



AEROSPACE STANDARD

AS4167™**REV. D**

Issued 1988-09
Reaffirmed 2004-01
Revised 2024-01

Superseding AS4167C & MA4360A

(R) Wrenches; Flare Nut, Crowfoot, 6- and 12-Point Non-Distorting

RATIONALE

The purpose of AS4167D is to incorporate improvements based on committee findings and combine inch and metric sizes into common standard. These tools are used for tightening and loosening hydraulic flare nut (tube) fittings.

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1. SCOPE

This SAE Aerospace Standard (AS) covers 6-point and 12-point flare nut crowfoot, flare nut wrenches, double end flare nut wrenches, combination box end and flare nut wrenches, combination open end 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 and ISO 8434-2; and (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 Classification

This document covers a limited number of wrench opening sizes, as required, to accommodate the needs of SAE J514 and ISO 8434-2 and for wrench types that are commercially available in accordance with the requirements of this document.

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

1.1.1 Type 1 - Crowfoot, Flare Nut

Class 1 - 1/4 square drive

Style A - Standard duty

Design (a) 6-point heads

Design (b) 12-point heads

Class 2 - 3/8 square drive

Style A - Standard duty

Design (a) 6-point heads

Design (b) 12-point heads

Style B - Heavy duty

Design (a) 6-point heads

Design (b) 12-point heads

Class 3 - 1/2 square drive

Style A - Standard duty

Design (a) 6-point heads

Design (b) 12-point heads

1.1.2 Type 2 - Flare Nut Wrenches

Class 1 - Double flare nut

Style A - Straight heads

Design (a) 6-point heads

Design (b) 12-point heads

Style B - 15-degree heads

Design (a) 6-point heads

Design (b) 12-point heads

Class 2 - Combination box end and flare nut

Style A - 6-point heads

Style B - 12-point heads

Class 3 - Combination open end and flare nut

Style A - 6-point heads

Style B - 12-point heads

Class 4 - Single flare nut

Style A - 6-point heads

Style B - 12-point heads

Class 5 - Ratcheting flare nut

Style A - 6-point heads

Style B - 12-point heads

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 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 +1 724-776-4970 (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

AS870 Wrenching Configuration, Bi-Hexagonal, (12 Point) Drive, Design Standard For

AS4984 Coating Requirements for Aerospace Hand Tools

SAE J514 Hydraulic Tube Fittings

2.2 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1 Surface Texture

ASME B107.4 Driving and Spindle Ends for Portable Hand, Air and Electric Tools

ASME B107.17 Gages and Mandrels for Wrench Openings

ASME 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 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials, Standard Methods of Test For

2.4 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 4095 Aerospace - Bihexagonal drives - Wrenching configuration - Metric series

ISO 8434-2 Hydraulic Tube Fittings

3. REQUIREMENTS

3.1 Illustrations

The illustrations shown herein are descriptive, not restrictive, and are not intended to preclude 6-point and 12-point flare nut crowfoot, flare nut wrenches, double end flare nut wrenches, combination box end and flare nut wrenches, combination open end and flare nut wrenches, and ratcheting flare nut wrenches which are otherwise in accordance with this document.

3.2 Materials

Unless otherwise specified hereinafter, the materials used in the manufacture of the wrenches shall be steel, the chemical composition and heat treatment of which shall be such as to produce tools conforming to the physical requirements specified herein. Powdered metal or cast steel shall not be used for the wrench body. Powdered metal or metal injection molding parts are permitted to use for internal components in the ratcheting end of Type 2, Class 5 wrenches.

3.3 Marking

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

3.4 Square Drive Ends

3.4.1 Drive End Dimensions

Internal drive end dimensions shall conform to ASME B107.4. External drive tangs in accordance with ASME B107.4 shall be used to judge the following requirements:

3.4.1.1 Internal Drive Opening

All internal drive openings shall be broached or formed in a smooth and well-defined manner. Tools having internal drive openings shall be firmly attachable to corresponding size external drive tangs by one of the following retention methods. For Type 1 Crowfoot Wrenches, if the internal drive end thickness is less than twice the dimension Df in ASME B107.4 "Square Drive Specifications for Hand, Power, and Impact Wrenches - Internal End" table, the retention feature shall be centered in the internal drive opening within 0.010 inch (0.25 mm). Two sides of the opening shall be parallel to the longitudinal axis of wrench within ± 3 degrees.

3.4.1.1.1 Detent Retention Feature

All four faces of the internal drive opening shall be recessed so that one of the recesses engages the spring-loaded steel ball on the corresponding external drive.

3.4.1.1.2 Cross-Hole Retention Feature

One or more of the faces of the internal drive opening shall be drilled with a cross-hole to engage the spring-loaded steel ball or plunger on the corresponding external drive.

3.4.2 Tang Engagement and Disengagement

The detachable Type 1 Crowfoot Wrenches shall be so designed that external drive tangs can be inserted into the corresponding internal drive openings without undue force and shall be manually detachable without the use of any tools or keys and meet the minimum force requirements to remove the external drive tang as specified in applicable tables of ASME B107.4. Binding between surfaces and corners shall not be evident.

3.5 Internal Wrenching Configuration

3.5.1 Wrench Design

The internal wrench design of all Type I Crowfoot Flare Nut and Type II Flare Nut Wrenches shall be of a 6-point single-hexagon or 12-point double-hexagon configuration, and when mated with double-hexagon fasteners conforming to the requirements of AS870 or ISO 4095, or single-hexagon hydraulic tube fittings that conform to the requirements of SAE J514 and ISO 8434-2, will transmit torque to the fastener without bearing on the outer 5% of the fastener's wrenching points (see Figure 1).

3.5.2 Wrench Design Verification Test

Conformance of the wrench design to the requirements of 3.5.1 shall be demonstrated on a sample tool by the use of a mandrel or a template. The mandrel or template shall conform to the requirements of Figure 2 and Table 1.

