SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS4167 REV. B

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Superseding AS4167A

(R) Wrenches; Flare Nut, Crowfoot, 12 Point Non-distorting

RATIONALE

This Aerospace Standard defines the requirements needed for nondistorting 12 point flare nut crowfoot, combination box and flare nut wrenches, and ratcheting flare nut wrenches.

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1. SCOPE

This SAE Aerospace Standard (AS) covers 12 point flare nut crowfoot, flare nut wrenches, double end flare nut wrenches, combination box and flare nut wrenches, and ratcheting flare nut wrenches that are designed with the following requirements: a. Non-distorting usage b. Possessing the strength, clearances, and internal wrenching design to be used on hydraulic tube fittings that conform to the requirements of SAE J514. c. Transmitting torque to tube fittings without bearing on the apex of fitting wrenching points. Inclusion of dimensional data in this document 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.

1.1 Purpose

These tools are used for tightening and loosening hydraulic flare nut (tube) fittings.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS4118 Aluminum Alloy, Rolled or Cold Finished Bars, Rods, and Wire, 4.0Cu - 0.70Mn - 0.60Mg - 0.50Si, (2017; -T4, -T451), Solution Heat Treated

AS478 Identification Marking Methods

AS4984 Coating Requirements for Aerospace Hand Tools

J514 Hydraulic Tube Fittings

2.2 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

B46.1 Surface Texture, Surface Roughness, Waviness and Lay

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

B107.17 Gages and Mandrels for Wrench Openings, Reference

B107.100 Flat Wrenches

2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E4 Standard Practices for Force Verification of Testing Machines

ASTM E18 Standard Test Methods for Rockwell Hardness of Metallic Materials

3. CLASSIFICATION

3.1 This document covers a limited number of wrench opening sizes, as required, to accommodate the needs of SAE J514 and for wrench types that are commercially available in accordance with the requirements of this document.

3.2 Wrenches shall be of the following Types, Classes, Styles, Designs, and Sizes. See Section 5.

3.2.1 Type I wrenches shall have a protective nickel-chromium finish in accordance with 4.8.2.

3.2.1.1 Class 1 - Crowfoot, Flare Nut

Style A - 1/4 square drive
Design (a) – Standard duty

Style B - 3/8 square drive
Design (a) – Standard duty
Design (b) – Heavy duty

Style C - 1/2 square drive
Design (a) – Standard duty

3.2.1.2 Class 2 - Flare Nut Wrenches

Style A - double flare nut
Design (a) - straight heads
Design (b) – 15 degree heads

Style B - combination box and flare nut

Style C - combination open end and flare nut

Style D - single flare nut

Style E - ratcheting flare nut

3.2.2 Type II wrenches shall be a protective black oxide, phosphate finish or other black finish coatings in accordance with 4.8.2.

3.2.2.1 Class 1 - Crowfoot, Flare Nut

Style A - 1/4 square drive
Design (a) – Standard duty

Style B - 3/8 square drive
Design (a) – Standard duty
Design (b) – Heavy duty

Style C - 1/2 square drive
Design (a) – Standard duty

3.2.2.2 Class 2 - Flare Nut Wrenches

Style A - double flare nut
Design (a) - straight heads
Design (b) – 15 degree heads

Style B - combination box and flare nut

Style C - combination open end and flare nut

Style D - single flare nut

Style E - ratcheting flare nut

4. REQUIREMENTS

4.1 Illustrations

4.1.1 The illustrations shown are descriptive and not restrictive, and are included for the convenience of requisitioning and purchasing officers. They are not intended to preclude the purchase of wrenches that are otherwise in accordance with this document.

4.2 Materials

4.2.1 Unless otherwise specified, the materials used in the manufacture of wrenches shall be steel. The chemical composition and heat treatment shall be such as to produce wrenches conforming to the physical requirements specified. Powder metal or cast steel shall not be used.

4.3 Marking

4.3.1 The wrenches shall be marked in a permanent manner with the country of origin and manufacturer's name or with a trademark so that the source of manufacture may be readily determined. In addition, the wrenches shall be marked in a permanent manner with the nominal opening size. Marking requirements shall be in accordance with AS478.

