025	0.076	35.10
32	0.025	0.076	36.25
33	0.025	0.076	37.38
34	0.025	0.076	38.52
35	0.025	0.076	39.68
36	0.025	0.076	40.83
38	0.025	0.076	43.11
40	0.025	0.177	45.32
41	0.025	0.177	46.45
42	0.025	0.177	47.59
46	0.025	0.177	52.12
50	0.025	0.177	56.65

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 38 mm nominal size.

ASME B107.9

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BOX WRENCHES DOUBLE HEAD (INCH AND METRIC SERIES)

1 SCOPE

This Standard provides the general, dimensional, performance, and safety requirements for box wrenches. Inclusion of dimensional data in this Standard is not intended to imply that all of the products described herein are stock production sizes. Consumers are requested to consult with manufacturers concerning lists of stock production sizes.

2 CLASSIFICATION

Box wrench, double head

Type I	15 deg offset each end
<i>Class 1</i>	Regular length
<i>Class 2</i>	Short length
Type II	modified offset each end
<i>Class 1</i>	Regular length
<i>Class 2</i>	Short length
Type III	deep offset each end
<i>Class 1</i>	Regular length
<i>Class 2</i>	Short length

3 NORMATIVE REFERENCES

The following documents form a part of this Standard to the extent specified herein. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

ASME B107.17M-1997 Gages, Wrench Openings, Reference

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

ASTM E 18-97 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM B 117-97 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B 537-70 Standard Practice for Rating of Electroplated Panels Subjected to Atmospheric Exposure

ASTM B 571-97 Standard Test Methods for Adhesion of Metallic Materials

ASTM D 968-93 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

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

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

4 REQUIREMENTS

4.1 Illustrations

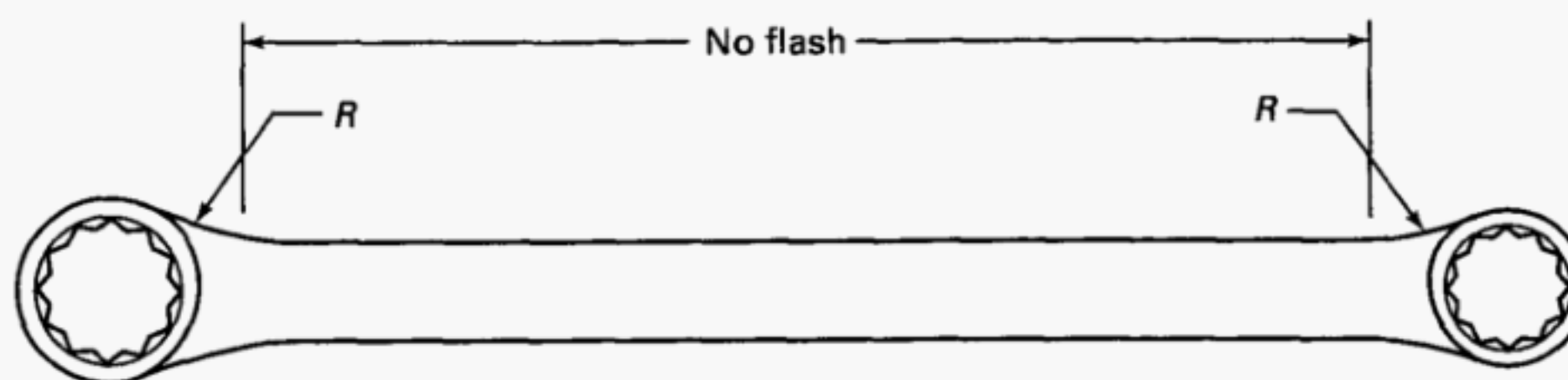
The illustrations shown herein are descriptive and not restrictive, and are not intended to preclude the manufacture of wrenches, which are otherwise in accordance with this Standard.

4.2 Materials

The materials used in the manufacturing of the wrenches shall be such as to produce wrenches conforming to the physical requirements hereinafter described.

4.3 Markings

Each wrench shall be marked on the handle as close to each head as is practical, in a legible and permanent manner with the respective nominal wrench opening as shown in the first column of the applicable table. In addition to size markings, each wrench shall be marked in a legible and permanent manner with manufacturer's name or trademark of such known character that the source of manufacture and country of origin may be readily determined.



R = Flash permissible for Type I, II, and III wrenches

FIG. 1 FINISH REQUIREMENTS

4.4 Hardness

Wrenches shall be heat treated to a hardness of 38 HRC to 55 HRC when tested as specified in para. 5.1.

4.5 Proof Torque

When tested as specified, wrenches shall withstand the proof torque specified in the applicable tables without failure or permanent deformation (set), which might affect the durability or serviceability of the wrenches. Proof torque is a predetermined test torque to which a sample is subjected before acceptance.

4.6 Wrench Opening

Wrench openings shall be such as to ensure acceptance when gaged with gages conforming to ASME B107.17M.

4.7 Finish

4.7.1 Surface Finish. See Fig. 1. All surfaces shall be thoroughly cleaned, free from cracks, and essentially free from burrs, pits, nodules, and other detrimental conditions.

(a) *Minimum Area of Surface Finish.* A minimum of 180 deg of the outer periphery of the box ends (90 deg on each side of the longitudinal axis of the wrench) and shall have a maximum roughness height value of 30 μ in. (0.76 μ m) (arithmetic average using a 0.03 in. cutoff on the surface measuring instrument). Wrenches with phosphate or oxide coatings are excluded from this requirement.

(b) *Flash.* Flash shall be completely removed from the periphery of the heads of all box wrenches, from the circumference of all open end wrenches, and from that portion of the handle which shall be essentially straight and uniform in sectional dimensions, as shown in Fig. 1. Any remaining flash on any surface shall blend smoothly with adjacent surfaces; external sharp edges shall be broken to 0.016 in. (0.38 mm) radius

minimum, and shall not project more than 0.016 in. (0.38 mm) from adjacent surfaces.

4.7.2 Coatings. The coating shall be adherent, smooth, continuous, and free from uncoated areas, pits, blisters, nodules, and any other conditions, which would interfere with their protective value and serviceability. Plating contact marks should be kept to a minimum. The wrench shall be coated with one of the coatings in accordance with (a), (b), (c), or (d) below. The customer may specify the type of coating required.

(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.

(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) *Alternative Coatings.* Wrenches not falling within one of the coating types listed above shall be finished in accordance with predetermined requirements between manufacturer and customer. Alternative coatings may be used in lieu of Nickel-Chromium and shall be subjected to the Coating Process Qualification Test as specified in para. 5.3.

4.8 Design

The wrench shall have two box openings of differing sizes and shall have either a 6 or 12 point opening on both ends as specified. The wrenches shall conform to Tables 1 or 2 as applicable. Wrenches shall be so designed as to afford 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.

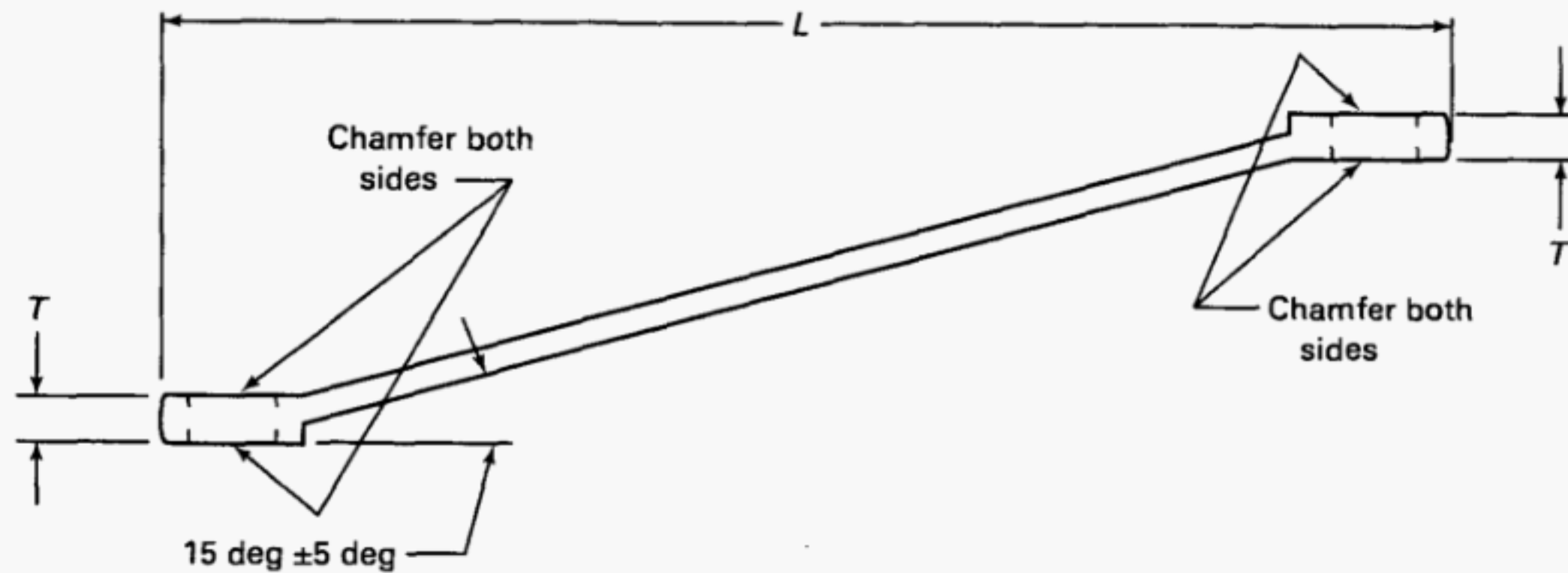
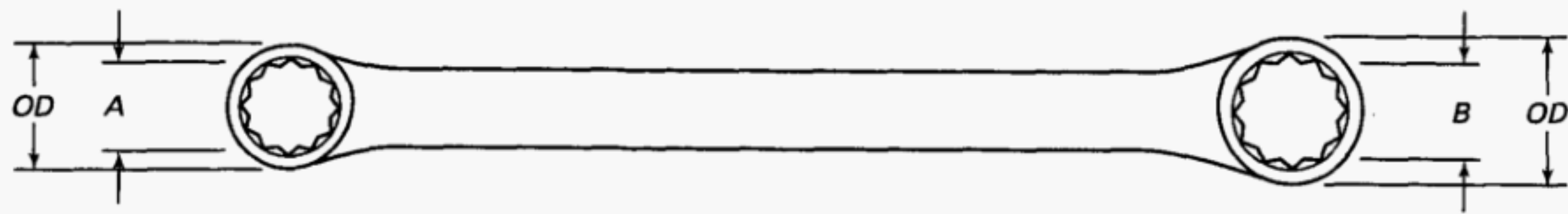


FIG. 2A TYPE I BOX WRENCH

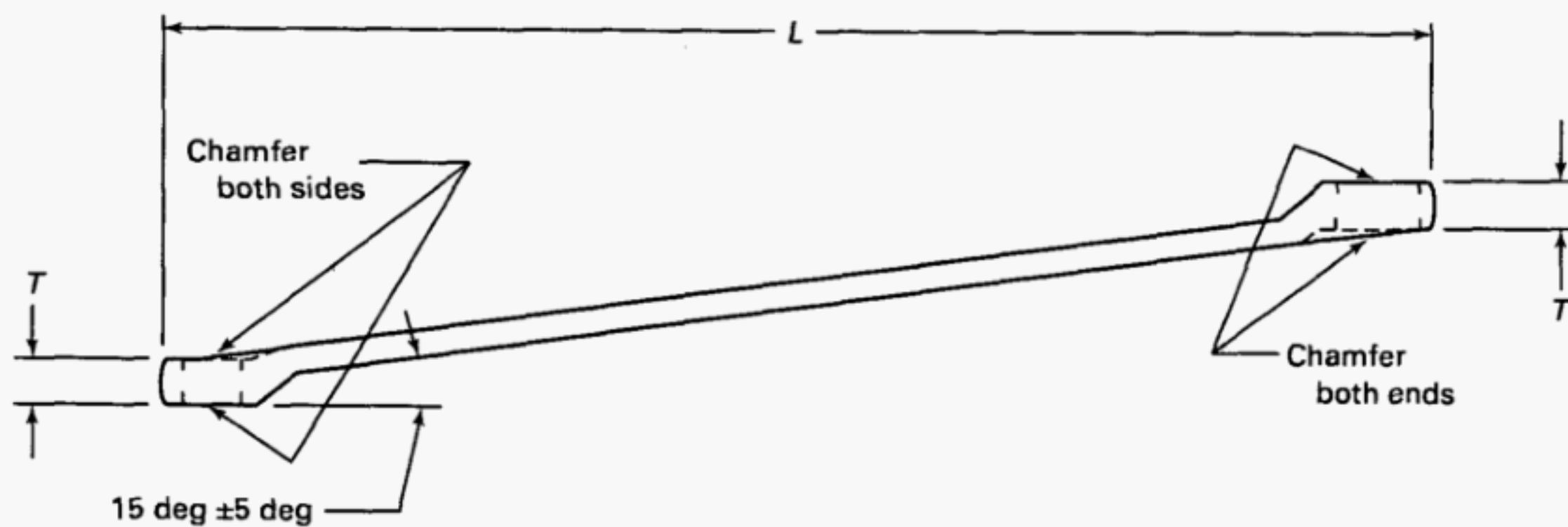


FIG. 2B TYPE I BOX WRENCH (ALTERNATE CONSTRUCTION)

The corners and serrations in the box wrench openings shall be clearly defined (not smeared or torn). The box ends of Type I shall be chamfered on both sides to provide a lead for the working surfaces and shall be similar to Figs. 2A and 2B. The box ends of Type II shall be chamfered on at least one side and shall be similar to Fig. 3. The box ends of Type III shall be chamfered on at least one side and shall be similar to Fig. 4.

5 TEST PROCEDURES

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

5.1 Hardness

Hardness shall be tested in accordance with ASTM E 18. When surface preparation is necessary, the amount of material removed shall not exceed 0.007 in. (0.18 mm) in the area contacted by the indenter.

5.2 Proof Torque Test

Proof Torque Test shall be conducted to determine conformance with the applicable proof torque requirements specified in para. 4.5.