NOTE: $H = 1/2 \text{ (NOMINAL HEX) } (1/\cos(30^\circ) - 1/\cos(15^\circ))$

$H = (.0597) \text{ (NOMINAL HEX)}$

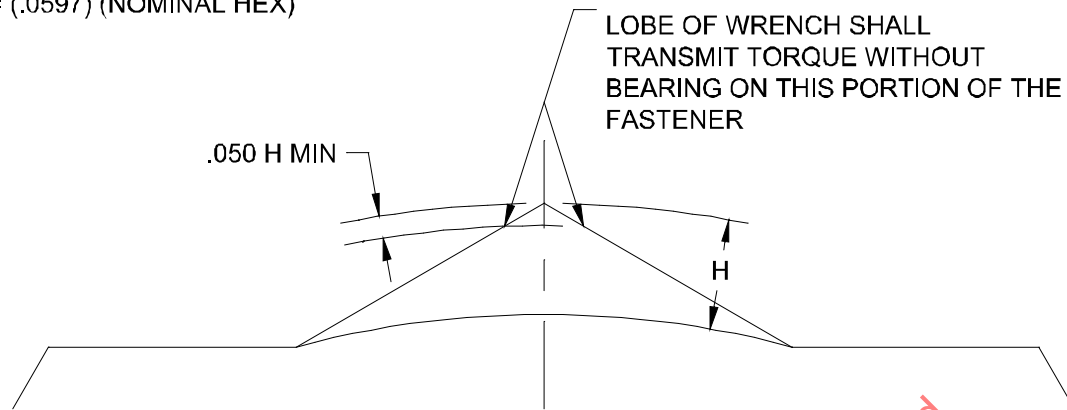
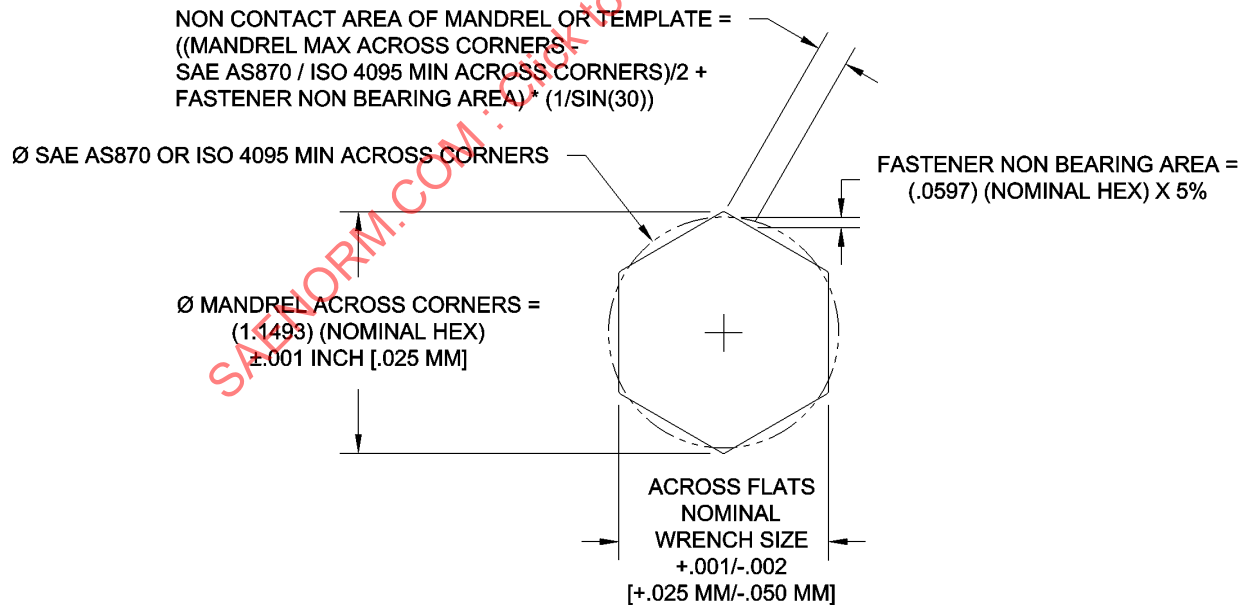


Figure 1 - Internal wrench engagement

- 3.5.2.1 The mandrel shall be of a nonferrous or ferrous material. When nonferrous material is used, torque shall be applied by the wrench to the mandrel to a level sufficient to cause an impression on the mandrel indicative of the loading pattern between the wrench and mandrel. When ferrous material is used, bluing shall be applied to the flats of the mandrel prior to the application of torque by the wrench to the mandrel to a level sufficient for the bluing to show the loading pattern. Care should be taken so that the true loading pattern can be discerned. The loading pattern shall not be on the corners of the mandrel.
- 3.5.2.2 The template shall be used in conjunction with an optical comparator. The centerline of the wrench configuration shall be placed on the centerline of the template and rotated until a point of contact between the wrench configuration and the template is established. The point of contact shall not be on the corners of the template.



NOTE: DRAWING NOT TO SCALE FOR PURPOSE OF CLARITY

Figure 2 - Mandrel for wrench design verification test

Table 1 - Hexagon mandrel or template dimensions for wrench design verification test**Table 1A - Wrench design verification test mandrel/template - inch sizes, primary dimensions in inches**

Nominal Wrench Size	Hexagon Across Flats Min (inches)	Hexagon Across Flats Max (inches)	Hexagon Across Corners Min (inches)	Hexagon Across Corners Max (inches)	AS870 Across Corners (A Min) Min (inches)	Non-Bearing Area Min (inches)	Non-Contact Area Min (inches)	Non-Contact Area Min (millimeters)
3/16	0.1855	0.1880	0.214	0.216	0.209	0.0006	0.008	0.20
7/32	0.2168	0.2193	0.250	0.252	0.244	0.0007	0.009	0.23
1/4	0.2480	0.2505	0.286	0.288	0.278	0.0007	0.011	0.28
9/32	0.2792	0.2818	0.322	0.324	0.313	0.0008	0.013	0.33
5/16	0.3105	0.3130	0.358	0.360	0.348	0.0009	0.014	0.36
11/32	0.3418	0.3443	0.394	0.396	0.385	0.0010	0.013	0.33
3/8	0.3730	0.3760	0.430	0.432	0.420	0.0011	0.014	0.36
7/16	0.4355	0.4385	0.502	0.504	0.490	0.0013	0.017	0.43
1/2	0.4980	0.5010	0.574	0.576	0.562	0.0015	0.017	0.43
9/16	0.5605	0.5635	0.645	0.647	0.632	0.0017	0.018	0.46
5/8	0.6230	0.6260	0.717	0.719	0.703	0.0019	0.020	0.51
11/16	0.6855	0.6885	0.789	0.791	0.775	0.0021	0.020	0.51
3/4	0.7480	0.7510	0.861	0.863	0.844	0.0022	0.023	0.58
25/32	0.7792	0.7822	0.897	0.899	0.879	0.0023	0.025	0.64
13/16	0.8105	0.8135	0.933	0.935	0.914	0.0024	0.026	0.66
7/8	0.8730	0.8760	1.005	1.007	0.986	0.0026	0.026	0.66
15/16	0.9355	0.9385	1.076	1.078	1.058	0.0028	0.026	0.66
1	0.9980	1.0010	1.148	1.150	1.129	0.0030	0.027	0.69
1-1/16	1.0605	1.0635	1.220	1.222	1.199	0.0032	0.029	0.74
1-1/8	1.1230	1.1260	1.292	1.294	1.271	0.0034	0.030	0.76
1-3/16	1.1855	1.1885	1.364	1.366	1.343	0.0035	0.030	0.76
1-1/4	1.2480	1.2510	1.436	1.438	1.409	0.0037	0.036	0.91
1-5/16	1.3105	1.3135	1.507	1.509	1.480	0.0039	0.037	0.94
1-3/8	1.3730	1.3760	1.579	1.581	1.552	0.0041	0.037	0.94
1-7/16	1.4355	1.4385	1.651	1.653	1.623	0.0043	0.039	0.99
1-1/2	1.4980	1.5010	1.723	1.725	1.694	0.0045	0.040	1.02
1-9/16	1.5605	1.5635	1.795	1.797	1.766	0.0047	0.040	1.02
1-5/8	1.6230	1.6260	1.867	1.869	1.837	0.0049	0.042	1.07
1-11/16	1.6855	1.6885	1.938	1.940	1.908	0.0050	0.042	1.07
1-3/4	1.7480	1.7510	2.010	2.012	1.979	0.0052	0.043	1.09