4.4 Female Drive Opening

4.4.1 Female drive opening dimensions for Class 1 wrenches shall conform to ASME B107.4, except as noted in 4.4.1.1 or 4.4.1.2. The openings shall be broached or punched in a smooth and well defined manner. Two sides of the opening shall be parallel to the longitudinal axis of wrench within ±3 degrees.

4.4.1.1 All four faces of the female drive opening shall be recessed so that one of the recesses engages the spring loaded steel ball on the corresponding male drive. If the length of engagement of the male tang is less than twice the dimension of Df in Table 7 of ASME B107.4, the recess shall be central in the corresponding female drive opening within 0.010.

4.4.1.2 One or more of the faces of the female drive opening shall be drilled with a cross hole to engage the spring loaded steel ball on the corresponding male drive. If the length of engagement of the male tang is less than twice the dimension of Df in Table 7 of ASME B107.4, the hole shall be centered within 0.010 in the corresponding female drive opening.

4.5 Edges and Corners

4.5.1 All edges and sharp corners, capable of causing injury, not otherwise covered herein, shall have sharp edges removed by rounding, chamfering, or other means.

4.6 Internal Wrenching Configuration

4.6.1 The internal 12 point wrenching configuration surfaces shall conform to Figure 1 and be finished in a smooth and well defined manner (not smeared or torn). These openings, except for Style E wrenches, shall be chamfered on both sides to provide a lead in for the working surfaces.

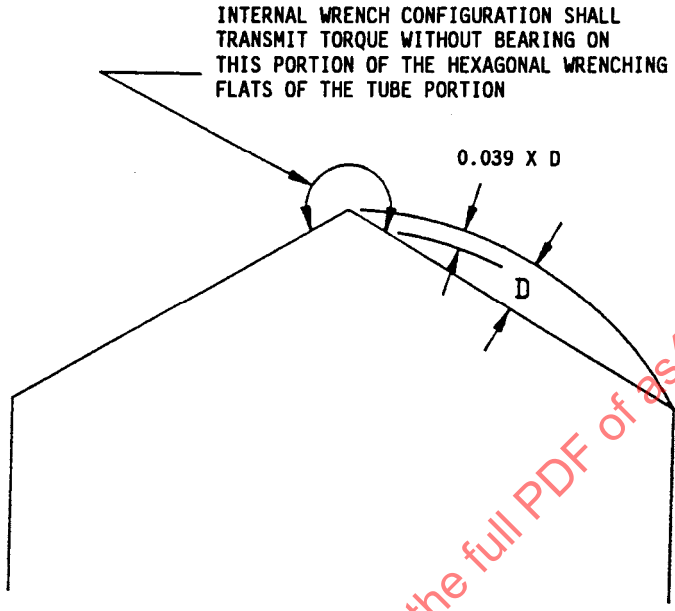


FIGURE 1 – INTERNAL WRENCH ENGAGEMENT

4.6.2 Tolerance for box end, flare nut, or both, openings shall be such as to ensure acceptance when gaged in accordance with requirements of ASME B107.17M.

4.7 Hardness

4.7.1 Unless otherwise specified, wrenches shall be hardened throughout to a Rockwell hardness of not less than 40 Rc nor more than 54 Rc. When grinding is necessary to prepare the test surface, the amount removed must not exceed 0.007 in on the surface contacted by the indenter. Hardness definitions, nomenclature, and procedures used can be found in ASTM E18.

4.8 Surface Finish

4.8.1 All surfaces shall be thoroughly cleaned, free from cracks, and essentially free from burrs, pits, nodules, and other detrimental defects. Areas ground, buffed, or finished by an equivalent method shall have a bright finish with a maximum surface roughness of 32 µin for Type I wrenches and a maximum surface roughness of 64 µin for Type II wrenches. Surfaces not ground or buffed shall have a surface conforming to good commercial practice and the surface roughness shall not exceed 250 µin.

4.8.1.1 Forge flash shall be removed from the periphery of the drive end for a minimum of 180 degrees (90 degrees on each side of the centerline of slotted openings on flare nut(s) or longitudinal axis, or both, of the wrench on box end(s)) on the periphery of box and/or flare nut, or both, portions of the wrench. Any remaining surfaces between the wrench end(s) shall blend smoothly with adjacent surfaces. External sharp edges shall be broken to a 0.015 in radius minimum, and shall not project more than 0.015 in from adjacent surfaces.

