SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS954 | REV. G

Issued 1967-06
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Revised 2011-12

Superseding AS954F

Wrenches, Hand, Twelve Point, High Strength, Thin Wall

RATIONALE

The update of AS954 is to incorporate improvements complied from committee findings after publication; consisting of appropriate range parameters within tables and proof/cyclic loads.

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1. SCOPE

This SAE Aerospace Standard (AS) covers high strength thin wall (commercial) sockets, universal sockets, box wrenches and torque adaptors which possess the strength, clearances, and internal wrenching design so configured that, when mated with 12-point fasteners conforming to the requirement of AS870, they shall transmit torque to the fastener without bearing on the outer 5% of the fastener's 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. The dimensional limits of box and combination wrench lengths have been established to provide configuration control for tool storage applications.

1.1 Classification

Wrenches, sockets, and adaptors covered by this AS shall be of the following types, classes, and styles, as specified:

1.1.1 Type I Sockets

Class 1 Sockets

Style A - Standard length

Style B - Long Length

Class 2 Universal Sockets (also known as Flexible Sockets)

1.1.2 Type II Wrenches, Box

Class 1 Angled End

Style A - Regular Length

Style B - Long Length

Class 2 Modified Offset

Style A - Regular Length

Style B - Short Length

Class 3 Deep Offset

Style A - Regular Length

Style B - Short Length

Class 4 Combination, Box and Open End Wrench

Style A - Regular Length

Style B - Short Length

1.1.3 Type III Torque Adaptors

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.

AS478N Identification Marking Methods

AS870D Wrenching Configuration, Double Hexagon (12-point) for Threaded Fasteners

AS4984A Coating Requirements for Aerospace Hand Tools

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.

ASME B46.1 Surface Texture

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

ASME B107.100 Flat Wrenches

ASME B107.17 Gages and Mandrels for Wrench Openings

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 E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials, Standard Methods of Test For

3. REQUIREMENTS

3.1 Illustrations

The illustrations shown herein are descriptive, not restrictive, and are not intended to preclude sockets, universal sockets, box wrenches, and torque adaptors which are otherwise in accordance with this document.

3.2 Materials

Unless otherwise specified hereinafter, the materials used in the manufacture of the sockets, universal sockets, box wrenches, and torque adaptors 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.

3.3 Marking

The sockets, universal sockets, box wrenches and torque adaptors shall be marked in a permanent manner with the nominal wrench opening size. In addition, the tools shall be marked with the country of origin and the manufacturer's name or with a trademark of known character that the source of manufacture may be determined. Marking requirement shall be in accordance with AS478N.

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 methods.

3.4.1.1.1 Detent

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. For Type III, if the internal drive end thickness is less than twice the dimension Df in Table 7 of ASME B107.4, the recess shall be centered in the internal drive opening within 0.010 in.

3.4.1.1.2 Cross-hole

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. For Type III, if the internal drive end thickness is less than twice the dimension Df in Table 7 of ASME B107.4, the cross-hole(s) shall be centered in the internal drive opening within 0.010 in.

3.4.2 Tang Engagement and Disengagement

The detachable sockets, universal sockets and torque adaptors shall be so designed that external tangs can be inserted into the corresponding internal 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 tang as specified in applicable tables of ASME B107.4. Binding between surfaces and corners shall not be evident.

3.5 Hardness

Unless otherwise specified herein, sockets, universal sockets, box wrenches and torque adaptors shall be hardened throughout to a Rockwell hardness of not less than 40 nor more than 54 on the "C" scale. Hardness definitions, nomenclature and procedures used herein can be found in ASTM E 18. 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.