Table 1B - Wrench design verification test mandrel/template - metric sizes, primary dimensions in SI units

Nominal Wrench Size	Hexagon Across Flats Min (millimeters)	Hexagon Across Flats Max (millimeters)	Hexagon Across Corners Min (millimeters)	Hexagon Across Corners Max (millimeters)	ISO 4095 Across Corners (A Min) Min (millimeters)	Non-Bearing Area Min (millimeters)	Non-Contact Area Min (millimeters)	Non-Contact Area Min (inches)
5	4.950	5.015	5.720	5.770	5.54	0.015	0.24	0.010
5.5	5.450	5.515	6.295	6.345	6.11	0.016	0.24	0.010
6	5.950	6.025	6.875	6.925	6.67	0.018	0.27	0.011
7	6.950	7.025	8.025	8.075	7.77	0.021	0.32	0.013
8	7.950	8.025	9.165	9.215	8.91	0.024	0.33	0.013
9	8.950	9.025	10.315	10.365	10.04	0.027	0.35	0.014
10	9.950	10.025	11.465	11.515	11.18	0.030	0.37	0.015
11	10.950	11.025	12.615	12.665	12.28	0.033	0.43	0.017
12	11.950	12.025	13.765	13.815	13.42	0.036	0.44	0.017
13	12.950	13.025	14.915	14.965	14.51	0.039	0.51	0.020
14	13.950	14.025	16.065	16.115	15.65	0.042	0.52	0.021
15	14.950	15.025	17.215	17.265	16.79	0.045	0.54	0.021
16	15.950	16.025	18.365	18.415	17.93	0.048	0.56	0.022
17	16.950	17.025	19.515	19.565	19.07	0.051	0.57	0.023
18	17.950	18.025	20.665	20.715	20.21	0.054	0.59	0.023
19	18.950	19.025	21.815	21.865	21.28	0.057	0.67	0.026
20	19.950	20.025	22.965	23.015	22.42	0.060	0.69	0.027
21	20.950	21.025	24.115	24.165	23.56	0.063	0.71	0.028
22	21.950	22.025	25.255	25.305	24.70	0.066	0.71	0.028
23	22.950	23.025	26.405	26.455	25.84	0.069	0.73	0.029
24	23.950	24.025	27.555	27.605	26.98	0.072	0.74	0.029
25	24.950	25.025	28.705	28.755	28.12	0.075	0.76	0.030
26	25.950	26.025	29.855	29.905	29.26	0.078	0.78	0.031
27	26.950	27.025	31.005	31.055	30.40	0.081	0.79	0.031
28	27.950	28.025	32.155	32.205	31.54	0.084	0.81	0.032
29	28.950	29.025	33.305	33.355	32.68	0.087	0.82	0.032
30	29.950	30.025	34.455	34.505	33.82	0.090	0.84	0.033
32	31.950	32.025	36.755	36.805	36.04	0.096	0.93	0.037
34	33.950	34.025	39.055	39.105	38.32	0.101	0.96	0.038
36	35.950	36.025	41.345	41.395	40.60	0.107	0.98	0.039
41	40.950	41.025	47.095	47.145	46.30	0.122	1.06	0.042
46	45.950	46.025	52.845	52.895	52.00	0.137	1.14	0.045

3.5.3 Wrench Opening Tolerance

Wrench opening tolerance for box end, open end, flare nut, or both, shall be as specified in ASME B107.17.

3.6 Hardness

Unless otherwise specified, wrench body shall be hardened throughout to a Rockwell hardness of not less than 40 nor more than 54 on the "C" scale. Ratcheting gears shall be hardened to a Rockwell hardness of not less than 42 nor more than 56 on the "C" scale.

Hardness definitions, nomenclature, and procedures used herein can be found in ASTM E18. When grinding is necessary to prepare the test surface, the amount removed must not exceed 0.007 inch (0.18 mm) on the surface contacted by the indenter.

3.7 Finish

Wrenches shall be protected with one of the following three types as specified within AS4984.

Type I - Nickel chromium coatings

Type II - Black oxide, black phosphate, or other black finish coatings

Type III - Alternative coatings

3.7.1 Surface Finish Requirements for Nickel Chromium Coatings (Bright and Black)

Areas ground, buffed, or finished by an equivalent method shall be bright with 32 microinches maximum Ra for Type I wrenches. The remaining surfaces not ground or buffed shall be 250 microinches maximum Ra.

Microinch measurements shall be made with a surface-measuring instrument using a 0.030-inch (0.76-mm) roughness width cutoff. Definitions and nomenclature used herein can be found in ASME B46.1.

3.7.2 Surface Finish Requirements for Black Oxide, Black Phosphate, or Other Black Finish Coatings

The tools shall be coated with a chemically produced oxide or phosphate coating followed with a coating of preventive oil. Alternatively, the tools shall be coated with other black finish coatings such as black chrome coatings. Areas ground, buffed, or finished by an equivalent method shall have be 64 microinches maximum Ra for Type II wrenches. The remaining surfaces not ground or buffed shall be 250 microinches maximum Ra.