4.8.2 Coatings: Wrenches shall be protected with the following three types as specified within AS4984B.

Type I – Nickel Chromium coating

Type II – Black Oxide, Black Phosphate, or other black finish coatings

Type III – Alternate coating (Used in lieu of Nickel chromium plating)

4.9 Tests

4.9.1 The load tests required herein are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting these tests.

4.9.2 Micro inch (μin) measurements shall be made with a surface measuring instrument using a 0.03 in roughness width cutoff. All surface roughness values shall be rated as arithmetical averages. Definitions and nomenclature used can be found in ASME B46.1.

4.9.3 All wrenches (except crowfoot flare nut wrenches) shall be capable of meeting the aluminum mandrel test, as specified in the applicable tables, when performed in accordance with the following procedures. In addition, the box end on Class 2, Style B wrenches and the open end on Class 2, Style C wrenches shall achieve the applicable torque loads as specified in ASME B107.100 (B107.6). Crowfoot wrenches shall achieve the applicable torque loads as specified in ASME B107.100 (B107.21).

4.9.3.1 Aluminum Mandrel Test: The flare nut(s) on wrenches shall achieve the torque loads in Table 1 when subjected to the following: Mandrels constructed from aluminum, conforming to AMS 4118 and to Figure 2, shall be used. The wrench shall be placed on the mandrel and located centrally to the 0.140 in-long portion of the mandrel. See Figures 2 and 3. Care shall be exercised to maintain the face of the wrench parallel to the face of the mandrel during the test. Force shall be applied to the wrench to transmit the required test load between the wrench and torque tester. See Figure 3. This shall be done a total of three times on each mandrel, rotating the wrench 30 degrees to the next gripping position of the wrench after each torque cycle. If the corners of the mandrel are deformed so that the test load values cannot be met, the wrench shall not comply with these requirements.

TABLE 1 – ALUMINUM MANDREL TEST

(This table is not applicable for crowfoot wrenches, because it does not specify the square drive size. For example, 1/4" drive x 3/8” crowfoot wrench will not be as strong as 3/8” drive x 3/8” crowfoot wrench)

Nominal Wrench Size (IN) A	Torque-Load (IN-LB)	Nominal Wrench Size (IN) A	Torque-Load (IN-LB)
3/8 (0.3750)	180	1 7/16 (1.4375)	1890
7/16 (0.4375)	260	1 1/2 (1.5000)	2025
1/2 (0.5000)	320	1 9/16 (1.5625)	2230
9/16 (0.5625)	380	1 5/8 (1.6250)	2430
5/8 (0.6250)	450	1 11/16 (1.6875)	2600
11/16 (0.6875)	560	1 3/4 (1.7500)	2850
3/4 (0.7500)	675	1 13/16 (1.8125)	2990
13/16 (0.8125)	775	1 7/8 (1.8750)	3400
7/8 (0/8750)	850	1 15/16 (1.9385)	3950
15/16 (0.9375)	960	2 (2.000)	4500
1 (1.000)	1050	2 1/8 (2.1250)	4500
1 1/16 (1.0625)	1175	2 1/4 (2.2502)	4500
1 1/8 (1.1250)	1300	2 3/8 (2.3750)	4500
1 3/16 (1.1875)	1410	2 5/8 (2.6250)	4500
1 1/4 (1.2500)	1525	2 3/4 (2.7500)	4500
1 5/16 (1.3125)	1640	2 7/8 (2.8750)	4500
1 3/8 (1.3750)	1750		