5.2.1 Wrench Preparation. In order to prepare the wrench for test, suitable reference lines may be scribed on the heads and handle. After application of

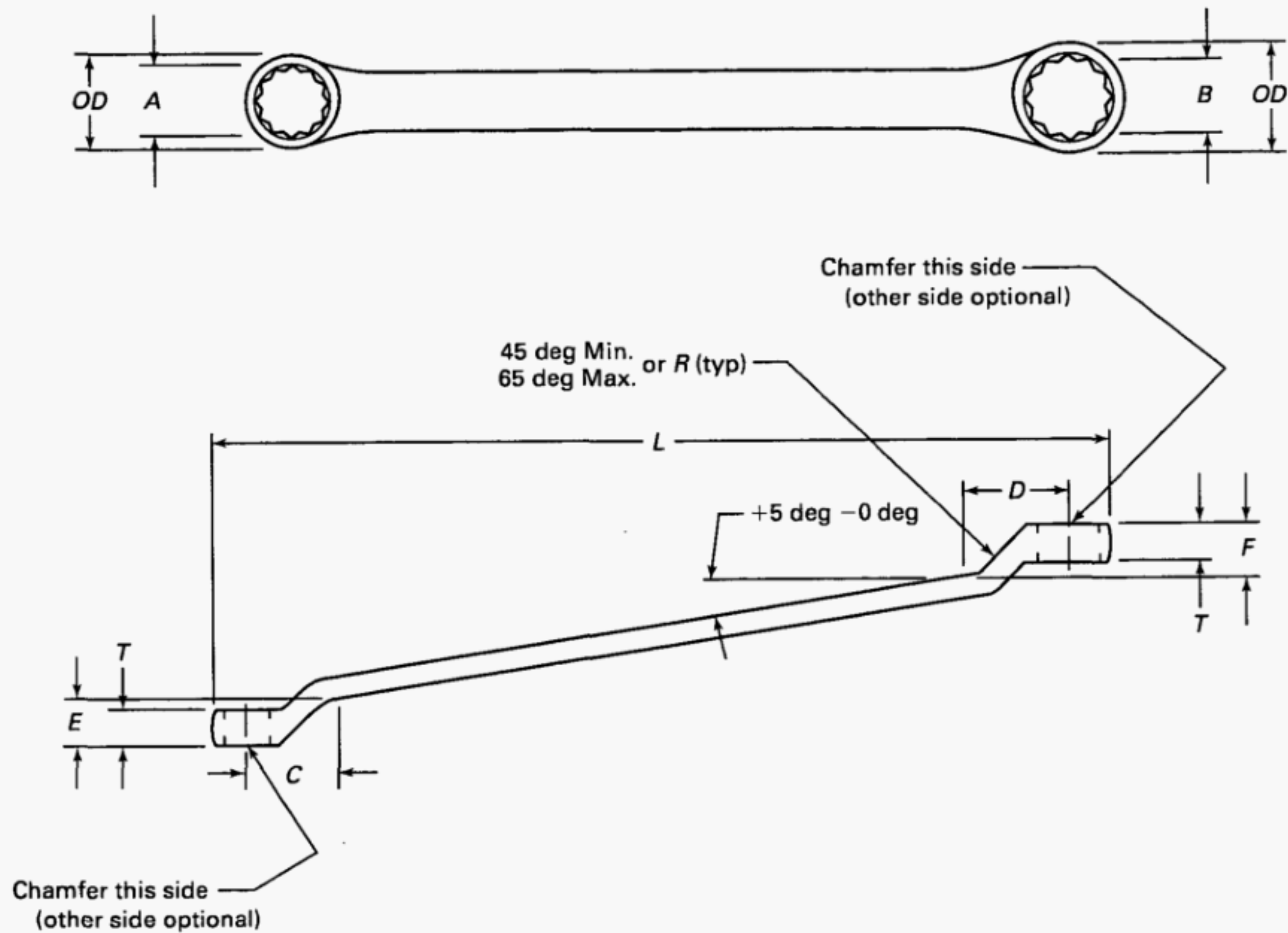


FIG. 3 TYPE II BOX WRENCH

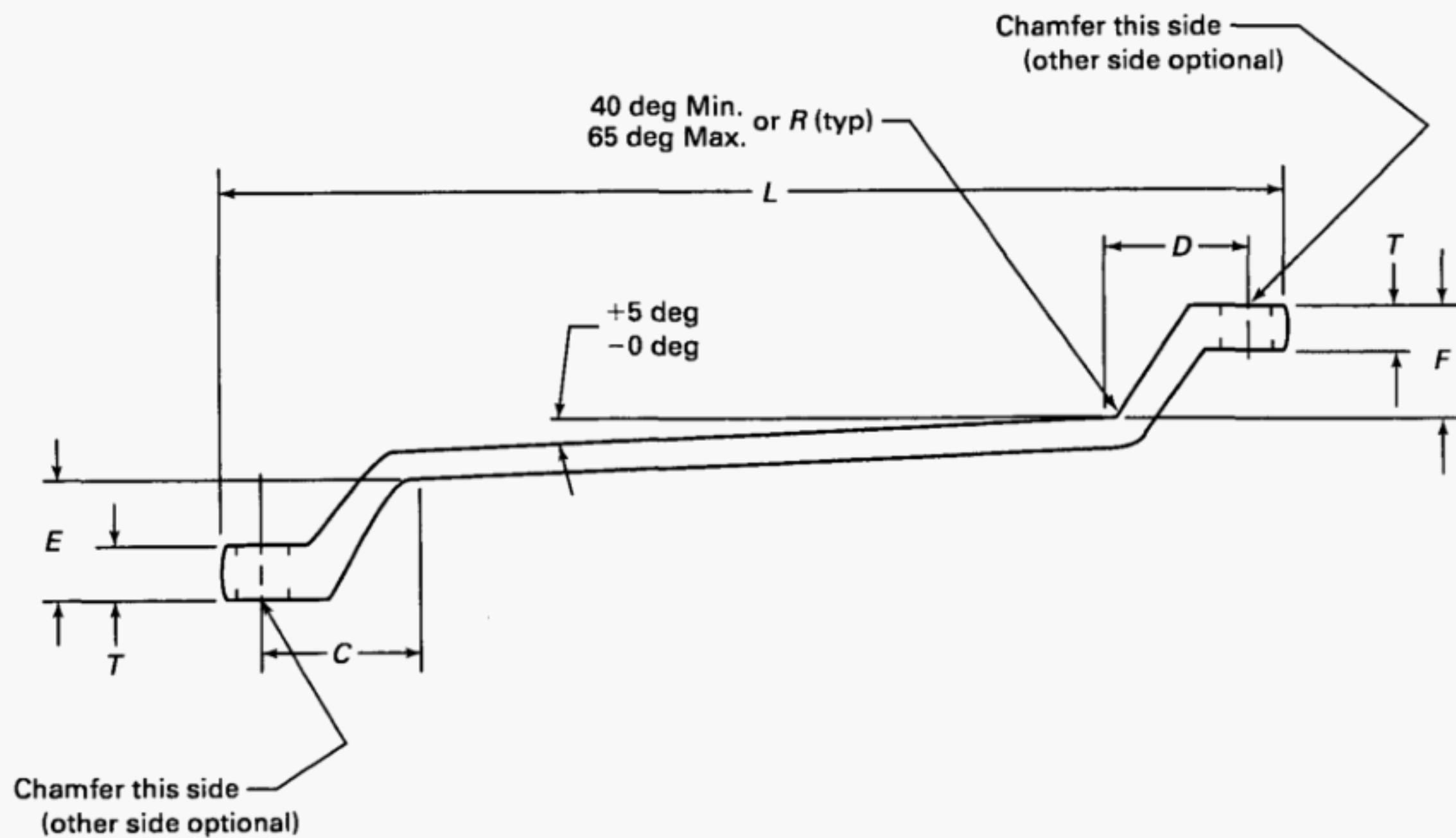


FIG. 4 TYPE III BOX WRENCH

TABLE 1 TYPE I, II, AND III BOX WRENCH (CUSTOMARY UNITS)

Nominal Wrench Opening Across Flats		Outside Diameter of Box Head OD		Permitted Eccentricity of Box Head Opening to Outside Diameter		Thickness of Box Head, T		Center Line of Opening to Point Where Offset Blends With Handle C and D			
								Type II		Type III	
								Small Head, A	Large Head, B	Small Head, A	Large Head, B
Small Head, A	Large Head, B	Small Head, A	Large Head, B	Small Head, A	Large Head, B	Small Head, A	Large Head, B	Max., in.	Max., in.	Max., in.	Max., in.
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
3/16	13/64	0.375	0.391	0.015	0.015	0.203	0.203	0.906	0.906	0.906	0.906
3/16	7/32	0.375	0.406	0.015	0.015	0.203	0.234	-	-	0.906	0.969
7/32	15/64	0.406	0.406	0.015	0.015	0.234	0.234	0.969	1.125	0.969	1.031
7/32	1/4	0.406	0.478	0.015	0.015	0.234	0.295	0.969	1.125	0.969	1.250
1/4	9/32	0.478	0.500	0.015	0.015	0.295	0.300	1.125	1.125	1.250	1.250
1/4	5/16	0.478	0.572	0.015	0.015	0.295	0.330	1.125	1.125	1.250	1.375
5/16	11/32	0.572	0.612	0.015	0.015	0.330	0.335	1.125	1.188	1.375	1.375
5/16	3/8	0.572	0.663	0.015	0.015	0.330	0.344	1.125	1.188	1.375	1.375
3/8	7/16	0.663	0.730	0.015	0.015	0.344	0.391	1.188	1.375	1.375	1.375
7/16	1/2	0.730	0.824	0.015	0.015	0.391	0.394	1.375	1.603	1.375	1.438
7/16	9/16	0.730	0.924	0.015	0.018	0.391	0.425	-	-	1.375	1.438
1/2	9/16	0.824	0.924	0.015	0.018	0.394	0.425	1.603	1.792	1.438	1.438
9/16	5/8	0.924	1.000	0.018	0.018	0.425	0.531	1.792	2.051	1.438	1.563
19/32	25/32	0.969	1.250	0.018	0.020	0.438	0.602	-	-	-	-
5/8	11/16	1.000	1.109	0.018	0.020	0.531	0.535	2.051	2.217	1.563	1.563
5/8	3/4	1.000	1.175	0.018	0.020	0.531	0.594	2.051	2.276	1.563	1.688
11/16	3/4	1.109	1.175	0.020	0.020	0.535	0.594	2.217	2.276	1.563	1.688
11/16	13/16	1.109	1.344	0.020	0.020	0.535	0.609	-	-	1.563	1.688
3/4	13/16	1.175	1.344	0.020	0.020	0.594	0.609	2.276	2.477	-	-
3/4	7/8	1.175	1.375	0.020	0.020	0.594	0.688	2.276	2.518	1.688	1.750
13/16	7/8	1.344	1.375	0.020	0.020	0.609	0.688	2.477	2.518	1.688	1.750
13/16	15/16	1.344	1.469	0.020	0.023	0.609	0.701	-	-	1.688	2.063
7/8	15/16	1.375	1.469	0.020	0.023	0.688	0.701	2.518	2.790	1.750	2.063
15/16	1	1.469	1.531	0.023	0.023	0.701	0.719	2.790	2.826	2.063	2.063
15/16	1 1/16	1.469	1.688	0.023	0.023	0.701	0.790	-	-	-	-
1	1 1/16	1.531	1.688	0.023	0.023	0.719	0.790	2.826	3.500	-	-
1 1/16	1 1/8	1.688	1.724	0.023	0.023	0.790	0.860	3.500	3.875	2.188	2.438
1 1/16	1 1/4	1.688	1.906	0.023	0.023	0.790	0.940	3.500	4.125	-	-
1 1/8	1 3/16	1.724	1.813	0.023	0.023	0.860	0.890	3.875	3.875	-	-
1 1/8	1 5/16	1.724	2.063	0.023	0.027	0.860	0.940	3.875	4.250	-	-
1 1/8	1 3/8	1.724	2.113	0.023	0.027	0.860	0.940	-	-	2.438	2.536
1 3/16	1 5/16	1.813	2.063	0.023	0.027	0.890	0.940	3.875	4.250	-	-
1 1/4	1 5/16	1.906	2.063	0.023	0.027	0.940	0.940	4.125	4.250	-	-
1 1/4	1 3/8	1.906	2.113	0.023	0.027	0.940	0.940	-	-	-	-
1 1/4	1 7/16	1.906	2.227	0.027	0.027	0.940	0.953	-	-	2.563	2.813
1 5/16	1 1/2	2.063	2.395	0.027	0.027	0.940	1.008	-	-	2.563	2.813
1 3/8	1 7/16	2.113	2.227	0.027	0.027	0.940	0.953	4.250	4.375	-	-
1 3/8	1 1/2	2.113	2.395	0.027	0.027	0.940	1.008	-	-	2.563	2.813
1 7/16	1 1/2	2.227	2.395	0.027	0.027	0.953	1.008	-	-	2.813	2.813
1 7/16	1 5/8	2.227	2.641	0.027	0.031	0.953	1.063	-	-	2.813	2.813
1 1/2	1 5/8	2.395	2.641	0.027	0.031	1.008	1.063	4.375	4.500	-	-
1 1/2	1 11/16	2.395	2.790	0.027	0.031	1.008	1.063	-	-	2.813	2.813

TABLE 1 TYPE I, II AND III BOX WRENCH (CUSTOMARY UNITS) (CONT'D)

Height From Opening to Point Where Offset Blends With Handle E and F				Overall Length						Proof Torque Box Head	
Type II		Type III		Type I		Type II		Type III		Small Head A, Min., in.	Large Head B, Min., in.
Small Head, A Min., in.	Large Head, B Min., in.	Small Head, A Min., in.	Large Head, B Min., in.	Class 1	Class 2	Class 1	Class 2	Class 1	Class 2		
				L, Min., in.	L, Max., in.	L, Min., in.	L, Max., in.	L, Min., in.	L, Max., in.		
0.156	0.188	0.188	0.250	-	-	-	3.000	-	3.000	150	165
-	-	0.188	0.281	-	-	-	-	-	4.000	150	165
0.188	0.219	0.281	0.281	-	-	-	3.250	-	3.250	165	184
0.188	0.219	0.281	0.219	4.500	-	-	-	-	-	165	220
0.219	0.219	0.219	0.281	-	-	-	3.475	-	4.375	220	248
0.219	0.275	0.219	0.297	5.000	5.000	-	4.750	6.375	5.000	220	275
0.275	0.281	0.297	0.344	-	-	-	4.750	-	5.000	275	275
0.275	0.287	0.297	0.500	6.000	5.000	-	5.000	-	5.000	275	605
0.287	0.295	0.500	0.500	6.500	5.125	7.375	5.250	6.813	5.500	605	715
0.295	0.297	0.500	0.500	7.500	5.500	7.750	5.750	7.750	5.750	715	1020
-	-	0.500	0.500	-	-	-	-	7.750	-	715	1500
0.297	0.375	0.500	0.500	7.500	5.625	8.500	6.000	7.969	6.250	1020	1500
0.375	0.452	0.500	0.625	8.250	6.000	8.750	6.250	8.500	6.375	1500	2200
-	-	-	-	9.375	-	-	-	-	-	1850	3080
0.452	0.461	0.625	0.719	9.375	6.250	9.625	6.500	9.250	6.781	2200	2640
0.452	0.500	0.625	0.750	9.375	6.750	9.750	6.750	9.750	6.800	2200	2860
0.461	0.500	0.719	0.750	9.438	-	10.000	-	9.750	-	2640	2860
-	-	0.719	0.750	9.438	-	-	-	10.000	7.250	2640	3300
0.500	0.625	-	-	-	-	11.000	-	-	-	2860	3300
0.500	0.625	0.750	0.750	10.875	-	11.250	-	11.250	-	2860	3630
0.625	0.625	0.750	0.750	11.750	-	11.500	-	11.375	-	3300	3630
-	-	0.750	0.750	-	-	-	-	11.375	-	3300	4510
0.625	0.688	0.750	0.750	-	-	12.000	-	12.000	-	3630	4510
0.688	0.750	0.750	1.000	13.188	-	13.000	-	13.500	-	4510	5390
-	-	-	-	13.750	-	-	-	-	-	4510	5940
0.750	0.766	-	-	-	-	13.875	-	-	-	5390	5940
0.766	0.797	1.000	1.000	15.063	-	14.500	-	15.813	-	5940	6430
0.766	0.875	-	-	15.875	-	14.625	-	-	-	5940	7920
0.797	0.797	-	-	-	-	14.750	-	-	-	6430	7200
0.797	0.875	-	-	17.000	-	15.500	-	-	-	6430	8400
-	-	1.000	1.000	-	-	-	-	16.000	-	6430	8970
0.797	0.875	-	-	-	-	16.000	-	-	-	7200	8400
0.875	0.875	-	-	17.375	-	16.000	-	-	-	7920	8400
-	-	-	-	18.250	-	-	-	-	-	7920	8970
-	-	1.000	1.000	19.000	-	-	-	18.000	-	7920	9240
-	-	1.000	1.188	-	-	-	-	19.500	-	8400	10365
1.125	1.175	-	-	-	-	17.500	-	-	-	8970	9240
-	-	1.000	1.188	-	-	-	-	19.500	-	8970	10365
-	-	1.000	1.188	21.000	-	-	-	20.000	-	9240	10365
-	-	1.000	1.313	22.000	-	-	-	21.500	-	9240	12800
1.225	1.325	-	-	-	-	18.500	-	-	-	10365	12800
-	-	1.188	1.313	-	-	-	-	21.000	-	10365	13570