Microinch measurements shall be made with a surface-measuring instrument using a 0.030-inch (0.76-mm) roughness width cutoff. Definitions and nomenclature used herein can be found in ASME B46.1.

3.7.3 Surface Finish Requirements for Alternative Coatings

Areas ground, buffed, or finished by an equivalent method shall be bright with 32 microinches maximum Ra for Type I wrenches. The remaining surfaces not ground or buffed shall be 250 microinches maximum Ra.

Microinch measurements shall be made with a surface-measuring instrument using a 0.030-inch (0.76-mm) roughness width cutoff. Definitions and nomenclature used herein can be found in ASME B46.1.

3.7.4 Surface Condition

All external surfaces shall be free from pits, nodules, forge flash, burrs, cracks, and other detrimental defects. The external 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-inch (0.38-mm) radius minimum and shall not project more than 0.015 inch (0.38 mm) from adjacent surfaces.

3.8 Tests

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

3.8.2 All Type 2 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 Type 2, Class 2 wrenches and the open end on Type 2, Class 3 wrenches shall achieve the applicable torque loads as specified in ASME B107.100 (Category 6). Crowfoot wrenches shall achieve the applicable torque loads as specified in ASME B107.100 (Category 21), and Flare Nut wrenches shall achieve the applicable torque loads as specified in ASME B107.100 (Category 40). Type 1 Crowfoot Flare Nut wrenches are exempt from the aluminum mandrel test.

3.8.2.1 Aluminum Mandrel Test

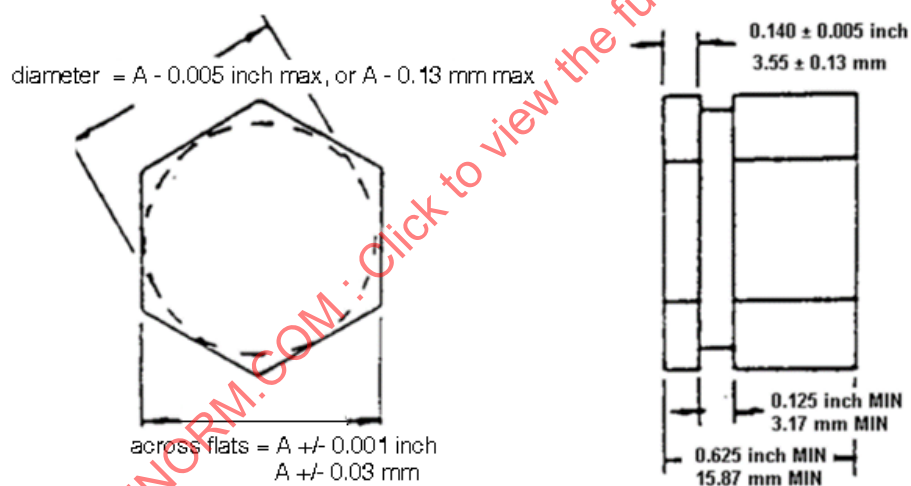
The flare nut(s) on wrenches shall achieve the torque loads in Tables 2A and 2B when subjected to the following: Mandrels constructed from aluminum, conforming to AMS4118 and to Tables 2A and 2B and Figure 3, shall be used. The wrench shall be placed on the mandrel and located centrally to the 0.140-inch (3.55-mm) long portion of the mandrel. See Figures 3 and 4. 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 4. This shall be done a total of three times on each mandrel, rotating the wrench 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 2 - Aluminum mandrel test requirements**Table 2A - Aluminum mandrel test - inch sizes, dimensions in inch units and SI units**

Wrench Size	Hexagonal Mandrel Across Flats "A" ±0.001 (inches)	Hexagonal Mandrel Across Flats "A" ±0.03 (millimeters)	Hexagonal Mandrel Across Corners Min (inches)	Hexagonal Mandrel Across Corners Min (millimeters)	Proof-Load (pound-force-inch)	Proof-Load (N·m)
3/8	0.375	9.53	0.423	10.74	180	20
7/16	0.438	11.13	0.493	12.52	260	29
1/2	0.500	12.70	0.563	14.31	320	36
9/16	0.563	14.27	0.634	16.10	380	43
5/8	0.625	15.88	0.704	17.89	450	51
11/16	0.688	17.48	0.775	19.68	560	63
3/4	0.750	19.05	0.845	21.47	675	76
13/16	0.813	20.62	0.916	23.26	775	88
7/8	0.875	22.23	0.986	25.05	850	96
15/16	0.938	23.83	1.056	26.84	960	108
1	1.000	25.40	1.127	28.63	1050	119
1-1/16	1.063	26.97	1.197	30.41	1175	133
1-1/8	1.125	28.58	1.268	32.20	1300	147
1-3/16	1.188	30.18	1.338	33.99	1410	159
1-1/4	1.250	31.75	1.409	35.78	1525	172
1-5/16	1.313	33.32	1.479	37.57	1640	185
1 3/8	1.375	34.93	1.550	39.36	1750	198
1-7/16	1.438	36.53	1.620	41.15	1890	214
1-1/2	1.500	38.10	1.690	42.94	2025	229
1-9/16	1.563	39.67	1.761	44.73	2230	252
1-5/8	1.625	41.28	1.831	46.52	2430	275
1-11/16	1.688	42.88	1.902	48.31	2600	294
1-3/4	1.750	44.45	1.972	50.10	2850	322
1-13/16	1.813	46.04	2.043	51.88	2990	338
1-7/8	1.875	47.63	2.113	53.67	3400	384
1-15/16	1.938	49.21	2.184	55.46	3950	446
2	2.000	50.80	2.254	57.25	4500	508
2-1/8	2.125	53.98	2.395	60.83	4500	508
2-1/4	2.250	57.15	2.536	64.41	4500	508
2-3/8	2.375	60.33	2.677	67.99	4500	508
2-5/8	2.625	66.68	2.958	75.14	4500	508
2-3/4	2.750	69.85	3.099	78.72	4500	508
2-7/8	2.875	73.03	3.240	82.30	4500	508

Table 2B - Aluminum mandrel test - metric sizes, dimensions in SI units and in inch units