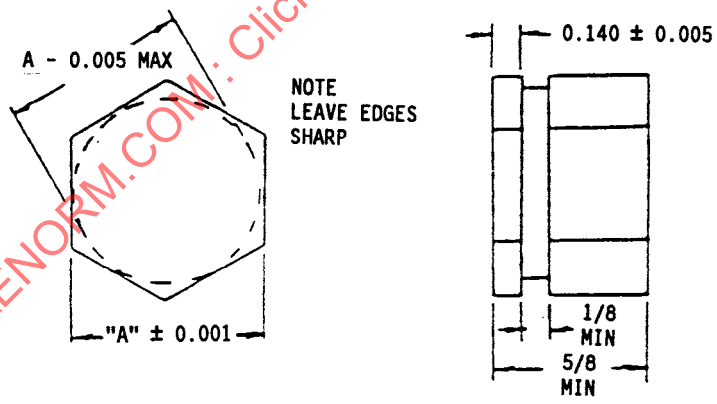


FIGURE 2 – SPECIMEN FOR ALUMINUM MANDREL TEST

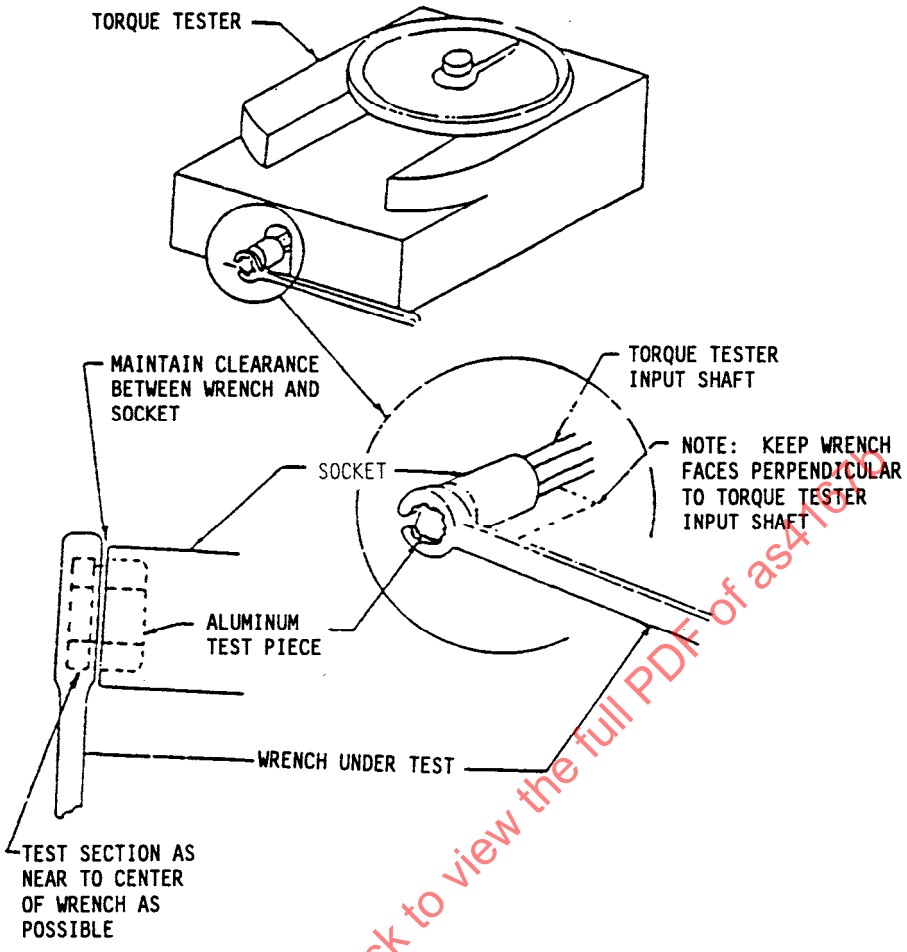


FIGURE 3 – TYPICAL TEST SETUP FOR ALUMINUM MANDREL TEST

4.9.4 Qualification Test: As a design and process qualification test, the manufacturer shall maintain a record of compliance with the tube fitting distortion test of 4.9.4.1. for the flare nut(s) of a sample tool. The test shall be required whenever the design or method of manufacture is significantly changed.