TABLE 2 TYPE I, II, AND III BOX WRENCH (SI UNITS)

Nominal Wrench Opening Across Flats		Outside Diameter of Box Head OD		Permitted Eccentricity of Box Head Opening to Outside Diameter		Thickness of Box Head, T		Center Line of Opening to Point Where Offset Blends With Handle C and D			
								Type II		Type III	
								Small Head, A	Large Head, B	Small Head, A	Large Head, B
Small Head, A, mm	Large Head, B, mm	Small Head, A Max., mm	Large Head, B Max., mm	Small Head, A Max., mm	Large Head, B Max., mm	Small Head, A Max., mm	Large Head, B Max., mm	Max., mm	Max., mm	Max., mm	Max., mm
6	7	12.7	14.3	0.38	0.38	7.4	7.7	16.3	20.0	20.3	21.6
6	8	12.7	15.0	0.38	0.38	7.4	8.2	-	-	-	-
7	8	14.3	15.0	0.38	0.38	7.7	8.2	20.0	25.0	-	-
7	9	14.3	17.4	0.38	0.38	7.7	9.0	20.0	30.0	-	-
8	9	15.0	17.4	0.38	0.38	8.2	9.0	25.0	30.0	21.6	22.9
8	10	15.0	18.8	0.38	0.38	8.2	9.0	25.0	31.8	-	-
9	10	17.4	18.8	0.38	0.38	9.0	9.0	30.0	31.8	22.9	24.1
9	11	17.4	19.9	0.38	0.38	9.0	10.0	30.0	35.3	22.9	29.6
10	11	18.8	19.9	0.38	0.38	9.0	10.0	31.8	35.3	24.1	29.6
10	12	18.8	21.4	0.38	0.46	9.0	10.0	31.8	35.6	-	-
10	13	18.8	23.1	0.38	0.46	9.0	10.5	31.8	41.3	-	-
11	12	19.9	21.4	0.38	0.46	10.0	10.0	35.3	35.6	29.6	30.0
11	13	19.9	23.1	0.38	0.46	10.0	10.5	35.3	41.3	-	-
12	13	21.4	23.1	0.46	0.46	10.0	10.5	35.6	41.3	30.0	30.6
12	14	21.4	24.4	0.46	0.46	10.0	11.5	35.6	41.6	30.0	30.6
13	14	23.1	24.4	0.46	0.46	10.5	11.5	41.3	41.6	30.6	30.6
13	15	23.1	26.0	0.46	0.46	10.5	11.5	41.3	42.2	30.6	33.5
14	15	24.4	26.0	0.46	0.46	11.5	11.5	41.6	42.2	30.6	33.5
15	16	26.0	27.0	0.46	0.46	11.5	12.1	-	-	33.5	34.0
15	17	26.0	29.3	0.46	0.46	11.5	12.7	42.2	54.0	33.5	35.8
15	18	26.0	29.3	0.46	0.46	11.5	12.7	42.2	56.9	-	-
16	17	27.0	29.3	0.46	0.46	12.1	12.7	52.1	54.0	34.0	35.8
16	18	27.0	29.3	0.46	0.46	12.1	12.7	52.1	56.9	34.0	37.0
16	19	27.0	31.2	0.46	0.46	12.1	14.8	-	-	-	-
17	19	29.3	31.2	0.46	0.46	12.7	14.8	54.0	57.8	35.8	41.7
18	19	29.3	31.2	0.46	0.46	12.7	14.8	56.9	57.8	37.0	41.7
18	20	29.3	32.9	0.46	0.51	12.7	14.8	-	-	37.0	42.5
18	21	29.3	33.8	0.46	0.51	12.7	16.3	56.9	63.5	-	-
19	20	31.2	32.9	0.46	0.51	14.8	14.8	57.8	63.2	41.7	42.5
19	21	31.2	33.8	0.46	0.51	14.8	16.3	-	-	41.7	44.2
19	22	31.2	35.6	0.46	0.51	14.8	16.3	57.8	66.0	-	-
20	22	32.9	35.6	0.51	0.51	14.8	16.3	63.2	66.0	42.5	45.7
21	22	33.8	35.6	0.51	0.51	16.3	16.3	63.5	66.0	-	-
21	23	33.8	37.3	0.51	0.51	16.3	16.5	63.5	68.6	44.2	45.7
21	24	33.8	38.1	0.51	0.51	16.3	17.8	63.5	71.6	-	-
22	23	35.6	37.3	0.51	0.51	16.3	16.5	-	-	45.7	45.7
22	24	35.6	38.1	0.51	0.51	16.3	17.8	66.0	71.6	45.7	50.0
23	24	37.3	38.1	0.51	0.51	16.5	17.8	68.6	71.6	-	-
24	26	38.1	42.2	0.51	0.58	17.8	18.0	71.6	75.7	50.0	56.0
24	27	38.1	44.2	0.51	0.58	17.8	19.8	71.6	88.9	-	-
25	28	40.2	45.3	0.51	0.58	17.9	19.8	71.8	89.8	52.8	61.9
26	29	42.2	45.3	0.58	0.58	18.0	19.8	75.7	93.7	56.0	61.9
27	30	44.2	47.5	0.58	0.58	19.8	20.0	88.9	94.5	-	-
27	32	44.2	49.8	0.58	0.58	19.8	22.0	88.9	96.8	61.9	63.9
28	32	45.3	49.8	0.58	0.58	19.8	22.0	-	-	-	-
30	32	47.5	49.8	0.58	0.58	20.0	22.0	94.5	96.8	-	-

TABLE 2 TYPE I, II AND III BOX WRENCH (SI UNITS) (CONT'D)

Height From Opening to Point Where Offset Blends With Handle E and F				Overall Length					Proof Torque Box Head	
Type II		Type III		Type I Class 1	Type II		Type III		Small Head A	Small Head B
Small Head, A	Large Head, B	Small Head, A	Large Head, B	L	Class 1	Class 2	Class 1	Class 2	Min., N-m	Min., N-m
Min., mm	Min., mm	Min., mm	Min., mm	Min., mm	Min., mm	Max., mm	Min., mm	Max., mm		
4.5	5.0	5.0	5.1	-	85	100	144	114	20	27
-	-	-	-	173	-	-	-	-	20	30
5.0	6.0	-	-	-	150	-	-	-	27	30
5.0	7.1	-	-	175	-	-	-	-	27	40
6.0	7.1	5.1	7.0	176	155	110	158	121	30	40
6.0	7.3	-	-	180	182	-	-	-	30	71
7.1	7.3	7.0	7.6	-	-	120	-	127	40	71
7.1	7.3	7.0	8.5	-	182	-	170	-	40	80
7.3	7.3	7.6	8.5	191	182	125	177	133	71	80
7.3	7.5	-	-	-	188	-	-	-	71	91
7.3	7.5	-	-	-	188	-	-	-	71	115
7.3	7.5	8.5	9.5	-	-	130	-	133	80	91
7.3	7.5	-	-	-	197	-	-	-	80	115
7.5	7.5	9.5	10.0	210	207	145	203	145	91	115
7.5	9.5	9.5	10.2	217	213	-	208	-	91	158
7.5	9.5	10.0	10.2	-	216	-	219	150	115	158
7.5	11.0	10.0	10.8	220	220	-	225	-	115	200
9.5	11.0	10.2	10.8	223	225	160	230	160	158	200
-	-	10.8	11.4	-	-	-	-	167	200	248
11.0	12.7	10.8	11.4	-	231	-	233	173	200	267
11.0	12.7	-	-	-	236	-	-	-	200	304
12.7	12.7	11.4	11.4	241	241	-	240	174	248	267
12.7	12.7	11.4	12.7	255	244	-	245	-	248	304
-	-	-	-	259	-	-	-	-	248	323
12.7	12.7	11.4	13.3	259	249	-	265	180	267	323
12.7	12.7	12.7	13.3	-	254	-	280	184	304	323
-	-	12.7	14.0	-	-	-	-	188	304	347
12.7	16.2	-	-	-	266	-	-	-	304	372
12.7	16.2	13.3	14.0	-	279	-	280	-	323	347
-	-	13.3	20.3	-	-	-	285	-	323	372
12.7	16.6	-	-	275	285	-	-	-	323	408
16.2	16.6	14.0	20.3	296	288	-	292	-	347	408
16.2	16.6	-	-	-	292	-	-	-	372	408
16.2	16.6	20.3	20.3	307	300	-	307	-	372	455
16.2	17.1	-	-	-	307	-	-	-	372	509
-	-	20.3	20.3	-	-	-	333	-	408	455
16.6	17.1	20.3	20.6	317	314	-	340	-	408	509
16.6	17.1	-	-	-	322	-	-	-	455	509
17.1	18.1	20.6	26.8	337	330	-	349	-	509	608
17.1	19.4	-	-	-	339	-	-	-	509	671
18.1	19.4	25.0	29.7	370	350	-	379	-	559	710
18.1	20.2	26.8	32.1	-	360	-	404	-	608	750
19.4	21.8	-	-	380	369	-	-	-	671	795
19.4	21.8	29.7	37.5	-	381	-	430	-	671	905
-	-	-	-	396	-	-	-	-	710	905
21.8	21.8	-	-	396	393	-	-	-	795	905

proof torque, examination for permanent deformation shall be made.

5.2.2 Mandrels for Wrench Openings. Suitable mandrels shall be used to fit into the wrench opening and to provide the proper support and necessary strength for the proof torque applied. The wrenches shall be tested on hexagonal mandrels. Mandrels shall conform to the dimensions and tolerances of Tables 3 and 4. Mandrels shall be hardened to show a hardness of not less than 55 HRC and smoothly finished on the wrench engaging surfaces.

5.2.3 Application of Proof Torque. The proof torque specified in the applicable table is the torque applied to the test mandrel which tends to rotate the mandrel about its longitudinal axis. Wrench openings shall be gaged prior to testing. The torque shall be applied to mandrels which 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. Box ends shall be torqued to the proof torque. Following the removal of the proof torque, they shall be regaged. Any box end which does not sustain the proof torque, cracks, fractures, slips on mandrel, or does not gage 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 head with respect to the handle in excess of 5 deg.

5.3 Coating Process Qualification Test

Alternative coatings shall be subjected to testing in order to certify the manufacturer's production coating process. The Coating Process Test consists of an adhesion, abrasion and corrosion test specified in paras. 5.3.2, 5.3.3, and 5.3.4. The Coating Process Qualification Test may also be performed to certify the manufacturer's Nickel-Chromium coating process. Passing the Coating Process Qualification tests, when agreed to by the customer, exempts the manufacturer from the Nickel-Chromium thickness requirement of para. 4.7.2(a). Re-testing may be required when a significant change

occurs in the process, when there is a change in the materials, or when contractually required by the customer.

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

5.3.2 Coating Process Adhesion Test. Sample wrenches shall pass the file or grind-saw test of ASTM B 571.

5.3.3 Coating Process Abrasion Test. Sample wrenches shall have no base material exposed when subjected to 100 L of falling sand test of ASTM D 968 Method A.

5.3.4 Coating Process Corrosion Test. Sample wrenches shall be tested for corrosion resistance by exposure to a 48 hr salt spray test, as specified in ASTM B 117, without falling below the ASTM B 537 rating of 6.

6 DESIGNATIONS

Wrenches shall be designated by the following data in the sequence shown:

- (a) Type
- (b) Class
- (c) Size of openings
- (d) Configuration of openings
- (e) Coating

EXAMPLE: Box Wrench Type III, Class 1, $\frac{1}{2} \times \frac{9}{16}$, 12 point openings, Nickel-chrome.

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.

**TABLE 3 HEXAGON MANDREL DIMENSIONS
(CUSTOMARY UNITS)**

Nominal Size of Wrench Opening, in.	Hexagon Mandrel Dimensions, in.		
	Across Flats Tolerance		Across Corners, Min., in. [Note (1)]
	Plus	Minus	
1/8	0.001	0.002	0.1403
5/32	0.001	0.002	0.1745
13/64	0.001	0.002	0.2095
3/16	0.001	0.002	0.2268
7/32	0.001	0.002	0.2440
15/64	0.001	0.002	0.2610
1/4	0.001	0.002	0.2780
9/32	0.001	0.002	0.3133
5/16	0.001	0.002	0.3495
11/32	0.001	0.002	0.3860
3/8	0.001	0.002	0.4225
7/16	0.001	0.002	0.4935
1/2	0.001	0.003	0.5635
9/16	0.001	0.003	0.6339
5/8	0.001	0.003	0.7055
11/16	0.001	0.003	0.7769
3/4	0.001	0.003	0.8485
13/16	0.001	0.003	0.9201
7/8	0.001	0.003	0.9917
15/16	0.001	0.003	1.0631
1	0.001	0.003	1.1297
1 1/16	0.001	0.003	1.2013
1 1/8	0.001	0.003	1.2728
1 3/16	0.001	0.003	1.343
1 1/4	0.001	0.003	1.416
1 5/16	0.001	0.003	1.487
1 3/8	0.001	0.003	1.559
1 7/16	0.001	0.003	1.631
1 1/2	0.001	0.003	1.702
1 9/16	0.001	0.007	1.770
1 5/8	0.001	0.007	1.841
1 11/16	0.001	0.007	1.912
1 3/4	0.001	0.007	1.983
1 13/16	0.001	0.007	2.054
1 7/8	0.001	0.007	2.124
1 15/16	0.001	0.007	2.195
2	0.001	0.007	2.266
2 1/16	0.001	0.007	2.337
2 1/8	0.001	0.007	2.408
2 3/16	0.001	0.007	2.479
2 1/4	0.001	0.007	2.549

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 1 1/2 in. nominal size.

**TABLE 4 HEXAGON MANDREL DIMENSIONS
(SI UNITS)**

Nominal Size of Wrench Opening, mm	Hexagon Mandrel Dimensions, mm		
	Across Flats Tolerance		Across Corners, Min., mm [Note (1)]
	Plus	Minus	
3.2	0.025	0.050	3.57
4	0.025	0.050	4.46
5	0.025	0.050	5.58
5.5	0.025	0.050	6.13
6	0.025	0.050	6.68
6.3	0.025	0.050	7.02
7	0.025	0.050	7.79
8	0.025	0.050	8.95
9	0.025	0.050	10.11
10	0.025	0.050	11.27
11	0.025	0.050	12.40
12	0.025	0.076	13.53
13	0.025	0.076	14.67
14	0.025	0.076	15.80
15	0.025	0.076	16.92
16	0.025	0.076	18.06
17	0.025	0.076	19.20
18	0.025	0.076	20.35
19	0.025	0.076	21.49
20	0.025	0.076	22.64
21	0.025	0.076	23.78
22	0.025	0.076	24.93
23	0.025	0.076	26.07
24	0.025	0.076	27.20
25	0.025	0.076	28.27
26	0.025	0.076	29.38
27	0.025	0.076	30.53
28	0.025	0.076	31.67
29	0.025	0.076	32.81
30	0.025	0.076	33.96
31	0.025	0.076	35.10
32	0.025	0.076	36.25
33	0.025	0.076	37.38
34	0.025	0.076	38.52
35	0.025	0.076	39.68
36	0.025	0.076	40.83
38	0.025	0.076	43.11
40	0.025	0.177	45.32
41	0.025	0.177	46.45
42	0.025	0.177	47.59
46	0.025	0.177	52.12
50	0.025	0.177	56.65

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 38 mm nominal size.