Wrench Size	Hexagonal Mandrel Across Flats "A" ±0.03 (millimeters)	Hexagonal Mandrel Across Flats "A" ±0.001 (inches)	Hexagonal Mandrel Across Corners Min (millimeters)	Hexagonal Mandrel Across Corners Min (inches)	Proof-Load (N·m)	Proof-Load (pound-force-inch)
7	7.00	0.276	7.79	0.307	8.0	70.8
8	8.00	0.315	8.95	0.352	15.8	139.8
9	9.00	0.354	10.11	0.398	20.3	179.7
10	10.00	0.394	11.27	0.444	24.9	220.3
11	11.00	0.433	12.40	0.488	29.4	260.2
12	12.00	0.472	13.53	0.533	33.5	296.5
13	13.00	0.512	14.67	0.578	38.0	336.3
14	14.00	0.551	15.80	0.622	42.9	379.7
15	15.00	0.591	16.92	0.666	46.9	415.1
16	16.00	0.630	18.06	0.711	53.1	470.0
17	17.00	0.669	19.20	0.756	59.3	524.9
18	18.00	0.709	20.35	0.801	67.8	600.1
19	19.00	0.748	21.49	0.846	76.2	674.4
20	20.00	0.787	22.46	0.884	81.9	724.9
21	21.00	0.827	23.78	0.936	87.6	775.3

**Figure 3 - Specimen for aluminum mandrel test**

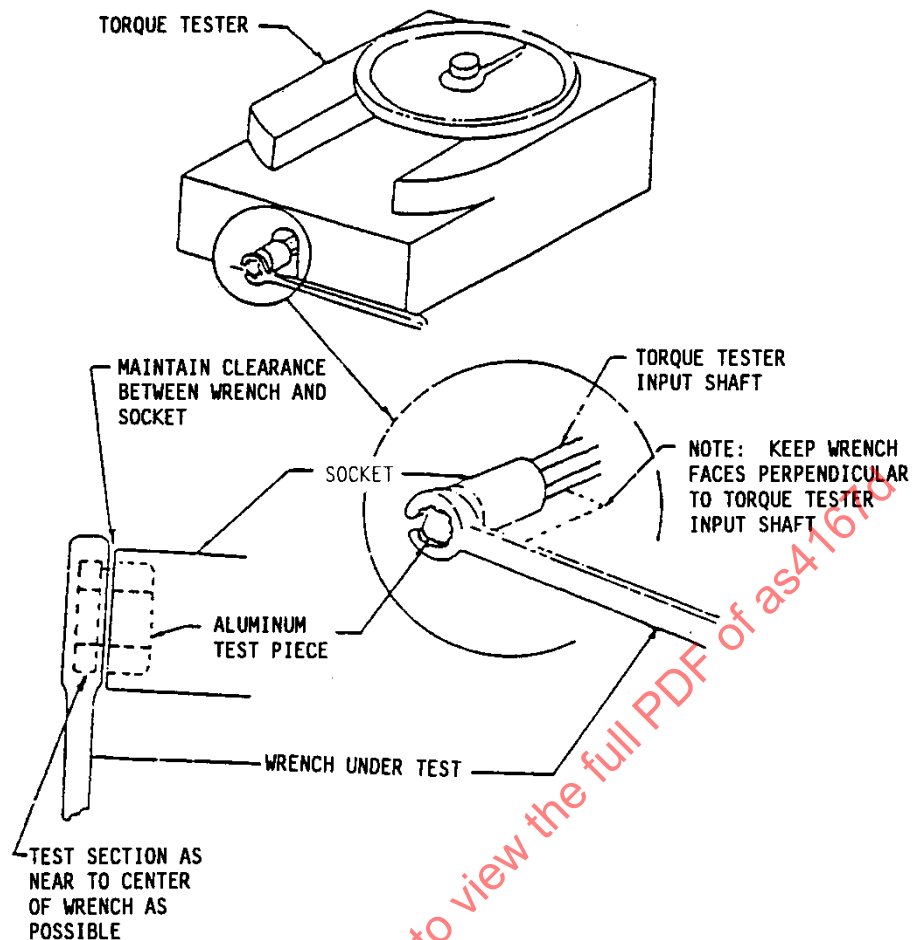


Figure 4 - Typical test setup for aluminum mandrel test

3.8.3 Tube Fitting Distortion Test

The flare nut(s) on wrenches shall achieve the torque loads in Tables 3A and 3B without distortion of tube fitting nut when subjected to the following:

Tube fitting nuts should be made from carbon steel with Style "B" thread sizes given in Tables 3A and 3B. Place a socket of the same hex size as the flare nut to be tested on a torque tester. See Figure 5. The tube fitting nuts should conform to the requirements of SAE J514 or ISO 8434-2. Insert into the socket a tube fitting nut with the corresponding hex size. Tube fitting nuts should pass the Class 2B GO and NO-GO thread gages. If the NO-GO end of the gage enters into the nut, it shall not bottom. The fitting nuts should be free of imperfections, and the GO gage should turn freely the full length of the fitting nuts. A light oil should be used on the threads for this test to minimize thread variables. After threading the GO gage to the bottom of the nut, the gage should be backed up one full turn. The wrench should be placed on the fitting nut with the center of the wrench as near to the center of the fitting nut 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 inch, or 3.18 mm, insertion). The wrench shall then be loaded up to one half the torque load specified for the wrench given in Tables 3 and 4. This shall be done three times at one half torque. After each single torque cycle, rotate the wrench to the next gripping position of the wrench (e.g., 30 degrees for 12-point flare nut wrenches). (In the case of Class 5 ratcheting flare nut wrenches, this shall be to the next ratcheting position.) Then, while constantly rotating the GO 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 loaded up to the torque where the GO gage can no longer be turned by hand. Record the lowest torque that stopped the GO gage for each time. This procedure should be repeated a total of six times, rotating the wrench to the next gripping position of the wrench after each single torque cycle, as before. The three lowest torque readings, at which the GO thread gage can no longer be turned by hand, shall be averaged. This average value shall be no lower than the values specified in Tables 3A and 3B.