4.9.4.1 Tube Fitting Distortion Test: The flare nut(s) on wrenches shall achieve the torque loads in Table 2 when subjected to the following: Place a socket of the same size as the flare nut to be tested on a torque tester. See Figure 4. Insert into the socket the corresponding size Style "B" nut conforming to the requirements of SAE J514. A Class 2B, go and no-go thread gage shall be used. If the no-go end of the gage enters into the nut, it shall not bottom. The nut should be free of imperfections, and the go gage should turn freely the full length of the fitting. A light oil should be used on the threads for this test to minimize thread variables. After threading the gage to the bottom of the nut, the gage should be backed up one full turn. The wrench should be placed on the fitting with the center of the wrench as near to the center of the fitting as possible by inserting the nut only as far into the socket as is necessary to hold it securely when the torque is applied to it (approximately 1/8 in). The wrench shall then be brought up to one half the torque load specified for the wrench. This shall be done three times at one half torque, rotating the wrench 30 degrees to the next gripping position of the wrench, after each single torque cycle. (In the case of Style E wrenches, this shall be to the next ratcheting position.) Then while constantly rotating the thread gage by hand, clockwise and counterclockwise, through a short arc (1/16 to 1/8 turn), sufficiently to keep the gage in motion, the wrench should be brought up to the torque where the gage can no longer be turned by hand. This procedure should be repeated a total of six times, rotating the wrench 30 degrees to the next gripping position of the wrench after each single torque cycle, as before. The three lowest torque readings, at which the thread gage can no longer be turned by hand, shall be averaged. This value shall be no lower than the values specified in Table 2.

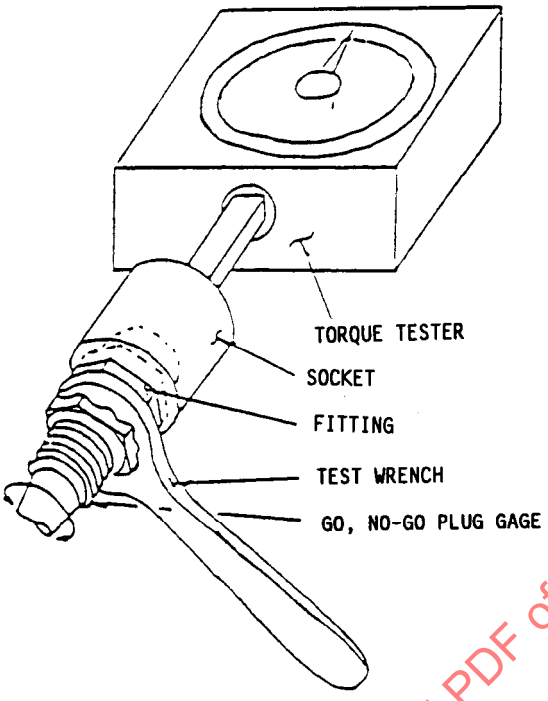


FIGURE 4 – TEST SETUP FOR TUBE FITTING DISTORTION TEST

TABLE 2 – TUBE FITTING DISTORTION TEST

Nominal Wrench Size (IN)	Torque-Load (IN-LB)
3/8	240
7/16	250
9/16	330
5/8	360
11/16	410
7/8	600
1	720

5. DESIGNATIONS

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

a. Type

b. Class

c. Style

d. Design, if applicable

e. Size

EXAMPLE: Type I, Class 1, Style B, Design (a), 5/8 in opening would be a chromium plated flare nut crowfoot with a 3/8 in square drive and an offset box end having a 5/8 in internal wrenching configuration.

6. CLASSIFICATION DESCRIPTIONS

6.1 Type I and II, Class 1, Design (a) and (b) wrenches shall be of the flare nut crowfoot design having a female drive opening at one end and a slotted internal wrenching configuration at the other end.

6.1.1 Design (a) wrenches shall be similar to Figure 5 and conform to requirements of Table 3. The slotted portion of the internal wrenching configuration may be rotated up to 35 degrees from wrench centerline.