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OPEN END WRENCHES (INCH AND METRIC SERIES)

1 SCOPE

This Standard provides the general, dimensional, performance, and safety requirements for open end wrenches, including but not restricted to Engineer's, angled, and tappet. Inclusion of dimensional data in this Standard is not intended to imply that all of the products described herein are stock production sizes. Consumers are requested to consult with manufacturers concerning lists of stock production sizes.

2 CLASSIFICATION

Open end wrench, double head

Type I Engineer's wrench, 15 deg angle

Class 1 Regular length

Class 2 Short length

Type II Angle wrench

Class 1 30 deg and 60 deg

Class 2 15 deg and 60 deg

Type III Tappet wrench, 15 deg angle

3 NORMATIVE REFERENCES

The following documents form a part of this Standard to the extent specified herein. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

ASME B107.17M-1997 Gages, Wrench Openings, Reference

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

ASTM E 18-97 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM B 117-97 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B 537-70 Standard Practice for Rating of Electroplated Panels Subjected to Atmospheric Exposure

ASTM B 571-97 Standard Test Methods for Adhesion of Metallic Materials

ASTM D 968-93 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

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

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

4 REQUIREMENTS

4.1 Illustrations

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

4.2 Materials

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

4.3 Markings

Each wrench shall be marked on one of the faces or on the handle as close to each head as is practical in a plain and permanent manner with the respective nominal wrench opening as shown in the first column of the applicable table. In addition to size markings, each wrench shall be marked in a plain and permanent manner with manufacturer's name or trademark of such known character that the source of manufacture and country of origin may be readily determined.

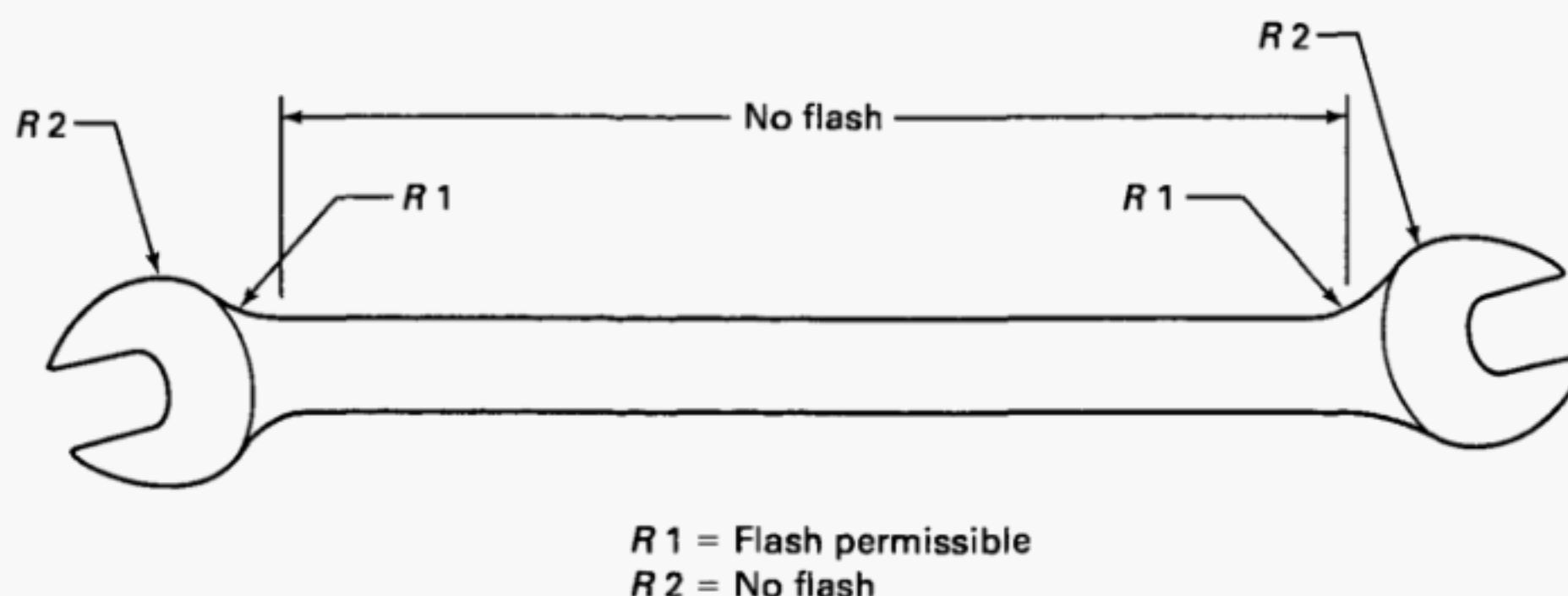


FIG. 1 FINISH REQUIREMENTS

4.4 Hardness

Wrenches shall be heat treated to a hardness of 38 HRC to 55 HRC when tested as specified in para. 5.1.

4.5 Proof Torque

When tested as specified, wrenches shall withstand the proof torque specified in the applicable tables without failure or permanent deformation (set), which might affect the durability or serviceability of the wrenches. Proof torque is a predetermined test torque to which a sample is subjected before acceptance.

4.6 Wrench Opening

Wrench openings shall be such as to insure acceptance when gaged with gages conforming to ASME B107.17M.

4.7 Finish

4.7.1 Surface Finish. See Fig. 1. All surfaces shall be thoroughly cleaned, free from cracks, and essentially free from burrs, pits, nodules, and other detrimental conditions.

(a) *Minimum Area of Surface Finish.* Both faces of the open end shall be bright and shall have a maximum roughness height value of 30 μ in. (0.76 μ m) (arithmetical average using a 0.03 in. cutoff on the surface measuring instrument). Wrenches with phosphate or oxide coatings are excluded from this requirement.

(b) *Flash.* Flash shall be completely removed from the circumference of all open end wrenches, and from that portion of the handle which shall be essentially straight and uniform in sectional dimensions. Any remaining flash on any surface shall blend smoothly with adjacent surfaces; external sharp edges shall be broken to 0.016 in. (0.38 mm) radius minimum, and shall not

project more than 0.016 in. (0.38 mm) from adjacent surfaces.

4.7.2 Coatings. The coating shall be adherent, smooth, continuous, and free from uncoated areas, pits, blisters, nodules, and any other defects, which would interfere with their protective value and serviceability. Plating contact marks should be kept to a minimum. The wrench shall be coated with one of the coatings in accordance with (a), (b), (c), or (d) below. The customer may specify the type of coating required.

(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.

(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) *Alternative Coatings.* Wrenches not falling within one of the coating types listed above shall be finished in accordance with predetermined requirements between manufacturer and customer. Alternative coatings may be used in lieu of Nickel-Chromium and shall be subjected to the Coating Process Qualification Test as specified in para. 5.3.

4.8 Design

Wrenches shall be suitable for use on hexagonal and square-headed bolts and nuts.

Type 1 wrenches shall have two open ends angled from the wrench handle, shall be similar to Fig. 2, and shall conform to Tables 1 and 2 as applicable.

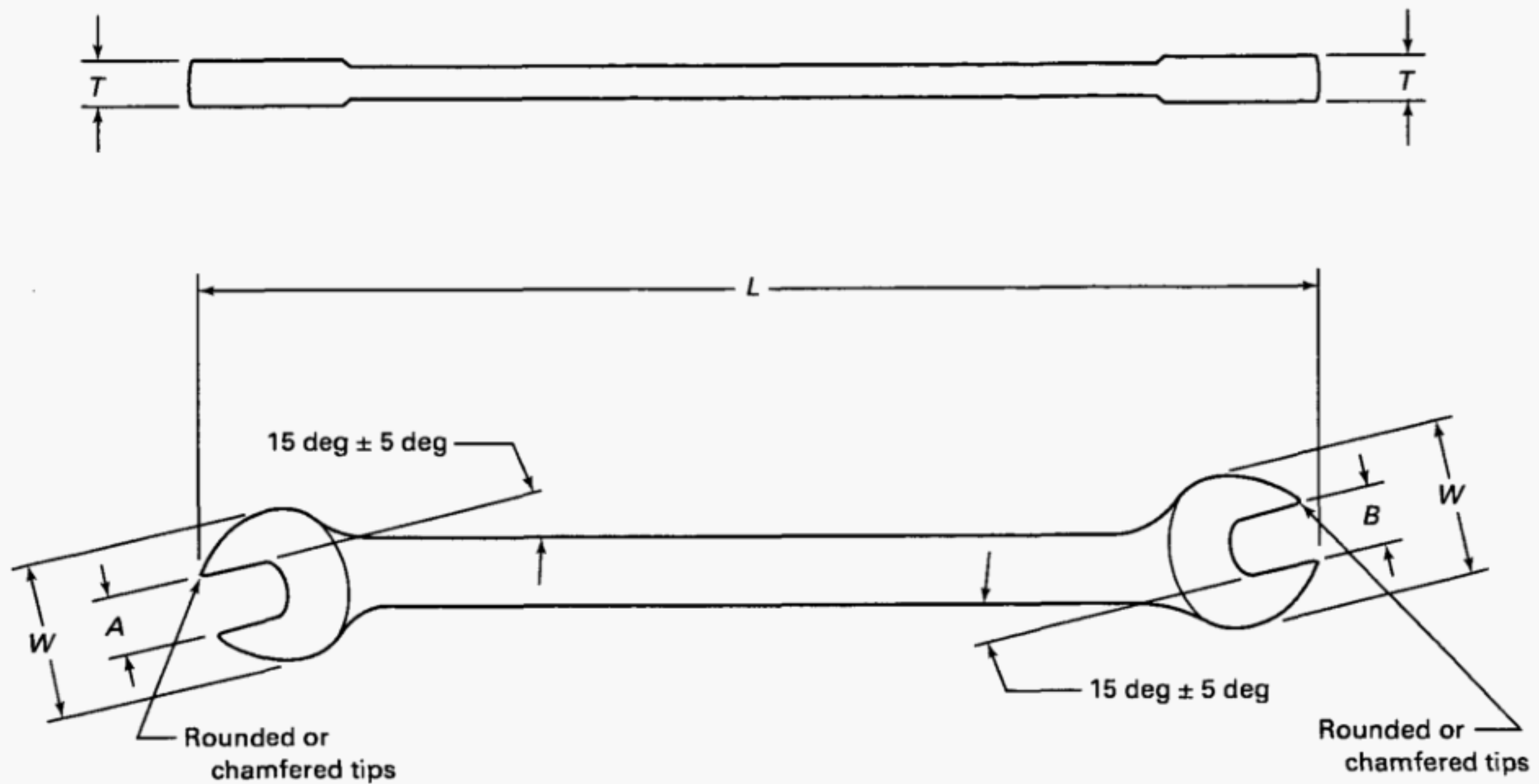


FIG. 2 TYPE I ENGINEER'S WRENCH

Type II wrenches shall have two open ends angled from the wrench handle and shall conform to Tables 3, 4, 5, and 6 as applicable. Classes 1 and 2 shall be similar to Figs. 3 and 4.

Type III wrenches shall have two open ends angled from the wrench handle. Wrenches shall be similar to Fig. 5 and conform to Tables 7 and 8 as applicable.

Wrenches shall be so designed as to afford 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. The tips (working ends) of all open end wrenches shall also be chamfered or rounded to eliminate burrs (see Figs. 2 through 5).

5 TEST PROCEDURES

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

5.1 Hardness

Hardness shall be tested in accordance with ASTM E 18. When surface preparation is necessary, the amount of material removed shall not exceed 0.007 in. (0.18 mm) in the area contacted by the indenter.

5.2 Proof Torque Test

Proof Torque Test shall be conducted to determine conformance with the applicable proof torque requirements specified in para. 4.5.

5.2.1 Wrench Preparation. In order to prepare the wrench for test, suitable reference lines may be scribed on the heads and handle. After application of proof torque, examination for permanent deformation shall be made.

5.2.2 Mandrels for Wrench Openings. Suitable mandrels shall be used to fit into the wrench opening and to provide the proper support and necessary strength for the proof torque applied. The wrenches shall be tested on hexagonal mandrels. Mandrels shall conform to the dimensions and tolerances of Tables 9 and 10. Mandrels shall be hardened to show a hardness of not less than 55 HRC and smoothly finished on the wrench engaging surfaces.

5.2.3 Application of Proof Torque. The proof torque specified in the applicable table is the torque applied to the test mandrel which tends to rotate the mandrel about its longitudinal axis. Wrench openings shall be gaged prior to testing. The torque shall be applied to mandrels which are fully seated and extend through the wrenching surfaces. The force required to

TABLE 1 TYPE I ENGINEER'S WRENCH (CUSTOMARY UNITS)

Nominal Wrench Opening Across Flats		Width of Open Head		Thickness of Open Head		Overall Length <i>L</i>		Proof Torque Open Head	
		Small Head, <i>W</i> Max., in.	Large Head, <i>W</i> Max., in.	Small Head, <i>T</i> Max., in.	Large Head, <i>T</i> Max., in.	Class 1 Min., in.	Class 2 Max., in.	Small Head Min., lbf-in.	Large Head Min., lbf-in.
Small Head, <i>A</i> , in.	Large Head, <i>B</i> , in.								
3/16	7/32	0.500	0.563	0.172	0.172	2.625	2.875	45	50
3/16	1/4	0.500	0.654	0.172	0.205	3.000	3.000	45	67
1/4	9/32	0.654	0.688	0.205	0.215	-	3.375	67	78
1/4	5/16	0.654	0.811	0.205	0.223	3.000	3.250	67	138
5/16	11/32	0.811	0.813	0.223	0.237	3.625	3.625	138	193
5/16	3/8	0.811	0.906	0.223	0.250	3.625	3.625	138	275
5/16	7/16	0.811	0.996	0.223	0.281	3.625	-	138	413
3/8	7/16	0.906	0.996	0.250	0.281	4.375	4.375	275	413
3/8	1/2	0.906	1.142	0.250	0.344	4.250	4.250	275	550
13/32	1/2	0.949	1.142	0.266	0.344	4.250	4.625	344	550
7/16	1/2	0.996	1.142	0.281	0.344	5.000	5.000	413	550
1/2	9/16	1.142	1.272	0.344	0.375	5.500	5.750	550	770
9/16	5/8	1.272	1.402	0.375	0.380	6.000	6.000	770	1100
5/8	11/16	1.402	1.536	0.380	0.400	7.000	7.250	1100	1375
5/8	3/4	1.402	1.672	0.380	0.406	7.000	7.250	1100	1650
11/16	3/4	1.536	1.672	0.400	0.406	7.000	-	1375	1650
11/16	13/16	1.536	1.828	0.400	0.516	7.500	-	1375	2200
3/4	13/16	1.672	1.828	0.406	0.516	8.000	8.000	1650	2200
3/4	7/8	1.672	1.959	0.406	0.516	8.000	8.250	1650	2475
13/16	7/8	1.828	1.959	0.516	0.516	8.250	8.500	2200	2475
13/16	15/16	1.828	2.078	0.516	0.594	9.000	9.000	2200	3025
7/8	15/16	1.959	2.078	0.516	0.594	9.000	9.125	2475	3025
7/8	1	1.959	2.250	0.516	0.625	9.000	10.000	2475	3575
7/8	1 1/16	1.959	2.344	0.516	0.625	9.750	10.000	2475	3850
15/16	1	2.078	2.250	0.594	0.625	9.875	10.000	3025	3575
15/16	1 1/16	2.078	2.344	0.594	0.625	10.000	10.000	3025	3850
1	1 1/16	2.250	2.344	0.625	0.625	10.250	10.500	3575	3850
1	1 1/8	2.250	2.500	0.625	0.656	10.250	10.750	3575	4400
1	1 1/2	2.250	3.375	0.625	0.813	11.000	11.000	3575	8500
1 1/16	1 1/8	2.344	2.500	0.625	0.656	11.750	11.750	3850	4400
1 1/16	1 1/4	2.344	2.766	0.625	0.719	11.750	11.750	3850	5775
1 1/8	1 1/4	2.500	2.766	0.656	0.719	11.750	12.000	4400	5775
1 1/8	1 5/16	2.500	2.938	0.656	0.719	12.000	12.500	4400	6600
1 1/8	1 3/8	2.500	3.063	0.656	0.750	13.000	-	4400	7425
1 3/16	1 5/16	2.630	2.938	0.688	0.719	13.000	13.000	5200	6600
1 1/4	1 5/16	2.766	2.938	0.719	0.719	13.500	13.500	5775	6600
1 1/4	1 3/8	2.766	3.063	0.719	0.750	13.500	13.500	5775	7425
1 1/4	1 7/16	2.766	3.188	0.719	0.813	13.500	13.500	5775	8250
1 3/8	1 7/16	3.063	3.188	0.750	0.813	14.000	14.000	7425	8250
1 3/8	1 1/2	3.063	3.375	0.750	0.813	14.500	15.500	7425	8500
1 7/16	1 5/8	3.188	3.625	0.813	0.813	14.750	15.500	8250	9000
1 7/16	1 13/16	3.188	4.188	0.813	0.875	15.250	-	8250	11750
1 1/2	1 5/8	3.375	3.625	0.813	0.813	15.250	15.500	8500	9000