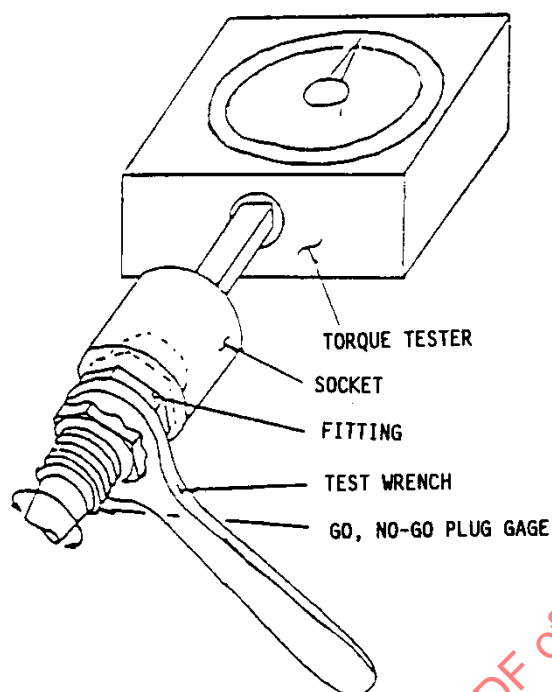


Figure 5 - Test setup for tube fitting distortion test

Table 3 - Tube fitting distortion test requirements

Table 3A - Tube fitting distortion test - inch sizes, proof loads in inch units and SI units

Nominal Wrench Size (inches)	Tube Fitting Thread Size (UNF/UN, Style B)	Tube OD (inches)	Proof-Load (pound-force-inch)	Proof-Load (N·m)
3/8	5/16-24	1/8	240	27
7/16	3/8-24	3/16	250	28
9/16	7/16-20	1/4	330	37
5/8	1/2-20	5/16	360	41
11/16	9/16-18	3/8	410	46
7/8	3/4-16	1/2	600	68
1	7/8-14	5/8	720	81

Table 3B - Tube fitting distortion test - metric sizes, proof loads in SI units and in inch units

Nominal Wrench Size (millimeters)	Tube Fitting Thread Size (UNF/UN, Style B)	Tube OD (millimeters)	Proof-Load (pound-force-inch)	Proof-Load (N·m)
9	5/16-24	3	240	27
11	3/8-24	4	250	28
14	7/16-20	6	330	37
16	1/2-20	8	360	41
18	9/16-18	10	410	46
22	3/4-16	12	600	68
25	7/8-14	16	720	81

4. DESIGNATIONS

AS4167 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 2, Style A Design (b) 5/8 inch opening would be a flare nut crowfoot with a 3/8 inch square drive, standard duty, and a 12-pt head having a 5/8 inch internal wrenching configuration.

5. CLASSIFICATION DESCRIPTIONS

5.1 Type I, Class 1 through 3, Style A and B wrenches shall be of the flare nut crowfoot design having an internal drive opening at one end and a slotted internal wrenching configuration at the other end.

5.1.1 Style A wrenches shall be similar to Figure 6 and conform to requirements of Tables 4A and 4B. The slotted portion of the internal wrenching configuration may be rotated up to 35 degrees from wrench centerline.

5.1.1.1 Design (a) wrenches shall have 6-point heads; Design (b) wrenches shall have 12-point heads.

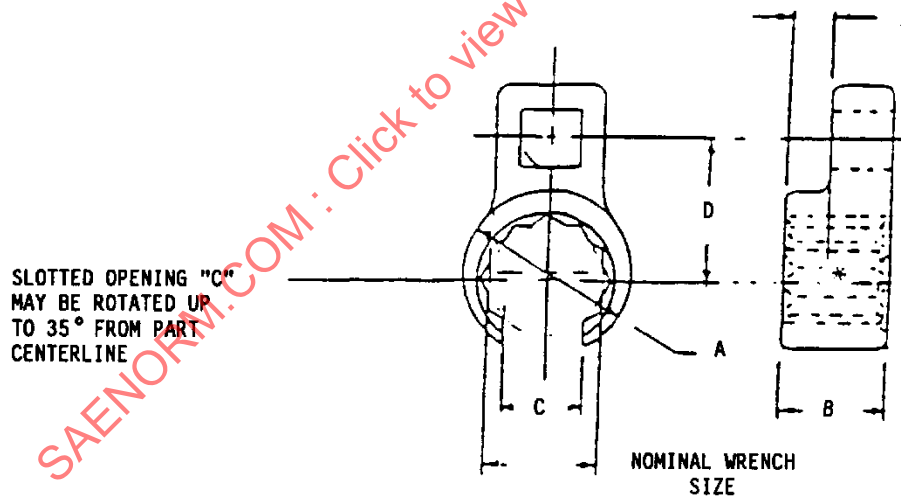


Figure 6 - Type I, Class 1 through 3, Style A crowfoot, flare nut (standard duty)

Table 4 - Type I, Class 1 through 3, Style A crowfoot, flare nut (standard duty)**Table 4A - Inch sizes, dimensions in inch units**

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

**Table 4B - Type I, Class 1 through 3, Style A crowfoot, flare nut
(standard duty) - inch sizes, dimensions in SI units**