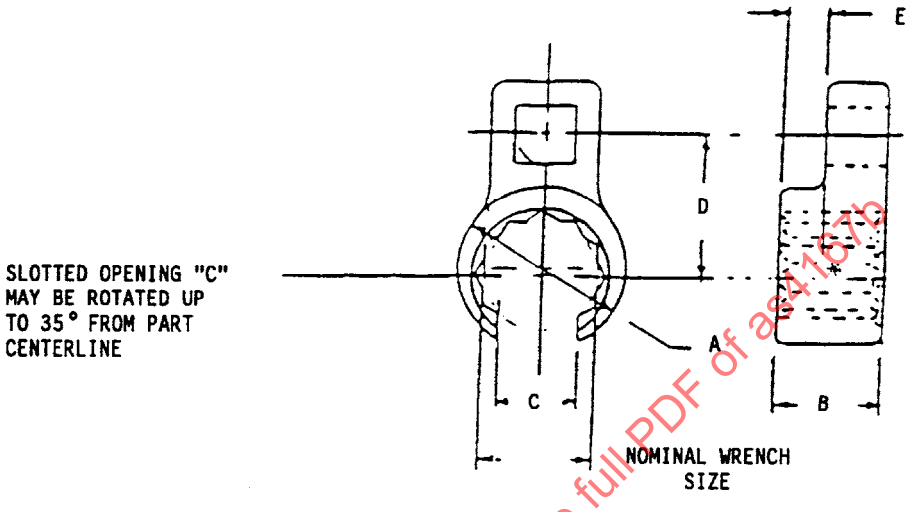


FIGURE 5 – TYPE I AND II, CLASS 1, STYLE A, B AND C,
DESIGN (A) CROWFOOT, FLARE NUT (STANDARD DUTY)

TABLE 3 - TYPE I AND II, CLASS 1, STYLE A, B AND C,
DESIGN (A) CROWFOOT, FLARE NUT (STANDARD DUTY)

Nominal Wrench Size (IN)	Style Size	Drive (IN)	Box End Diameter Max (IN) A	Box End Thickness Max (IN) B	Slotted Opening Min (IN) C	Torque Center 0.035 (IN) D	Offset Min (IN) E
3/8	A	(1/4 Sq. Dr.)	0.625	0.531	0.193	0.500	0.156
7/16	A	(1/4 Sq. Dr.)	0.719	0.594	0.255	0.547	0.219
1/2	A	(1/4 Sq. Dr.)	0.813	0.594	0.317	0.594	0.219
9/16	A	(1/4 Sq. Dr.)	0.875	0.594	0.343	0.625	0.219
5/8	B	(3/8 Sq. Dr.)	0.984	0.750	0.406	0.719	0.280
11/16	B	(3/8 Sq. Dr.)	1.078	0.750	0.442	0.766	0.280
3/4	B	(3/8 Sq. Dr.)	1.172	0.781	0.442	0.813	0.313
13/16	B	(3/8 Sq. Dr.)	1.250	0.781	0.531	0.859	0.313
7/8	B	(3/8 Sq. Dr.)	1.344	0.813	0.531	0.925	0.344
15/16	B	(3/8 Sq. Dr.)	1.422	0.813	0.578	0.954	0.344
1	B	(3/8 Sq. Dr.)	1.500	0.844	0.656	1.000	0.344
1 1/16	B	(3/8 Sq. Dr.)	1.578	0.844	0.755	1.032	0.344
1 1/8	C	(1/2 Sq. Dr.)	1.688	0.938	0.755	1.140	0.344
1 3/16	C	(1/2 Sq. Dr.)	1.763	0.938	0.755	1.188	0.344
1 1/4	C	(1/2 Sq. Dr.)	1.844	0.938	0.890	1.219	0.344
1 5/16	C	(1/2 Sq. Dr.)	1.906	1.000	0.890	1.265	0.344
1 3/8	C	(1/2 Sq. Dr.)	2.000	1.000	1.015	1.297	0.407
1 7/16	C	(1/2 Sq. Dr.)	2.062	1.063	1.015	1.328	0.407
1 1/2	C	(1/2 Sq. Dr.)	2.125	1.063	1.015	1.360	0.407
1 9/16	C	(1/2 Sq. Dr.)	2.203	1.063	1.015	1.406	0.407
1 5/8	C	(1/2 Sq. Dr.)	2.281	1.063	1.130	1.469	0.407
1 11/16	C	(1/2 Sq. Dr.)	2.375	1.063	1.265	1.515	0.469
1 3/4	C	(1/2 Sq. Dr.)	2.438	1.063	1.265	1.531	0.469
1 13/16	C	(1/2 Sq. Dr.)	2.529	1.063	1.265	1.578	0.469
1 7/8	C	(1/2 Sq. Dr.)	2.625	1.125	1.265	1.625	0.530
2	C	(1/2 Sq. Dr.)	2.781	1.125	1.515	1.703	0.530
2 1/8	C	(1/2 Sq. Dr.)	2.904	1.188	1.515	1.812	0.590
2 1/4	C	(1/2 Sq. Dr.)	3.094	1.188	1.515	1.875	0.590
2 3/8	C	(1/2 Sq. Dr.)	3.250	1.250	1.630	1.969	0.657
2 5/8	C	(1/2 Sq. Dr.)	3.562	1.312	2.015	2.125	0.719
2 3/4	C	(1/2 Sq. Dr.)	3.719	1.312	2.015	2.219	0.719