TABLE 2 TYPE I ENGINEER'S WRENCH (SI UNITS)

Nominal Wrench Opening Across Flats		Width of Open Head		Thickness of Open Head		Overall Length <i>L</i>	Proof Torque Open Head	
Small Head, <i>A</i> , mm	Large Head, <i>B</i> , mm	Small Head, <i>W</i> , Max., mm	Large Head, <i>W</i> , Max., mm	Small Head, <i>T</i> , Max., mm	Large Head, <i>T</i> , Max., mm		Small Head Min., N·m	Large Head Min., N·m
6	7	17.3	18.3	5.8	6.3	90	7	8
6	8	17.3	21.4	5.8	6.3	95	7	15
7	8	18.3	21.4	6.3	6.3	95	8	15
7	9	18.3	21.8	6.3	6.6	95	8	21
8	9	21.4	21.8	6.3	6.6	100	15	21
8	10	21.4	26.0	6.3	6.9	100	15	31
9	10	21.8	26.0	6.6	6.9	105	21	31
9	11	21.8	26.0	6.6	7.0	110	21	46
10	11	26.0	26.0	6.9	7.0	110	31	46
11	13	26.0	30.2	7.0	8.9	130	46	62
12	13	27.7	30.2	8.0	8.9	140	49	62
12	14	27.7	32.8	8.0	8.9	145	49	86
13	15	30.2	34.8	8.9	8.9	150	62	104
14	15	32.8	34.8	8.9	8.9	155	86	104
14	16	32.8	36.4	8.9	9.4	155	86	124
15	17	34.8	39.7	8.9	9.8	160	104	139
15	18	34.8	41.3	8.9	10.0	160	104	155
16	17	36.4	39.7	9.4	9.8	165	124	139
16	18	36.4	41.3	9.4	10.0	165	124	155
17	19	39.7	42.7	9.8	10.1	180	139	186
18	19	41.3	42.7	10.0	10.1	185	155	186
18	21	41.3	47.6	10.0	11.7	190	155	248
19	22	42.7	48.3	10.1	12.0	195	186	279
20	21	46.4	47.6	11.4	11.7	200	217	248
20	22	46.4	48.3	11.4	12.0	200	217	279
21	22	47.6	48.3	11.7	12.0	215	248	279
21	23	47.6	52.4	11.7	12.4	220	248	310
21	24	47.6	53.5	11.7	12.5	230	248	341
22	24	48.3	53.5	12.0	12.5	240	279	341
24	26	53.5	57.2	12.5	12.8	245	341	403
24	27	53.5	60.2	12.5	14.7	250	341	432
25	27	55.7	60.2	12.7	14.7	270	372	432
25	28	55.7	62.3	12.7	14.9	280	372	497
27	29	60.2	65.5	14.7	14.9	305	432	514
27	30	60.2	67.0	14.7	14.9	305	432	570
27	32	60.2	71.0	14.7	15.7	310	432	650
28	30	62.3	67.0	14.9	14.9	315	497	570
30	32	67.0	71.0	14.9	15.7	330	570	650
32	36	71.0	76.8	15.7	19.0	395	650	894
36	41	76.8	88.9	19.0	19.3	425	894	1154

**TABLE 3 TYPE II, CLASS 1 ANGLE WRENCH, 30 deg / 60 deg
HEAD OFFSETS (CUSTOMARY UNITS)**

Nominal Wrench Opening Across Flats, A or B, in.	Width of Open Head W Max., in.	Thickness of Open Head, T Max., in.	Overall Length, L Class 1 Max., in.	Proof Torque Open Head Min., lbf-in.
1/4	0.654	0.205	4.000	67
5/16	0.811	0.223	4.500	138
11/32	0.813	0.237	4.750	193
3/8	0.906	0.250	6.050	275
7/16	0.996	0.281	6.330	413
1/2	1.142	0.344	6.700	550
9/16	1.272	0.375	7.060	770
5/8	1.402	0.380	7.500	1100
11/16	1.536	0.400	8.000	1375
3/4	1.672	0.406	8.510	1650
13/16	1.828	0.516	9.080	2200
7/8	1.959	0.516	9.700	2475
15/16	2.078	0.594	10.400	3025
1	2.250	0.625	11.050	3575
1 1/16	2.344	0.625	11.219	3850
1 1/8	2.500	0.656	11.813	4400
1 3/16	2.630	0.688	12.375	5200
1 1/4	2.766	0.719	12.938	5775
1 5/16	2.938	0.719	13.500	6600
1 3/8	3.063	0.750	14.125	7425
1 7/16	3.188	0.813	14.750	8250
1 1/2	3.375	0.813	15.250	8500
1 5/8	3.625	0.813	16.438	9000
1 11/16	3.750	0.813	17.000	10500
1 3/4	4.000	0.875	17.625	11100
1 13/16	4.188	0.875	19.000	11750
1 7/8	4.344	0.938	20.500	12400
2	4.469	0.938	22.000	13650

produce the torque shall be applied as far from the mandrel as practical. Open ends shall be torqued to the proof torque. Following the removal of the proof test torque they shall be regaged. Open ends which do not sustain the test torque, 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 B107.17M size by more than the following:

(a) 0.002 (0.05 mm) for wrench opening sizes 5/32 in. (4 mm) through 1 in. (25 mm)

(b) 0.003 (0.08 mm) for wrench opening sizes 1 1/16 in. (26 mm) through 2 1/4 in. (50 mm)

5.3 Coating Process Qualification Test

Alternative coatings shall be subjected to testing in order to certify the manufacturer's production coating process. The Coating Process Test consists of an adhesion, abrasion and corrosion test specified in paras. 5.3.2, 5.3.3, and 5.3.4. The Coating Process Qualification Test may also be performed to certify the manufacturer's Nickel-Chromium coating process. Passing the Coating

TABLE 4 TYPE II, CLASS 1 ANGLE WRENCH, 30 deg / 60 deg HEAD OFFSETS (SI UNITS)

Nominal Wrench Opening Across Flats, A or B, mm	Width of Open Head, W Max., mm	Thickness of Open Head, T Max., mm	Overall Length, L Class 1 Max., mm	Proof Torque Open Head Min., N·m
9	21.8	6.6	130	21
10	26.0	6.9	135	31
11	26.0	7.0	142	46
12	27.7	8.0	150	49
13	30.2	8.9	160	62
14	32.8	8.9	170	86
15	34.8	8.9	180	104
16	36.4	9.4	190	124
17	39.7	9.8	200	139
18	41.3	10.0	210	155
19	42.7	10.1	220	186
21	47.6	11.7	236	248
22	48.3	12.0	247	279
24	53.5	12.5	262	341
27	60.2	14.7	291	432

TABLE 5 TYPE II, CLASS 2 ANGLE WRENCH, 15 deg / 60 deg HEAD OFFSETS (CUSTOMARY UNITS)

Nominal Wrench Opening Across Flats A or B		Width of Open Head		Thickness of Open Head		Overall Length, L Class 1 Max., in.	Proof Torque Open Head	
15 deg Head, in.	60 deg Head, in.	15 deg Head, W Max., in.	60 deg Head, W Max., in.	15 deg Head, T Max., in.	60 deg Head, T Max., in.		15 deg Head Min., lbf-in.	60 deg Head Min., lbf-in.
1/8	1/8	0.359	0.359	0.141	0.141	3.130	15	15
5/32	5/32	0.438	0.438	0.141	0.141	3.190	20	20
3/16	3/16	0.500	0.500	0.156	0.156	3.280	24	24
7/32	7/32	0.563	0.563	0.172	0.172	3.380	28	28
15/64	1/4	0.600	0.654	0.188	0.205	3.400	38	38
1/4	15/64	0.654	0.600	0.205	0.188	3.440	38	38
1/4	1/4	0.654	0.654	0.205	0.205	3.500	38	38
9/32	9/32	0.688	0.688	0.215	0.215	3.590	43	43
9/32	5/16	0.688	0.811	0.215	0.223	3.600	43	62
5/16	9/32	0.811	0.688	0.223	0.215	3.690	62	43
5/16	5/16	0.811	0.811	0.223	0.223	3.720	62	62
11/32	11/32	0.813	0.813	0.237	0.237	3.840	105	105
11/32	3/8	0.813	0.906	0.237	0.250	3.890	105	105
3/8	11/32	0.906	0.813	0.250	0.237	3.940	105	105
3/8	3/8	0.906	0.906	0.250	0.250	3.970	105	105

TABLE 6 TYPE II, CLASS 2 ANGLE WRENCH, 15 deg AND 60 deg HEAD OFFSETS (SI UNITS)

Nominal Wrench Opening Across Flats A or B		Width of Open Head		Thickness of Open Head		Overall Length, L Class 1 Max., mm	Proof Torque Open Head	
15 deg Head, mm	60 deg Head, mm	15 deg Head, W Max., mm	60 deg Head, W Max., mm	15 deg Head, T Max., mm	60 deg Head, T Max., mm		15 deg Head Min., N·m	60 deg Head Min., N·m
3.2	5.5	8.9	15.5	3.4	5.3	75	1	4
4	5	10.8	12.5	3.7	3.9	78	2	3
5	4	12.5	10.8	3.9	3.7	82	3	2
5.5	3.2	15.5	8.9	5.3	3.4	84	4	1
6	7	17.3	18.3	5.8	6.3	86	6	7
7	6	18.3	17.3	6.3	5.8	90	7	6
8	9	21.4	21.8	6.3	6.6	94	13	19
9	8	21.8	21.4	6.6	6.3	98	19	13
10	11	26.0	26.0	6.9	7.0	102	28	41
11	10	26.0	26.0	7.0	6.9	106	41	28

Process Qualification tests, when agreed to by the customer, exempts the manufacturer from the Nickel-Chromium thickness requirement of para. 4.7.2(a). Re-testing may be required when a significant change occurs in the process, when there is a change in the materials, or when contractually required by the customer.

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

5.3.2 Coating Process Adhesion Test. Sample wrenches shall pass the file or grind-saw test of ASTM B 571.

5.3.3 Coating Process Abrasion Test. Sample wrenches shall have no base material exposed when subjected to 100 L of falling sand test of ASTM D 968 Method A.

5.3.4 Coating Process Corrosion Test. Sample wrenches shall be tested for corrosion resistance by exposure to a 48 hr salt spray test, as specified in ASTM B 117, without falling below the ASTM B 537 rating of 6.

6 DESIGNATIONS

Wrenches shall be designated by the following data in the sequence shown:

- (a) Type
- (b) Class
- (c) Size of openings
- (d) Coating

EXAMPLE: Engineer's Wrench, Type I, Class 1, $\frac{1}{2} \times \frac{9}{16}$ openings, Nickel-chrome.

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.