Nominal Wrench Opening (inches)	Class Drive Size (inches)	Box End Diameter Max (millimeters) A	Box End Thickness Max (millimeters) B	Slotted Opening Min (millimeters) C	Torque Center Min (millimeters) D	Offset Min (millimeters) E
3/8	Class 1 (1/4 Sq. Dr.)	15.88	13.49	4.90	12.70	3.96
7/16	Class 1 (1/4 Sq. Dr.)	18.26	15.09	6.48	13.89	5.56
1/2	Class 1 (1/4 Sq. Dr.)	20.65	15.09	8.05	15.09	5.56
9/16	Class 1 (1/4 Sq. Dr.)	22.23	15.09	8.71	15.88	5.56
5/8	Class 2 (3/8 Sq. Dr.)	24.99	19.05	10.31	18.26	7.11
11/16	Class 2 (3/8 Sq. Dr.)	27.38	19.05	11.23	19.46	7.11
3/4	Class 2 (3/8 Sq. Dr.)	29.77	19.84	11.23	20.65	7.95
13/16	Class 2 (3/8 Sq. Dr.)	31.75	19.84	13.49	21.82	7.95
7/8	Class 2 (3/8 Sq. Dr.)	34.14	20.65	13.49	23.50	8.74
15/16	Class 2 (3/8 Sq. Dr.)	36.12	20.65	14.68	24.23	8.74
1	Class 2 (3/8 Sq. Dr.)	38.10	21.44	16.66	25.40	8.74
1-1/16	Class 2 (3/8 Sq. Dr.)	40.08	21.44	19.18	26.21	8.74
1-1/8	Class 3 (1/2 Sq. Dr.)	42.88	23.83	19.18	28.96	8.74
1-3/16	Class 3 (1/2 Sq. Dr.)	44.78	23.83	19.18	30.18	8.74
1-1/4	Class 3 (1/2 Sq. Dr.)	46.84	23.83	22.61	30.96	8.74
1-5/16	Class 3 (1/2 Sq. Dr.)	48.41	25.40	22.61	32.13	8.74
1-3/8	Class 3 (1/2 Sq. Dr.)	50.80	25.40	25.78	32.94	10.34
1-7/16	Class 3 (1/2 Sq. Dr.)	52.37	27.00	25.78	33.73	10.34
1-1/2	Class 3 (1/2 Sq. Dr.)	53.98	27.00	25.78	34.54	10.34
1-9/16	Class 3 (1/2 Sq. Dr.)	55.96	27.00	25.78	35.71	10.34
1-5/8	Class 3 (1/2 Sq. Dr.)	57.94	27.00	28.70	37.31	10.34
1-11/16	Class 3 (1/2 Sq. Dr.)	60.33	27.00	32.13	38.48	11.91
1-3/4	Class 3 (1/2 Sq. Dr.)	61.93	27.00	32.13	38.89	11.91
1-13/16	Class 3 (1/2 Sq. Dr.)	64.24	27.00	32.13	40.08	11.91
1-7/8	Class 3 (1/2 Sq. Dr.)	66.68	28.58	32.13	41.28	13.46
2	Class 3 (1/2 Sq. Dr.)	70.64	28.58	38.48	43.26	13.46
2-1/8	Class 3 (1/2 Sq. Dr.)	73.76	30.18	38.48	46.02	14.99
2-1/4	Class 3 (1/2 Sq. Dr.)	78.59	30.18	38.48	47.63	14.99
2-3/8	Class 3 (1/2 Sq. Dr.)	82.55	31.75	41.40	50.01	16.69
2-5/8	Class 3 (1/2 Sq. Dr.)	90.47	33.32	51.18	53.98	18.26
2-3/4	Class 3 (1/2 Sq. Dr.)	94.46	33.32	51.18	56.36	18.26

5.1.2 Style B wrenches shall be similar to Figure 7 and conform to requirements of Tables 5A and 5B. The slotted portion of the internal wrenching configuration may be rotated up to 35 degrees from wrench centerline.

5.1.2.1 Design (a) wrenches shall have 6-point heads; Design (b) wrenches shall have 12-point heads.

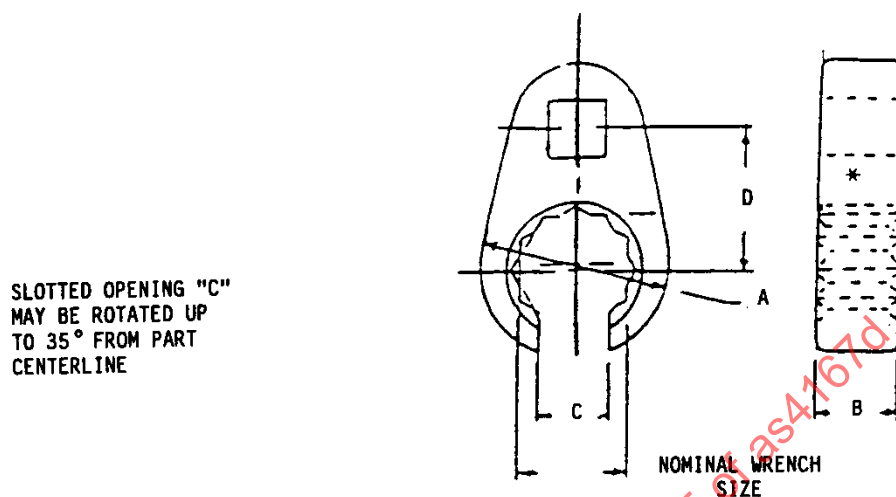


Figure 7 - Type I, Class 1 through 3, Style B crowfoot, flare nut, heavy duty

Table 5 - Type I, Class 1 through 3, Style B crowfoot, flare nut, heavy duty

Table 5A - Type I, Class 1 through 3, Style B crowfoot, flare nut, heavy duty - inch sizes, dimensions in inch units

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

Table 5B - Type I, Class 1 through 3, Style B crowfoot, flare nut, heavy duty - inch sizes, dimensions in SI units

Nominal Wrench Opening (inches)	Class Drive Size (inches)	Flare Nut Diameter Max (millimeters) A	Flare Nut Thickness Max (millimeters) B	Slotted Opening Min (millimeters) C	Torque Center Min (millimeters) D
3/8	Class 2 (3/8 Sq. Dr.)	22.63	10.31	4.90	14.30
7/16	Class 2 (3/8 Sq. Dr.)	25.40	10.31	6.48	14.30
1/2	Class 2 (3/8 Sq. Dr.)	27.79	11.89	8.05	14.30
9/16	Class 2 (3/8 Sq. Dr.)	30.96	11.89	8.71	19.05
5/8	Class 2 (3/8 Sq. Dr.)	30.96	11.89	10.31	19.05
11/16	Class 2 (3/8 Sq. Dr.)	35.71	13.11	11.23	20.65
3/4	Class 2 (3/8 Sq. Dr.)	35.71	13.11	11.23	20.65
13/16	Class 2 (3/8 Sq. Dr.)	43.66	15.06	13.49	22.23
7/8	Class 2 (3/8 Sq. Dr.)	43.66	15.06	13.49	22.23
15/16	Class 2 (3/8 Sq. Dr.)	50.39	16.28	14.68	23.01
1	Class 2 (3/8 Sq. Dr.)	50.39	16.28	16.66	23.01

5.2 Type 2 wrenches shall be of the flare nut design, in accordance with one of the following styles:

5.2.1 Class 1, 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 8 and conform to requirements of Tables 6A, 6B, 7A, and 7B. The slotted portion of the internal wrenching configuration may be rotated up to 35 degrees from the wrench centerline.

5.2.1.1 Style A wrenches shall have straight heads; Style B wrenches shall have heads at a 15-degree angle to the wrench beam.