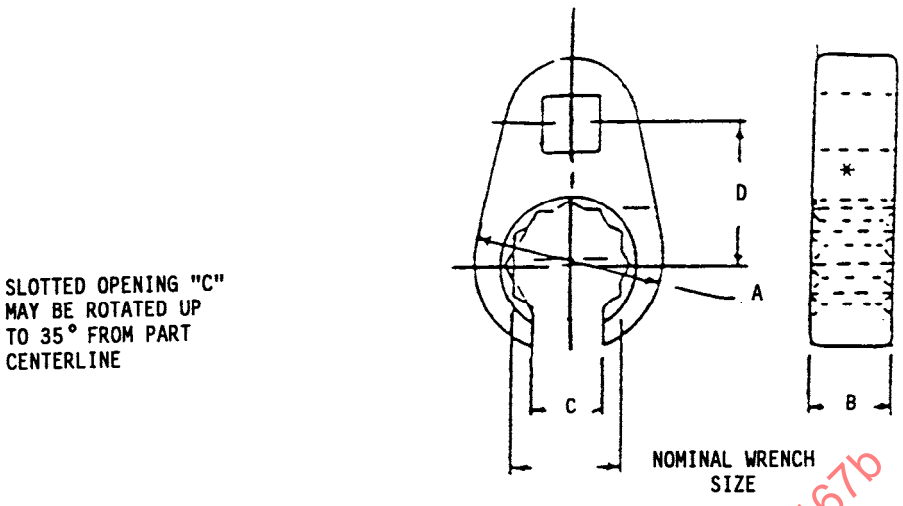


FIGURE 6 - TYPE I AND II, CLASS 1, STYLE B DESIGN (B) CROWFOOT, FLARE NUT, HEAVY DUTY

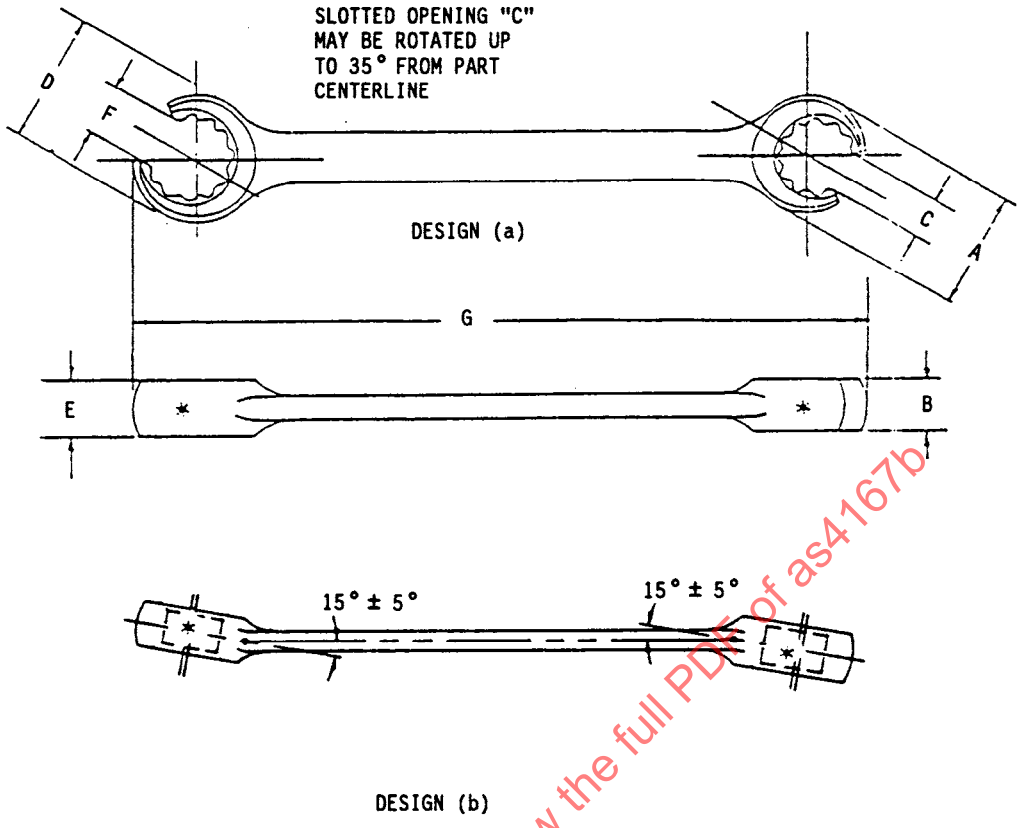
TABLE 4 – TYPE I AND II, CLASS 1, STYLE B DESIGN (B) CROWFOOT, FLARE NUT, HEAVY DUTY