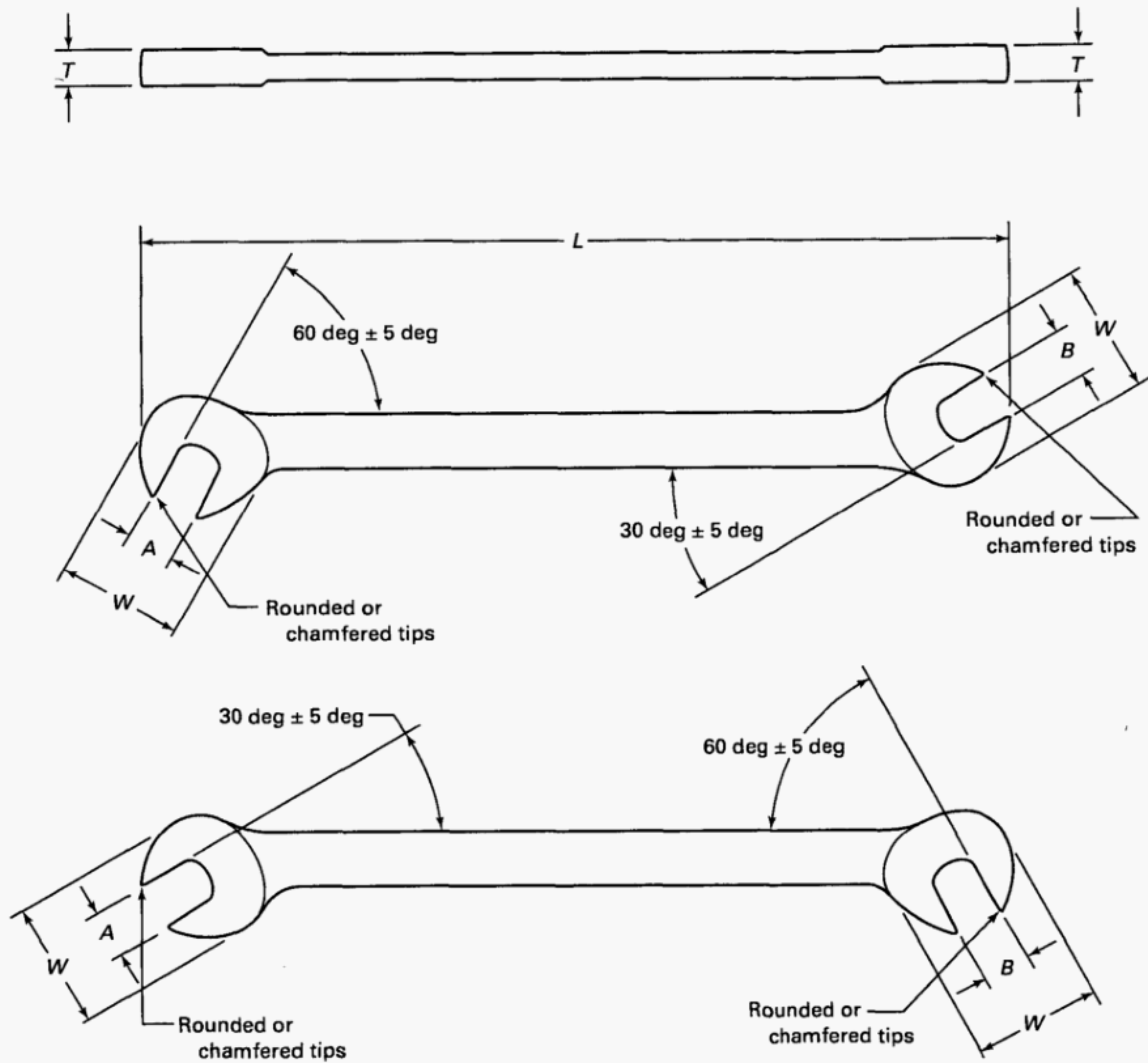


FIG. 3 TYPE II, CLASS 1, ANGLE WRENCH

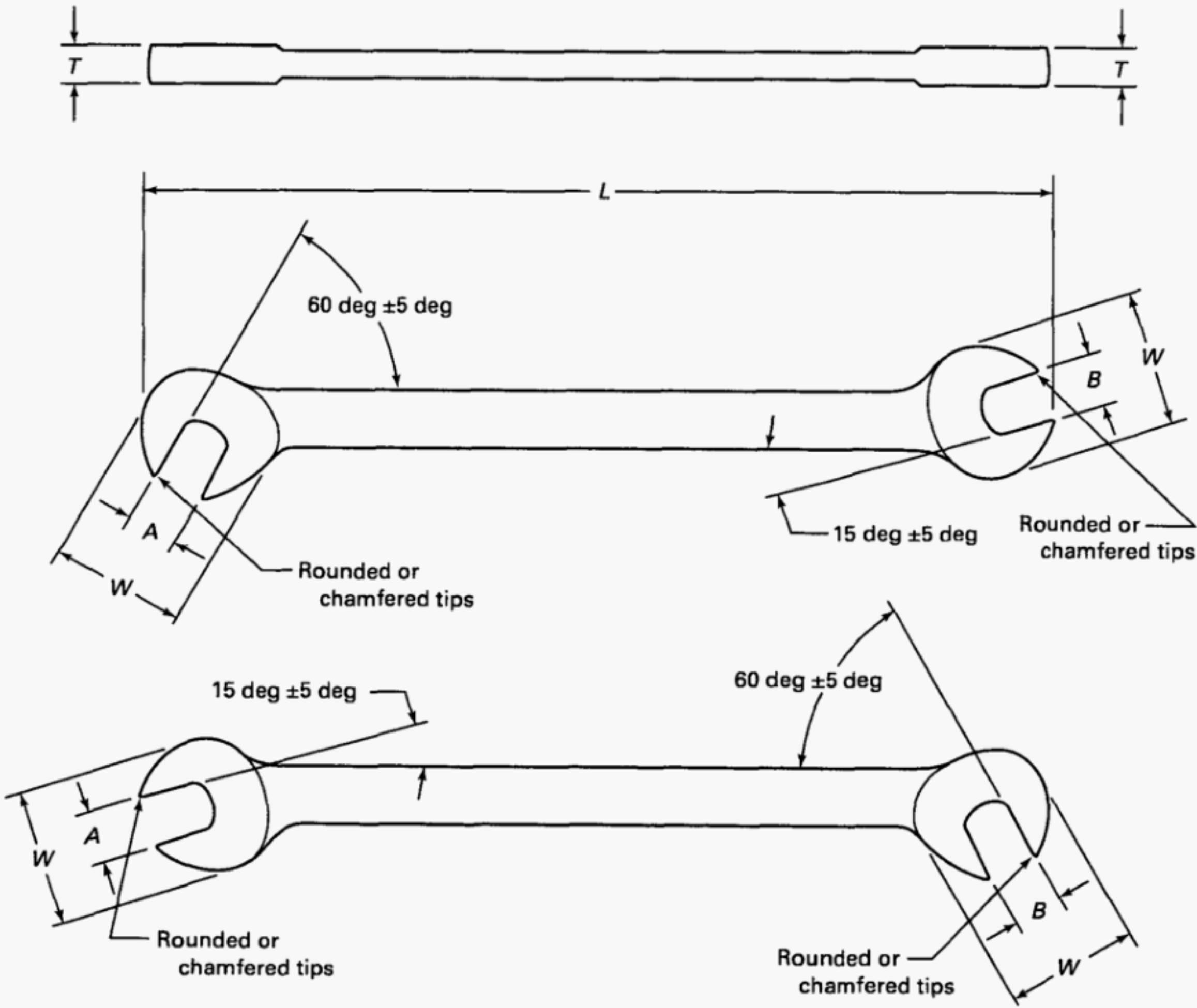


FIG. 4 TYPE II, CLASS 2, ANGLE WRENCH

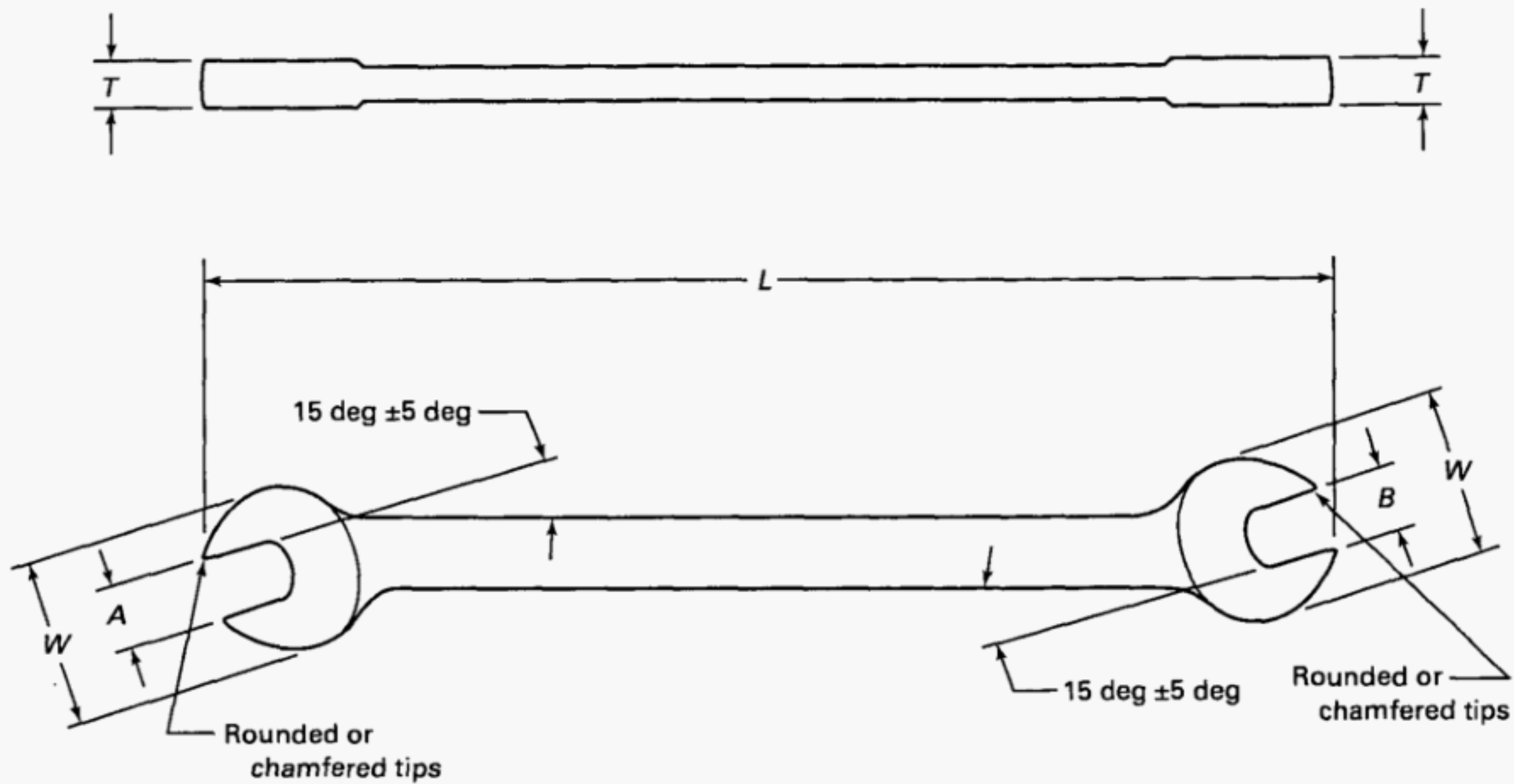


FIG. 5 TYPE III TAPPET WRENCH

TABLE 7 TYPE III, CLASS 1 TAPPET WRENCH, 15 deg ANGLE (CUSTOMARY UNITS)

Nominal Wrench Opening Across Flats A or B		Width of Open Head		Thickness of Open Head		Overall Length, L Class 1 Max., in.	Proof Torque Open Head	
Small Head, in.	Large Head, in.	Small Head, W Max., in.	Large Head, W Max., in.	Small Head, T Max., in.	Large Head, T Max., in.		Small Head Min., lbf-in.	Large Head Min., lbf-in.
5/16	3/8	0.750	0.938	0.218	0.218	-5.700	75	-120
3/8	7/16	0.938	1.187	0.218	0.218	-5.700	-120	-165
7/16	1/2	1.187	1.290	0.218	0.218	-6.000	-165	-286
7/16	17/32	1.187	1.290	0.218	0.218	-6.000	-165	-300
1/2	9/16	1.290	1.437	0.218	0.218	-6.300	-286	-355
9/16	5/8	1.437	1.500	0.218	0.234	-6.500	-355	-432
5/8	11/16	1.500	1.598	0.234	0.234	-7.000	-432	-516
11/16	3/4	1.598	1.705	0.234	0.234	-7.500	-516	-607
3/4	7/8	1.705	1.990	0.234	0.234	-8.000	-607	-812
13/16	7/8	1.840	1.990	0.234	0.234	-8.500	-710	-812
15/16	1	2.115	2.250	0.250	0.250	-8.700	-941	1053
1 1/16	1 1/8	2.357	2.494	0.250	0.250	10.000	1318	1494
1 1/4	1 5/16	2.768	2.905	0.260	0.260	11.000	1886	2100
1 3/8	1 7/16	3.042	3.179	0.277	0.277	12.000	2326	2564
1 1/2	1 5/8	3.315	3.589	0.291	0.291	13.000	2815	3353
1 11/16	1 7/8	3.725	4.136	0.315	0.315	14.000	3641	4550

TABLE 8 TYPE III, CLASS 1 TAPPET WRENCH, 15 deg ANGLE (SI UNITS)

Nominal Wrench Opening Across Flats		Width of Open Head		Thickness of Open Head		Overall Length, <i>L</i> Class 1 Min., mm	Proof Torque Open Head	
Small Head, <i>A</i> mm	Large Head, <i>B</i> , mm	Small Head, <i>W</i> Max., mm	Large Head, <i>W</i> Max., mm	Small Head, <i>T</i> Max., mm	Large Head, <i>T</i> Max., mm		Small Head Min., N·m	Large Head Min., N·m
6	7	16.4	18.4	4.0	4.0	114	4	6
8	9	20.4	21.9	4.2	4.2	120	9	13
8	10	20.4	24.4	4.2	4.5	125	9	17
10	11	24.4	26.4	4.5	4.5	136	17	21
12	13	28.4	30.4	4.7	4.8	142	26	32
12	14	28.4	32.4	4.7	4.8	147	26	38
13	15	30.4	34.4	4.8	4.8	152	32	46
14	15	32.4	34.4	4.8	4.8	150	38	46
16	18	36.6	41.0	5.0	5.1	169	53	71
17	19	38.8	43.2	5.1	5.6	174	62	81
19	22	43.2	48.3	5.6	6.0	185	81	116
21	24	46.3	52.3	6.0	6.0	196	103	143
27	30	56.0	62.0	7.1	7.1	300	187	238

**TABLE 9 HEXAGON MANDREL DIMENSIONS
(CUSTOMARY UNITS)**

Nominal Size of Wrench Opening, in.	Hexagon Mandrel Dimensions, in.		
	Across Flats Tolerance		Across Corners, Min., in. [Note (1)]
	Plus	Minus	
1/8	0.001	0.002	0.1403
5/32	0.001	0.002	0.1745
13/64	0.001	0.002	0.2095
3/16	0.001	0.002	0.2268
7/32	0.001	0.002	0.2440
15/64	0.001	0.002	0.2610
1/4	0.001	0.002	0.2780
9/32	0.001	0.002	0.3133
5/16	0.001	0.002	0.3495
11/32	0.001	0.002	0.3860
3/8	0.001	0.002	0.4225
7/16	0.001	0.002	0.4935
1/2	0.001	0.003	0.5635
9/16	0.001	0.003	0.6339
5/8	0.001	0.003	0.7055
11/16	0.001	0.003	0.7769
3/4	0.001	0.003	0.8485
13/16	0.001	0.003	0.9201
7/8	0.001	0.003	0.9917
15/16	0.001	0.003	1.0631
1	0.001	0.003	1.1297
1 1/16	0.001	0.003	1.2013
1 1/8	0.001	0.003	1.2728
1 3/16	0.001	0.003	1.343
1 1/4	0.001	0.003	1.416
1 5/16	0.001	0.003	1.487
1 3/8	0.001	0.003	1.559
1 7/16	0.001	0.003	1.631
1 1/2	0.001	0.003	1.702
1 9/16	0.001	0.007	1.770
1 5/8	0.001	0.007	1.841
1 11/16	0.001	0.007	1.912
1 3/4	0.001	0.007	1.983
1 13/16	0.001	0.007	2.054
1 7/8	0.001	0.007	2.124
1 15/16	0.001	0.007	2.195
2	0.001	0.007	2.266
2 1/16	0.001	0.007	2.337
2 1/8	0.001	0.007	2.408
2 3/16	0.001	0.007	2.479
2 1/4	0.001	0.007	2.549

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 1 1/2 in. nominal size.

**TABLE 10 HEXAGON MANDREL
DIMENSIONS (SI UNITS)**

Nominal Size of Wrench Opening, mm	Hexagon Mandrel Dimensions, mm		
	Across Flats Tolerance		Across Corners, Min., mm [Note (1)]
	Plus	Minus	
3.2	0.025	0.050	3.57
4	0.025	0.050	4.46
5	0.025	0.050	5.58
5.5	0.025	0.050	6.13
6	0.025	0.050	6.68
6.3	0.025	0.050	7.02
7	0.025	0.050	7.79
8	0.025	0.050	8.95
9	0.025	0.050	10.11
10	0.025	0.050	11.27
11	0.025	0.050	12.40
12	0.025	0.076	13.53
13	0.025	0.076	14.67
14	0.025	0.076	15.80
15	0.025	0.076	16.92
16	0.025	0.076	18.06
17	0.025	0.076	19.20
18	0.025	0.076	20.35
19	0.025	0.076	21.49
20	0.025	0.076	22.64
21	0.025	0.076	23.78
22	0.025	0.076	24.93
23	0.025	0.076	26.07
24	0.025	0.076	27.20
25	0.025	0.076	28.27
26	0.025	0.076	29.38
27	0.025	0.076	30.53
28	0.025	0.076	31.67
29	0.025	0.076	32.81
30	0.025	0.076	33.96
31	0.025	0.076	35.10
32	0.025	0.076	36.25
33	0.025	0.076	37.38
34	0.025	0.076	38.52
35	0.025	0.076	39.68
36	0.025	0.076	40.83
38	0.025	0.076	43.11
40	0.025	0.177	45.32
41	0.025	0.177	46.45
42	0.025	0.177	47.59
46	0.025	0.177	52.12
50	0.025	0.177	56.65

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 38 mm nominal size.