3.6 Finish Wrenches shall be protected with one of the following three types as specified within AS4984A

Type I - Nickel Chromium coating

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

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

3.6.1 Surface Finish Requirements of Nickel Chromium Plate

On all Type I sockets and universal sockets, the outer longitudinal surface or major diameter thereof shall be bright with 30 µin maximum Ra, except where knurled or grooved. The remaining exterior longitudinal socket surface shall be 150 µin maximum Ra. On all Type II box wrenches and Type III torque adaptors, a minimum of 180 degrees of the outer periphery of the box ends (90 degrees on each side of the longitudinal axis of the wrench) shall be 30 µin maximum Ra. Microinch measurements shall be made with a surface-measuring instrument using a 0.030 in roughness width cutoff. Definitions and nomenclature usedherein can be found in ASME B46.1

3.6.2 Black Oxide or Phosphate Treatment

The tools shall be coated with a chemically produced oxide or phosphate coating followed with a coating of rust preventive oil. All external surfaces shall have a maximum Ra roughness height value of 250 µin. Microinch measurements shall be made with a surface-measuring instrument using a 0.030 in roughness width cutoff. Definitions and nomenclature usedherein can be found in ASME B46.1

3.6.3 Surface Condition

All external surfaces shall be free from pits, nodules, forge flash, burrs, cracks, and other detrimental defects. The external forge flash shall blend smoothly with adjacent surfaces except that the forge flash shall be completely removed from the periphery of the heads of box wrenches and torque adaptors and from that portion of the handle which shall be essentially straight and uniform in section dimensions.

3.7 Test Proof Load

Torque shall be applied with a suitable torque producing machine. Torque shall be applied at a speed of 15deg/min to 30deg/min until proof load value is achieved; test load shall be held for 10 seconds, then torque shall be released. This proof load test shall be performed in the clockwise and counter clockwise direction. The items covered herein shall withstand the proof loads set forth in the applicable tables, without failure or permanent deformation (set) which might affect durability or serviceability of the tools. Adequate safeguards for personnel and property shall be employed in conducting all tests. Approved eye protection shall be worn at all times and equipment safety shields in place when tests are in progress.

3.7.1 Mandrels for Wrench Openings

Wrench openings shall be tested on hexagonal mandrels. The size of all mandrels shall conform to the dimensions and tolerances specified in Table 1. The fourth column of Table 1 (Mandrel Engagement Maximum Depth) does not apply when testing Type II, Wrenches and Type III, Torque Adaptors.

Mandrels shall be hardened to a Rockwell hardness of not less than 55 on the "C" scale and shall have smoothly finished wrench engagement surfaces.

TABLE 1 - HEXAGON MANDREL DIMENSIONS AND ENGAGEMENT DATA

For Wrench Sizes	Nominal Wrench Opening	Hexagonal Mandrel Across Flats Tolerances		Mandrel Engagement Maximum Depth of Insertion	No Bearing Area for Mandrel (Ref)
3/16	0.1875	+0.001	-0.002	0.094	0.0006
7/32	0.2188	+0.001	-0.002	0.109	0.0007
1/4	0.2500	+0.001	-0.002	0.125	0.0007
9/32	0.2812	+0.001	-0.002	0.141	0.0008
5/16	0.3125	+0.001	-0.002	0.141	0.0009
11/32	0.3438	+0.001	-0.002	0.156	0.0010
3/8	0.3750	+0.001	-0.002	0.156	0.0011
7/16	0.4375	+0.001	-0.002	0.218	0.0013
1/2	0.5000	+0.001	-0.003	0.265	0.0015
9/16	0.5625	+0.001	-0.003	0.328	0.0017
5/8	0.6250	+0.001	-0.003	0.375	0.0019
11/16	0.6875	+0.001	-0.003	0.375	0.0021
3/4	0.7500	+0.001	-0.003	0.437	0.0022
25/32	0.7812	+0.001	-0.003	0.453	0.0023
13/16	0.8125	+0.001	-0.003	0.453	0.0024
7/8	0.8750	+0.001	-0.003	0.500	0.0026
15/16	0.9375	+0.001	-0.003	0.546	0.0028
1	1.0000	+0.001	-0.003	0.546	0.0030
1-1/16	1.0625	+0.001	-0.003	0.625	0.0032
1/18	1.1250	+0.001	-0.003	0.656	0.0034
1-3/16	1.1875	+0.001	-0.003	0.656	0.0035
1-1/4	1.2500	+0.001	-0.003	0.750	0.0037
1-5/16	1.3125	+0.001	-0.003	0.765	0.0039
1-3/8	1.3750	+0.001	-0.003	0.781	0.0041
1-7/16	1.4375	+0.001	-0.003	0.875	0.0043
1-1/2	1.5000	+0.001	-0.003	0.875	0.0045
1-9/16	1.5625	+0.001	-0.007	0.875	0.0047
1-5/8	1.6250	+0.001	-0.007	1.000	0.0049
1-11/16	1.6875	+0.001	-0.007	1.000	0.0050
1-3/4	1.7500	+0.001	-0.007	1.093	0.0052