5.2.1.1.1 Design (a) wrenches shall have 6-point heads; Design (b) wrenches shall have 12-point heads.

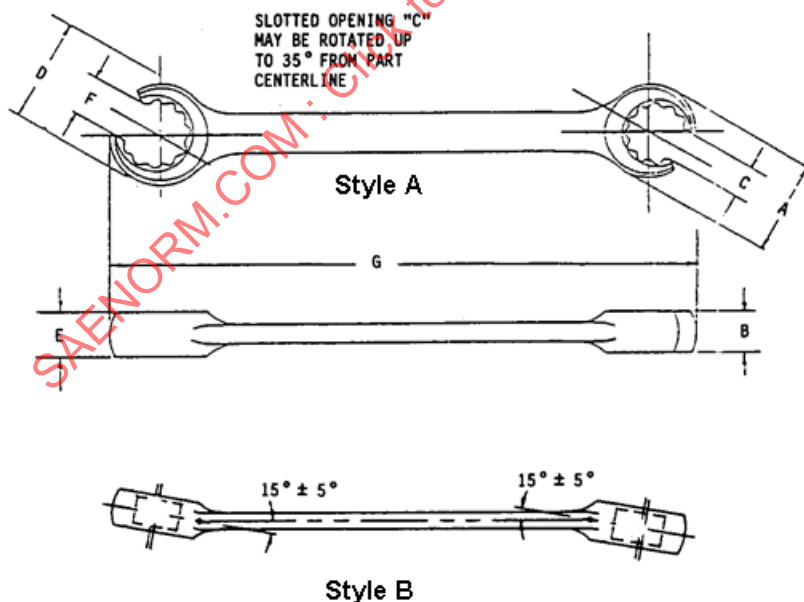
**Figure 8 - Type 2, Class 1, flare nut wrench, double flare nuts**

Table 6 - Type 2, Class 1, flare nut, double flare nuts (inches)**Table 6A - Type 2, Class 1, flare nut, double flare nuts - inch sizes, dimensions in inch units**

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

Table 6B - Type 2, Class 1, flare nut, double flare nuts - inch sizes, dimensions in SI units

Nominal Wrench Opening (inches)	Small Flare Nut Diameter Max (millimeters) A	Small Flare Nut Thickness Max (millimeters) B	Small Flare Nut Slot Opening Min (millimeters) C	Large Flare Nut Diameter Max (millimeters) D	Large Flare Nut Thickness Max (millimeters) E	Large Flare Nut Slot Opening Min (millimeters) F	Overall Length Min (millimeters) G
3/8 x 7/16	21.84	9.25	4.90	23.39	10.03	6.48	139.70
7/16 x 1/2	23.39	10.03	6.48	25.81	10.03	8.05	162.05
1/2 x 9/16	25.81	10.03	8.05	27.79	11.63	8.71	162.05
5/8 x 11/16	28.98	11.63	10.31	32.16	13.11	11.23	177.80
5/8 x 3/4	28.98	11.63	10.31	32.54	14.27	11.23	177.80
5/8 x 15/16	28.98	11.51	10.31	38.89	17.45	14.68	177.80
3/4 x 13/16	32.54	14.27	11.23	34.93	15.88	13.49	193.55
3/4 x 7/8	32.54	14.27	11.23	37.29	15.88	13.49	193.55
3/4 x 1	32.54	14.27	11.23	42.06	19.84	16.66	193.55
13/16 x 1-1/16	34.93	15.88	13.49	44.45	19.84	16.66	215.90
7/8 x 1	37.29	15.88	13.49	42.06	19.84	16.66	228.60
7/8 x 1-1/8	37.29	15.88	13.49	46.81	19.84	19.18	234.95

Table 7 - Type 2, Class 1, flare nut, double flare nuts (metric)**Table 7A - Type 2, Class 1, flare nut, double flare nuts - metric sizes, dimensions in SI units**

Nominal Wrench Opening (millimeters)	Small Flare Nut Diameter Max (millimeters) A	Small Flare Nut Thickness Max (millimeters) B	Small Flare Nut Slot Opening Min (millimeters) C	Large Flare Nut Diameter Max (millimeters) D	Large Flare Nut Thickness Max (millimeters) E	Large Flare Nut Slot Opening Min (millimeters) F	Overall Length Min (millimeters) G
7 x 8	17.30	7.30	4.80	18.90	8.30	5.60	127.00
7 x 9	17.30	7.30	4.80	21.90	9.20	5.80	127.00
8 x 10	18.90	8.30	5.60	22.90	10.20	6.60	127.00
9 x 11	21.90	9.20	5.80	23.50	10.20	7.30	127.00
10 x 12	22.90	10.20	6.60	25.20	10.20	8.10	140.00
11 x 13	23.50	10.20	7.30	25.70	10.20	8.60	140.00
12 x 14	25.20	10.20	8.10	27.60	11.70	9.90	157.00
13 x 14	25.70	10.20	8.60	27.60	11.70	9.90	157.00
15 x 17	28.50	11.70	10.40	31.80	13.20	11.60	173.00
16 x 18	30.00	12.50	11.00	31.80	13.20	11.60	181.00
18 x 20	31.80	13.20	11.60	33.80	14.00	14.80	194.00
19 x 21	32.80	14.00	13.90	35.10	14.80	15.70	194.00

Table 7B - Type 2, Class 1, flare nut, double flare nuts - metric sizes, dimensions in inch units

Nominal Wrench Opening (millimeters)	Small Flare Nut Diameter Max (inches) A	Small Flare Nut Thickness Max (inches) B	Small Flare Nut Slot Opening Min (inches) C	Large Flare Nut Diameter Max (inches) D	Large Flare Nut Thickness Max (inches) E	Large Flare Nut Slot Opening Min (inches) F	Overall Length Min (inches) G
7 x 8	0.681	0.287	0.189	0.744	0.327	0.220	5.000
7 x 9	0.681	0.287	0.189	0.862	0.362	0.228	5.000
8 x 10	0.744	0.327	0.220	0.902	0.402	0.260	5.000
9 x 11	0.862	0.362	0.228	0.925	0.402	0.287	5.000
10 x 12	0.902	0.402	0.260	0.992	0.402	0.319	5.512
11 x 13	0.925	0.402	0.287	1.012	0.402	0.339	5.512
12 x 14	0.992	0.402	0.319	1.087	0.461	0.390	6.181
13 x 14	1.012	0.402	0.339	1.087	0.461	0.390	6.181
15 x 17	1.122	0.461	0.409	1.252	0.520	0.457	6.811
16 x 18	1.181	0.492	0.433	1.252	0.520	0.457	7.126
18 x 20	1.252	0.520	0.457	1.331	0.551	0.583	7.638
19 x 21	1.291	0.551	0.547	1.382	0.583	0.618	7.638