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FLARE NUT WRENCHES (INCH AND METRIC SERIES)

1 SCOPE

This Standard provides the general, dimensional, performance, and safety requirements for flare nut wrenches, including combination, offset slotted box and open end. Inclusion of dimensional data in this Standard is not intended to imply that all of the products described herein are stock production sizes. Customers are requested to consult with manufacturers concerning lists of stock production sizes.

2 CLASSIFICATION

Flare nut wrench

Type I double head, slotted box end

Type II combination, open end and 15 deg offset
slotted box end

3 NORMATIVE REFERENCES

The following documents form a part of this Standard to the extent specified herein. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

ASME B107.17M-1997 Gages, Wrench Openings, Reference

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

ASTM E 18-97 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM B 117-97 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B 537-70 Standard Practice for Rating of Electroplated Panels Subjected to Atmospheric Exposure

ASTM B 571-97 Standard Test Methods for Adhesion of Metallic Materials.

ASTM D 968-93 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

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

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

4 REQUIREMENTS

4.1 Illustrations

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

4.2 Materials

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

4.3 Markings

Each flare nut wrench shall be marked on one of the faces or on the handle as close to each head as is practical in a plain and permanent manner with the respective nominal wrench opening as shown in the first column of the applicable table. In addition to size markings, each wrench shall be marked in a plain and permanent manner with manufacturer's name or trademark of such known character that the source of manufacture and country of origin may be readily determined.

4.4 Hardness

Wrenches shall be heat treated to a hardness of 38 HRC to 55 HRC when tested as specified in para. 5.1.

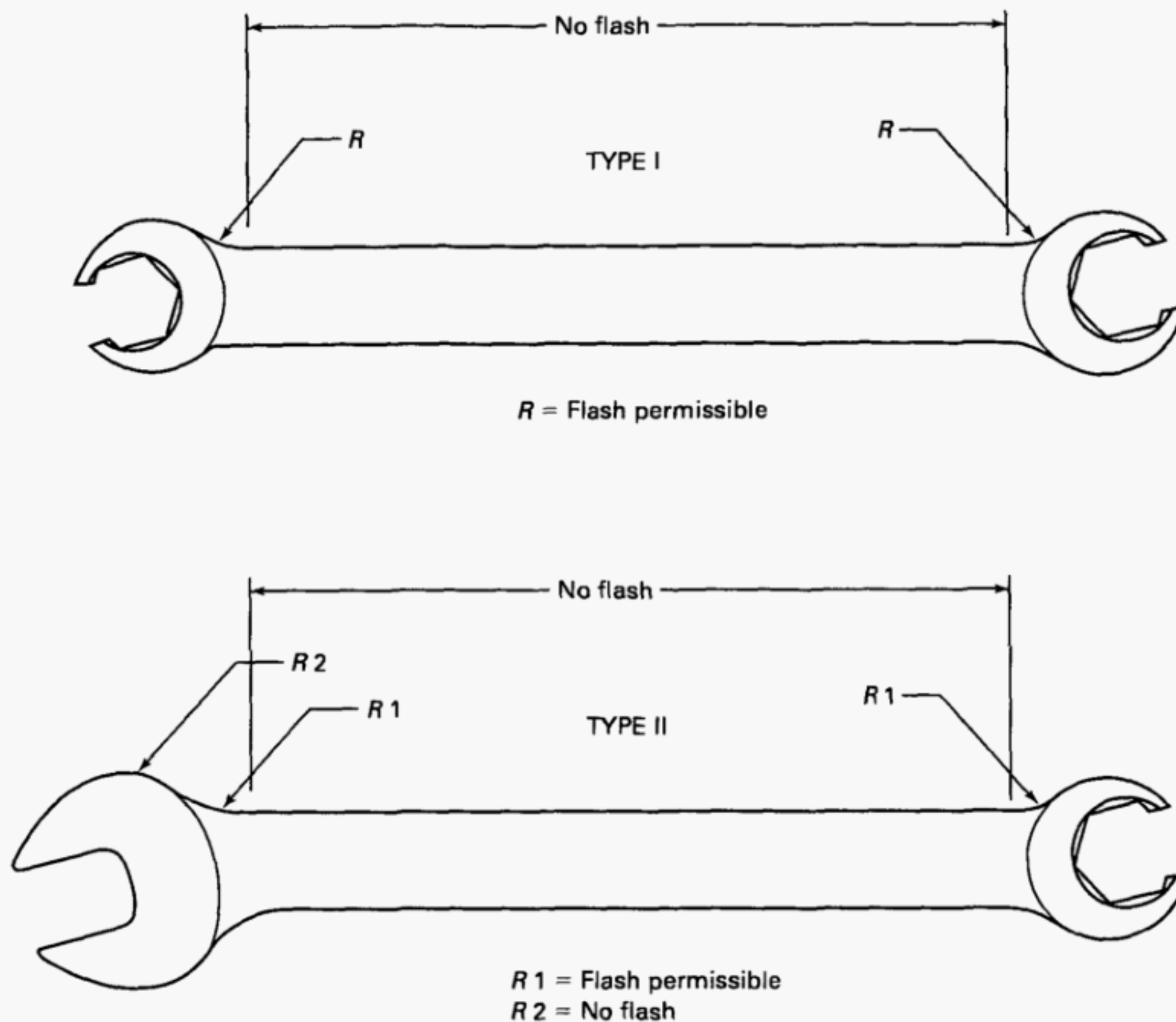


FIG. 1 FINISH REQUIREMENTS

4.5 Proof Torque

When tested as specified, wrenches shall withstand the proof torque specified in the applicable tables without failure or permanent deformation (set), which might affect the durability or serviceability of the wrenches. Proof torque is a predetermined test torque to which a sample is subjected before acceptance.

4.6 Wrench Opening

Wrench openings shall be such as to insure acceptance when gaged with gages conforming to ASME B107.17M.

4.7 Finish

4.7.1 Surface Finish. See Fig. 1. All surfaces shall be thoroughly cleaned, free from cracks, and essentially free from burrs, pits, nodules, and other detrimental conditions.

(a) *Minimum Area of Surface Finish.* A minimum of 180 deg of the outer periphery (90 deg on each side of the longitudinal axis of the wrench opening), or the faces of the slotted box ends, and both faces of the open end, shall be bright and shall have a maximum roughness height value of 30 μ in. (0.76 μ m) (arithmetic average using a 0.03 in. cutoff on the surface measurement instrument). Wrenches with phosphate or oxide coatings are excluded from this requirement.

(b) *Flash.* Flash shall be completely removed from the periphery of the heads of all slotted box ends, from the circumference of all open ends, and from that portion of the handle which shall be essentially straight and uniform in sectional dimensions. Any remaining flash on any surface shall blend smoothly with adjacent surfaces; external sharp edges shall be broken to 0.016 in. (0.38 mm) radius minimum, and shall not project more than 0.016 in. (0.38 mm) from adjacent surfaces.

4.7.2 Coatings. The coating shall be adherent, smooth, continuous, and free from uncoated areas, pits, blisters, nodules, and any other conditions which would interfere with their protective value and serviceability. The wrench shall be coated with one (or a combination) of the coatings in accordance with (a), (b), (c), or (d) below. The customer may specify the type of coating required.

(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.

(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) *Alternative Coatings.* Wrenches not falling within one of the coating types listed above shall be finished in accordance with predetermined requirements between manufacturer and consumer. Alternative coatings may be used in lieu of Nickel-Chromium and shall be subjected to the Coating Process Qualification Test as specified in para. 5.3.

4.8 Design

Type I wrenches shall be suitable for use with hexagonal flare nuts. Each opening shall have either 6 or 12 point slotted box opening as specified. Wrenches shall be similar to Fig. 2 and conform to Tables 1 and 2 as applicable.

Type II wrenches shall have one open end and one with a 6 or 12 point slotted box opening of identical nominal size. The wrench shall be suitable for use on hexagonal flare nuts. Wrenches shall be similar to Fig. 3 and conform to Tables 3 and 4 as applicable. Wrenches shall be so designed as to afford 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. The corners and serrations in the slotted box wrench openings shall be clearly defined (not smeared or torn). Wrenches that have a slotted box end design, shall be chamfered on both sides to provide a lead for the working surfaces as illustrated in Figs. 2 and 3. Wrenches that have an open end design shall have the tips (working ends) chamfered or rounded to eliminate burrs as illustrated in Fig. 3.

5 TEST PROCEDURES

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

5.1 Hardness

Hardness shall be tested in accordance with ASTM E 18. When surface preparation is necessary, the amount of material removed shall not exceed 0.007 in. (0.18 mm) in the area contacted by the indenter.

5.2 Proof Torque Test

Proof Torque Test shall be conducted to determine conformance with the applicable proof torque requirements specified in para. 4.5.

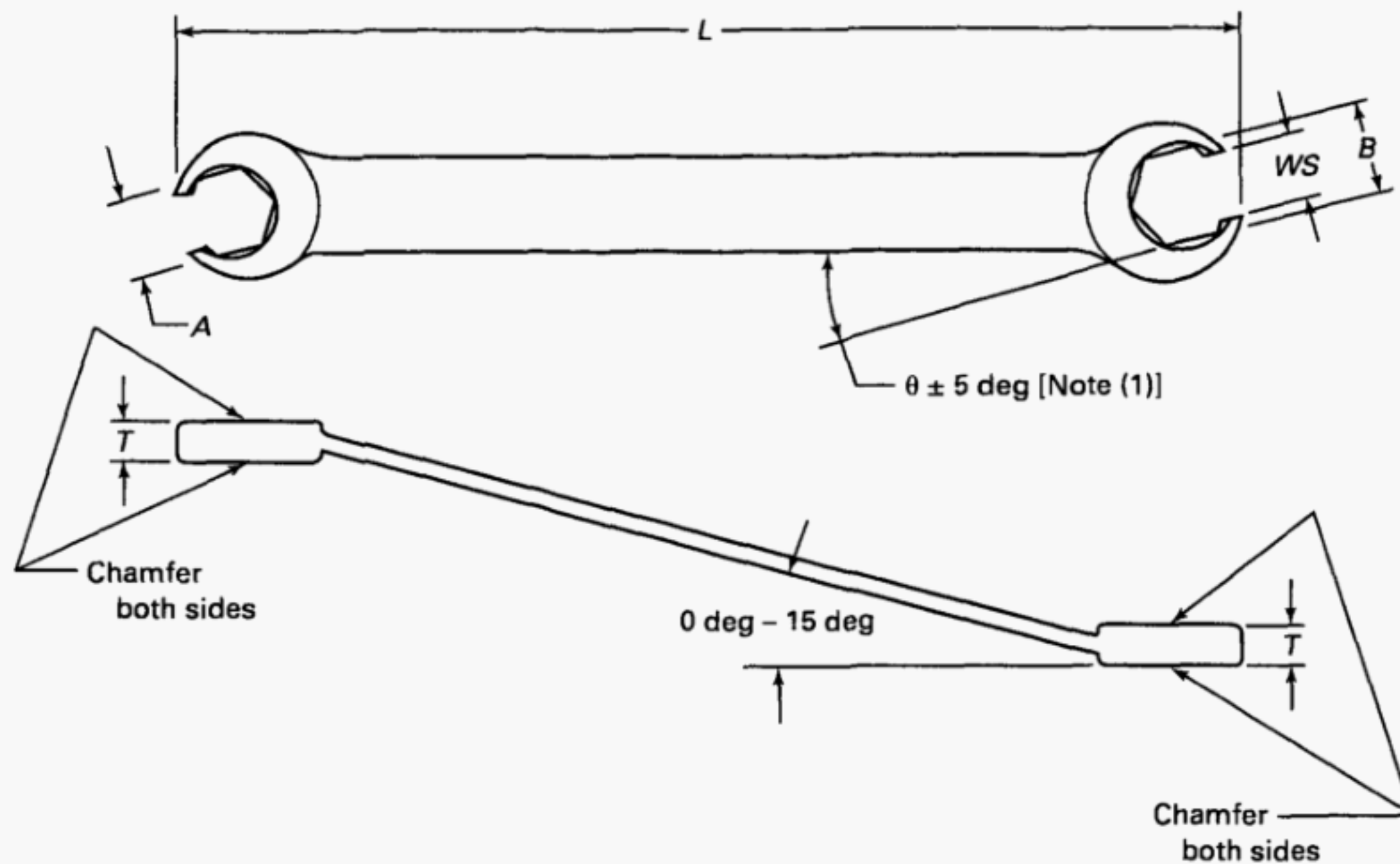
5.2.1 Wrench Preparation. In order to prepare the wrench for test, suitable reference lines may be scribed on the heads and handle. After application of proof torque, examination for permanent deformation shall be made.

5.2.2 Mandrels for Wrench Openings. Suitable mandrels shall be used to fit into the wrench opening and to provide the proper support and necessary strength for the proof torque applied. The wrenches shall be tested on hexagonal mandrels. Mandrels shall conform to the dimensions and tolerances of Tables 5 and 6. Mandrels shall be hardened to show a hardness of not less than 55 HRC and smoothly finished on the wrench engaging surfaces.

5.2.3 Application of Proof Torque. The proof torque specified in the applicable table is the torque applied to the test mandrel which tends to rotate the mandrel about its longitudinal axis. Wrench openings shall be gaged prior to testing. The torque shall be applied to mandrels, which 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) *Slotted Box Ends.* Slotted box ends shall be torqued to the proof torque. Following the removal of the proof torque, they shall be regaged. Any slotted box end which does not sustain the test torque, cracks, fractures, slips on mandrel, or does not gage 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 slotted box head with respect to the handle in excess of 5 deg.