3.7.2 Test Plug

3.7.2.1 Type I, Class 1 Sockets

A square test plug of suitable strength and complying with the minimum dimensional requirements of the external drive tang specified in ASME B107.4 shall be employed. The test plug may be driven by any suitable manual or mechanical means. The socket shall then be engaged on the end of the mandrel to a maximum depth in accordance with Table 1. A stop may be set at the outer end of the test plug to prevent slippage of the socket end-wise from the mandrel.

3.7.2.2 Type I, Class 2 Universal Sockets

A test plug as in 3.7.2.1 shall be used except that a means shall be provided to keep universal socket parts in the axis about which the load is applied.

3.7.3 Qualification Test

3.7.3.1 All Type I Sockets, Type II Wrenches, Type III Torque Adaptors

As a design and process qualification test the manufacturer shall maintain a record of compliance with the cyclic load requirements with a sample tool conforming to the applicable Figures. The test shall be required whenever the design or method of manufacture is significantly changed.

The cycle load test shall consist of 2000 applications of the cyclic torque load both the clockwise and counter clockwise direction at the rate between 15 - 120 cycles per minute, using the Table 1 mandrel dimensions and engagements. The tool being tested shall be indexed 30 degrees after 1000 load applications and shall withstand the torques proof load following the cyclic load test. The cyclic load value for Type I Sockets is to be 70% of the proof load. The cyclic load value for Type II Wrenches and Type III Torque Adapters is located in the respective tables.

3.7.3.2 Fragmentation Test

One sample of each tool of Type I, II and III shall be loaded to failure. Failure shall not result in fragmentation into two or more pieces. The tool shall be considered to have passed the fragmentation test if it:

a. Fails without fragmentation at any torque above the proof load

b. Reaches the following maximum torque levels without failure

   1. 1/4 in square drive tools - 800 in-lbs
   2. 3/8 in square drive tools - 3000 in-lbs
   3. 1/2 in square drive tools - 7800 in-lbs
   4. 3/4 in square drive tools - 21600 in-lbs

3.8 Wrench Opening

3.8.1 Wrench Design

The internal wrench design of all Type I Sockets, Type II Wrenches, and Type III Torque Adaptors shall be so configured that, when mated with 12-point fasteners conforming to the requirements of AS870D, they transmit torque to the fastener without bearing on the outer 5% of the fastener's wrenching points (see Figure 1A).

3.8.2 Qualification Test Procedure for Wrench Design

Conformance of the wrench design to the requirements of 3.8.1 shall be demonstrated on a sample tool by the use of a mandrel or a template. The mandrel or template shall conform with the requirements of Figure 1B.

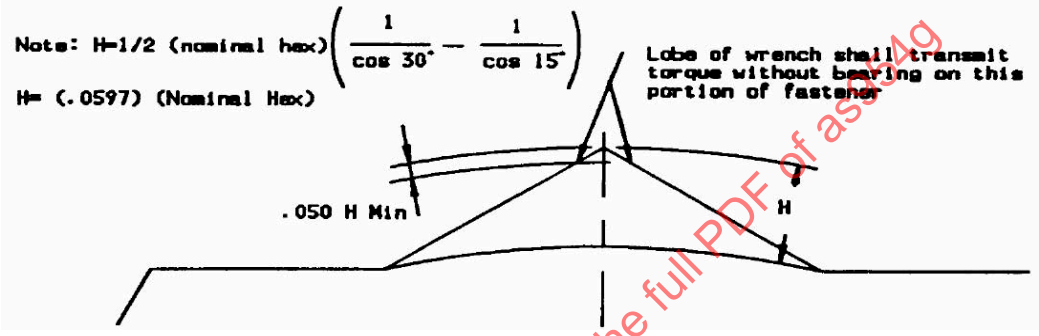


FIGURE 1A - INTERNAL WRENCH ENGAGEMENT

3.8.2.1 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

3.8.2.2 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.