Nominal Wrench Size (IN)	Style Size Drive (IN)	Flare Nut Diameter Max (IN) A	Flare Nut Thickness Max (IN) B	Slotted Opening Min (IN) C	Torque Center 0.030 (IN) D
3/8	B (3/8 Sq. Dr.)	0.891	0.406	0.193	0.563
7/16	B (3/8 Sq. Dr.)	1.000	0.406	0.255	0.563
1/2	B (3/8 Sq. Dr.)	1.094	0.468	0.317	0.563
9/16	B (3/8 Sq. Dr.)	1.219	0.468	0.343	0.750
5/8	B (3/8 Sq. Dr.)	1.219	0.468	0.406	0.750
11/16	B (3/8 Sq. Dr.)	1.406	0.516	0.442	0.813
3/4	B (3/8 Sq. Dr.)	1.406	0.516	0.442	0.813
13/16	B (3/8 Sq. Dr.)	1.719	0.593	0.531	0.875
7/8	B (3/8 Sq. Dr.)	1.719	0.593	0.531	0.875
15/16	B (3/8 Sq. Dr.)	1.984	0.641	0.578	0.906
1	B (3/8 Sq. Dr.)	1.984	0.641	0.656	0.906

6.2 Type I and II, Class 2 wrenches shall be of the flare nut design, in accordance with one of the following styles:

6.2.1 Style A, double flare nut wrenches shall have two slotted internal wrenching configurations, one located on each end of the wrench. They shall be similar to Figure 7 and conform to requirements of Table 5. The slotted portion of the internal wrenching configuration may be rotated up to 35 degrees from the wrench centerline.

6.2.1.1 Design (a) wrenches shall have straight heads, design (b) wrenches shall have heads at a 15 degree angle to the wrench beam.



*NICKEL AND CHROMIUM PLATING TEST AREAS FOR TYPE I WRENCH.

FIGURE 7 - TYPE I AND II, CLASS 2, STYLE A, FLARE NUT WRENCH, DOUBLE FLARE NUTS

TABLE 5 - TYPE I AND II, CLASS 2, STYLE A, FLARE NUT, DOUBLE FLARE NUTS

Nominal Wrench Size (IN)	Small Flare Nut Diameter Max (IN) A	Small Flare Nut Thickness Max (IN) B	Small Flare Nut Slot Opening Min (IN) C	Large Flare Nut Diameter Max (IN) D	Large Flare Nut Thickness Max (IN) E	Large Flare Nut Slot Opening Min (IN) F	OAL Min (IN) G
3/8 & 7/16	0.860	0.364	0.193	0.921	0.395	0.255	5.50
7/16 & 1/2	0.921	0.395	0.255	1.016	0.395	0.317	6.38
1/2 & 9/16	1.016	0.395	0.317	1.094	0.458	0.343	6.38
5/8 & 11/16	1.141	0.458	0.406	1.266	0.516	0.442	7.00
5/8 & 3/4	1.141	0.458	0.406	1.281	0.562	0.442	7.00
5/8 & 15/16	1.141	0.453	0.406	1.531	0.687	0.578	7.00
3/4 & 13/16	1.281	0.562	0.442	1.375	0.625	0.531	7.62
3/4 & 7/8	1.281	0.562	0.442	1.468	0.625	0.531	7.62
3/4 & 1	1.281	0.562	0.442	1.656	0.781	0.656	7.62
13/16 & 1 1/16	1.375	0.625	0.531	1.750	0.781	0.656	8.50
7/8 & 1	1.468	0.625	0.531	1.656	0.781	0.656	9.00
7/8 & 1 1/8	1.468	0.625	0.531	1.843	0.781	0.755	9.25