(b) *Open Ends.* Open ends shall be torqued to the



NOTE:

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

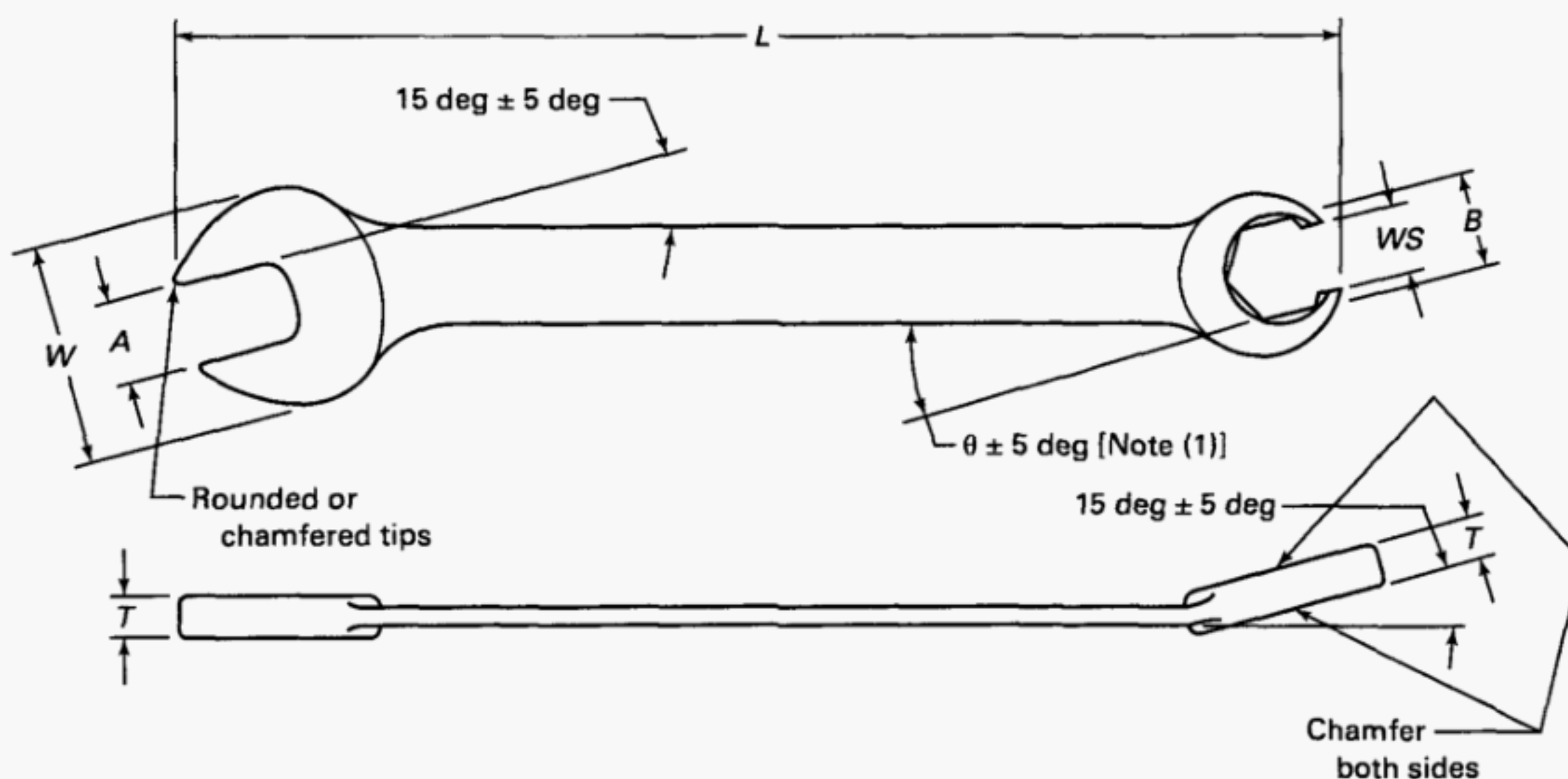
FIG. 2 TYPE I, FLARE-NUT WRENCH

TABLE 1 TYPE I FLARE NUT WRENCH (CUSTOMARY UNITS)

Nominal Wrench Opening Across Flats		Outside Diameter of Head, OD		Width of Slot in Head, WS		Thickness of Head, T		Overall Length, L	Proof Torque	
		Small Head, A	Large Head, B	Small Head, A	Large Head, B	Small Head, A	Large Head, B		Small Head, A	Large Head, B
Small Head, A	Large Head, B	Max., in.	Max., in.	Min., in.	Min., in.	Max., in.	Max., in.	Type I Min., in.	Min., lbf-in.	Min., lbf-in.
$\frac{1}{4}$	$\frac{5}{16}$	0.656	0.750	0.109	0.141	0.291	0.344	3.750	110	170
$\frac{5}{16}$	$\frac{3}{8}$	0.750	0.875	0.141	0.188	0.344	0.406	4.500	170	240
$\frac{3}{8}$	$\frac{7}{16}$	0.875	0.938	0.188	0.250	0.406	0.453	4.875	240	320
$\frac{7}{16}$	$\frac{1}{2}$	0.938	1.156	0.250	0.313	0.453	0.484	5.500	320	400
$\frac{1}{2}$	$\frac{9}{16}$	1.156	1.188	0.313	0.344	0.484	0.484	5.625	400	510
$\frac{5}{8}$	$\frac{11}{16}$	1.281	1.438	0.406	0.438	0.625	0.625	6.250	625	750
$\frac{5}{8}$	$\frac{3}{4}$	1.281	1.438	0.406	0.438	0.625	0.625	6.750	625	880
$\frac{5}{8}$	$\frac{13}{16}$	1.281	1.500	0.406	0.531	0.625	0.625	7.000	625	1025
$\frac{3}{4}$	$\frac{13}{16}$	1.438	1.500	0.438	0.531	0.625	0.625	7.000	880	1025
$\frac{3}{4}$	$\frac{7}{8}$	1.438	1.641	0.438	0.531	0.625	0.625	7.000	880	1180
$\frac{3}{4}$	1	1.438	1.750	0.438	0.656	0.625	0.813	8.000	880	1510
$\frac{7}{8}$	$\frac{15}{16}$	1.641	1.750	0.531	0.578	0.625	0.813	8.000	1180	1340
$\frac{7}{8}$	1	1.641	1.750	0.531	0.656	0.625	0.813	8.000	1180	1510
$\frac{7}{8}$	$1\frac{1}{8}$	1.641	1.938	0.531	0.750	0.625	0.875	8.000	1180	1880
$1\frac{5}{16}$	$1\frac{1}{16}$	1.750	1.813	0.578	0.656	0.813	0.813	8.000	1340	1700
1	$1\frac{1}{16}$	1.750	1.813	0.656	0.656	0.813	0.813	9.000	1510	1700

TABLE 2 TYPE I FLARE NUT WRENCH (SI UNITS)

Nominal Wrench Opening Across Flats		Outside Diameter of Head, <i>OD</i>		Width of Slot in Head, <i>WS</i>		Thickness of Head, <i>T</i>		Overall Length, <i>L</i>	Proof Torque	
		Small Head, <i>A</i> Max., mm	Large Head, <i>B</i> Max., mm	Small Head, <i>A</i> Min., mm	Large Head, <i>B</i> Min., mm	Small Head, <i>A</i> Max., in.	Large Head, <i>B</i> Max., mm		Small Head, <i>A</i> Min., N·m	Large Head, <i>B</i> Min., N·m
7	8	17.3	19.0	4.5	4.5	7.6	8.5	101	15	20
7	9	17.3	22.0	4.5	4.7	7.6	10.0	109	15	25
8	10	19.0	23.5	4.5	5.5	8.5	10.5	116	20	30
9	11	22.0	24.0	4.7	6.4	10.0	10.5	123	25	35
10	12	23.5	25.5	5.5	7.0	10.5	11.1	135	30	40
11	13	24.0	27.0	6.4	8.5	10.5	11.1	140	35	45
12	14	25.5	28.0	7.0	9.5	11.1	12.0	140	40	55
13	14	27.0	28.0	8.5	9.5	11.1	12.0	150	45	55
15	17	30.2	32.2	10.3	12.0	12.0	13.5	170	65	85
16	17	31.2	32.2	10.3	12.0	12.0	13.5	170	75	85
16	18	31.2	33.6	10.3	12.5	12.0	14.7	177	75	95
18	20	33.6	37.5	12.5	14.0	14.0	14.7	180	95	120
19	21	35.9	41.3	13.0	15.1	14.7	15.2	184	105	130
19	22	35.9	41.3	13.0	15.9	14.7	15.2	190	105	145



NOTE:

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

FIG. 3 TYPE II FLARE-NUT COMBINATION WRENCH

TABLE 3 TYPE II FLARE NUT COMBINATION WRENCH (CUSTOMARY UNITS)

Nominal Opening Across Flats, A or B, in.	Width of Open Head, W Max., in.	Outside Diameter of Flare Head, OD Max., in.	Width of Slot in Flare Head, WS Min., in.	Thickness of Open Head, T Max., in.	Thickness of Flare Head, T Max., in.	Overall Length, L Type II Min., in.	Proof Torque	
							Open Head Min., lbf-in.	Flare Head Min., lbf-in.
5/16	0.811	0.750	0.141	0.344	0.344	4.500	138	170
3/8	0.906	0.875	0.188	0.406	0.406	4.875	275	240
7/16	1.031	0.938	0.250	0.453	0.453	5.375	413	320
1/2	1.219	1.156	0.313	0.484	0.484	5.625	550	400
9/16	1.281	1.188	0.344	0.484	0.484	5.750	770	510
5/8	1.406	1.281	0.406	0.484	0.625	6.250	1,100	625
11/16	1.563	1.438	0.438	0.563	0.625	7.000	1,375	750
3/4	1.672	1.438	0.438	0.563	0.625	7.500	1,650	880
13/16	1.828	1.500	0.531	0.594	0.625	8.000	2,200	1,025
7/8	1.938	1.641	0.531	0.625	0.625	8.300	2,475	1,180
15/16	2.094	1.750	0.578	0.656	0.813	9.000	3,025	1,340
1	2.250	1.750	0.656	0.750	0.813	10.000	3,575	1,510

TABLE 4 TYPE II FLARE NUT COMBINATION WRENCH (SI UNITS)

Nominal Opening Across Flats, A or B, mm	Width of Open Head, W Max., mm	Outside Diameter of Flare Head, OD Max., mm	Width of Slot in Flare Head, WS Min., mm	Thickness of Open Head, T Max., mm	Thickness of Flare Head, T Max., mm	Overall Length, L Type II Min., mm	Proof Torque	
							Open Head Min., N·m	Flare Head Min., N·m
8	21.4	19.0	4.5	8.5	8.5	100	15	20
9	21.8	22.0	4.7	10.0	10.0	103	21	25
10	26.0	23.5	5.5	10.5	10.5	119	31	30
11	26.0	24.0	6.4	10.5	10.5	124	46	35
12	27.7	25.5	7.0	10.5	11.1	140	49	40
13	30.2	27.0	8.5	11.0	11.1	143	62	45
14	32.8	28.0	9.5	12.0	12.0	150	86	55
15	34.8	30.2	10.3	12.0	12.0	153	104	65
16	36.4	31.2	10.3	12.0	12.0	156	124	75
17	39.7	32.2	12.0	13.5	13.5	162	139	85
18	41.0	33.6	12.5	13.5	14.0	170	155	95
19	42.7	35.9	13.0	14.0	14.7	180	186	105

proof torque. Following the removal of the proof test torque, they shall be regaged. Open ends, which do not sustain the test torque, 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 B107.17M size by more than the following:

(1) 0.002 (0.05 mm) for wrench opening sizes 5/32 in. (4 mm) through 1 in. (25 mm)

(2) 0.003 (0.08 mm) for wrench opening sizes 1 1/16 in. (26 mm) through 2 1/4 in. (50 mm)

5.3 Coating Process Qualification Test

Alternative coatings shall be subjected to testing in order to certify the manufacturer's production coating process. The Coating Process Test consists of an adhesion, abrasion and corrosion test specified in paras. 5.3.2, 5.3.3, and 5.3.4. The Coating Process Qualification

**TABLE 5 HEXAGON MANDREL DIMENSIONS
(CUSTOMARY UNITS)**

Nominal Size of Wrench Opening, in.	Hexagon Mandrel Dimensions, in.		
	Across Flats Tolerance		Across Corners, Min., in. [Note 1]
	Plus	Minus	
1/8	0.001	0.002	0.1403
5/32	0.001	0.002	0.1745
13/64	0.001	0.002	0.2095
3/16	0.001	0.002	0.2268
7/32	0.001	0.002	0.2440
15/64	0.001	0.002	0.2610
1/4	0.001	0.002	0.2780
9/32	0.001	0.002	0.3133
5/16	0.001	0.002	0.3495
11/32	0.001	0.002	0.3860
3/8	0.001	0.002	0.4225
7/16	0.001	0.002	0.4935
1/2	0.001	0.003	0.5635
9/16	0.001	0.003	0.6339
5/8	0.001	0.003	0.7055
11/16	0.001	0.003	0.7769
3/4	0.001	0.003	0.8485
13/16	0.001	0.003	0.9201
7/8	0.001	0.003	0.9917
15/16	0.001	0.003	1.0631
1	0.001	0.003	1.1297
1 1/16	0.001	0.003	1.2013
1 1/8	0.001	0.003	1.2728
1 3/16	0.001	0.003	1.343
1 1/4	0.001	0.003	1.416
1 5/16	0.001	0.003	1.487
1 3/8	0.001	0.003	1.559
1 7/16	0.001	0.003	1.631
1 1/2	0.001	0.003	1.702
1 9/16	0.001	0.007	1.770
1 5/8	0.001	0.007	1.841
1 11/16	0.001	0.007	1.912
1 3/4	0.001	0.007	1.983
1 13/16	0.001	0.007	2.054
1 7/8	0.001	0.007	2.124
1 15/16	0.001	0.007	2.195
2	0.001	0.007	2.266
2 1/16	0.001	0.007	2.337
2 1/8	0.001	0.007	2.408
2 3/16	0.001	0.007	2.479
2 1/4	0.001	0.007	2.549

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 1 1/2 in. nominal size.

**TABLE 6 HEXAGON MANDREL DIMENSIONS
(SI UNITS)**

Nominal Size of Wrench Opening, mm	Hexagon Mandrel Dimensions, mm		
	Across Flats Tolerance		Across Corners, Min., mm [Note 1]
	Plus	Minus	
3.2	0.025	0.050	3.57
4	0.025	0.050	4.46
5	0.025	0.050	5.58
5.5	0.025	0.050	6.13
6	0.025	0.050	6.68
6.3	0.025	0.050	7.02
7	0.025	0.050	7.79
8	0.025	0.050	8.95
9	0.025	0.050	10.11
10	0.025	0.050	11.27
11	0.025	0.050	12.40
12	0.025	0.076	13.53
13	0.025	0.076	14.67
14	0.025	0.076	15.80
15	0.025	0.076	16.92
16	0.025	0.076	18.06
17	0.025	0.076	19.20
18	0.025	0.076	20.35
19	0.025	0.076	21.49
20	0.025	0.076	22.64
21	0.025	0.076	23.78
22	0.025	0.076	24.93
23	0.025	0.076	26.07
24	0.025	0.076	27.20
25	0.025	0.076	28.27
26	0.025	0.076	29.38
27	0.025	0.076	30.53
28	0.025	0.076	31.67
29	0.025	0.076	32.81
30	0.025	0.076	33.96
31	0.025	0.076	35.10
32	0.025	0.076	36.25
33	0.025	0.076	37.38
34	0.025	0.076	38.52
35	0.025	0.076	39.68
36	0.025	0.076	40.83
38	0.025	0.076	43.11
40	0.025	0.177	45.32
41	0.025	0.177	46.45
42	0.025	0.177	47.59
46	0.025	0.177	52.12
50	0.025	0.177	56.65

NOTE:

(1) For sizes not listed, multiply nominal size by 1.133055 for mandrel dimension across corners. Applicable to mandrels over 38 mm nominal size.

Test may also be performed to certify the manufacturer's Nickel-Chromium coating process. Passing the Coating Process Qualification tests, when agreed to by the customer, exempts the manufacturer from the Nickel-Chromium thickness requirement of para. 4.7.2(a). Re-testing may be required when a significant change occurs in the process, when there is a change in the materials, or when contractually required by the customer.

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

5.3.2 Coating Process Adhesion Test. Sample wrenches shall pass the file or grind-saw test of ASTM B 571.

5.3.3 Coating Process Abrasion Test. Sample wrenches shall have no base material exposed when subjected to 100 L of falling sand test of ASTM D 968 Method A.

5.3.4 Coating Process Corrosion Test. Sample wrenches shall be tested for corrosion resistance by exposure to a 48 hr salt spray test, as specified in ASTM B 117, without falling below the ASTM B 537 rating of 6.

6 DESIGNATIONS

Wrenches shall be designated by the following data in the sequence shown:

- (a) Type
- (b) Size of openings
- (c) Configuration of openings
- (d) Coating

EXAMPLE: Flare Nut Wrench Type I, $\frac{1}{2} \times \frac{9}{16}$ openings, 6-point (single hexagon), Nickel-chrome.

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.

AMERICAN NATIONAL STANDARDS FOR HAND TOOLS

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