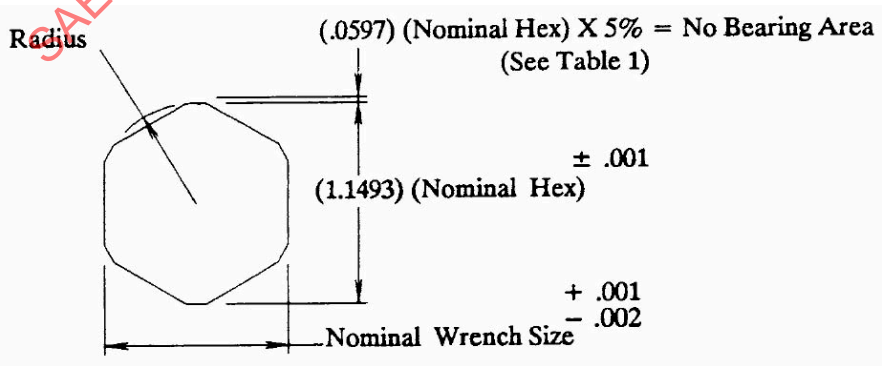
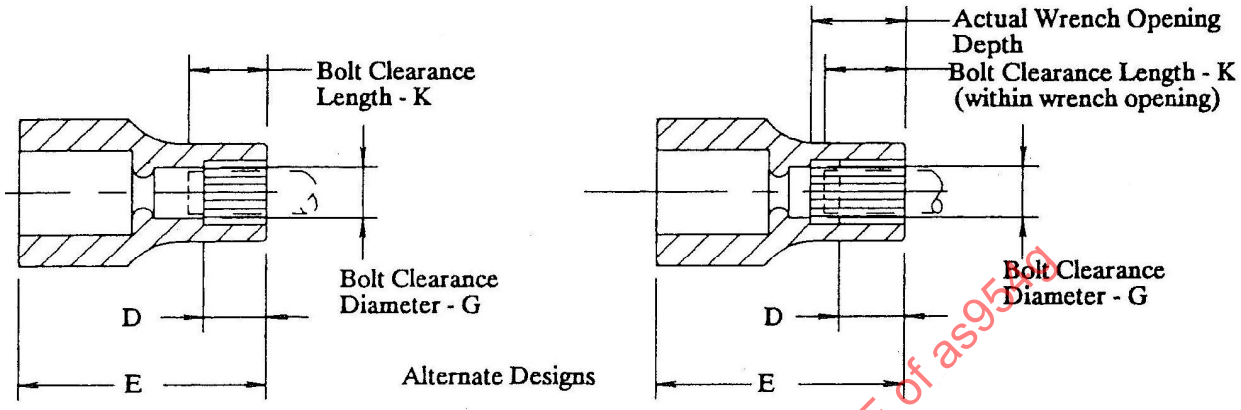


FIGURE 1B - MANDREL FOR WRENCH DESIGN TEST PROCEDURE

3.8.3 Bolt and Nut End Opening Tolerance

Wrench opening tolerance shall be as specified in ASME B107.17. The bolt clearance hole shall not infringe on the internal wrench design or alter its shape for the minimum depth of the wrench opening "D" in the appropriate figure.



For Type I, Class 1, Style A Sockets, G and K per Table 2

For Type I, Class 1, Style B Sockets, K=60% of E, G per Table 2

FIGURE 2A - BOLT CLEARANCE HOLE

3.8.4 Clearance Holes

3.8.4.1 Through Hole Clearance

A through clearance hole with a minimum diameter of 1/2 the nominal square drive size, or equal to the bolt clearance diameter, shall extend completely through each socket.

3.8.4.2 Bolt Clearance Hole

The bolt clearance hole shall be in accordance with the diameter, length and location defined in Figures 2A and 2B, and Table 2. The bolt clearance hole shall be measured using the gage in Figure 2C. A "web" within the bolt clearance hole is acceptable provided all dimensional requirements are met.

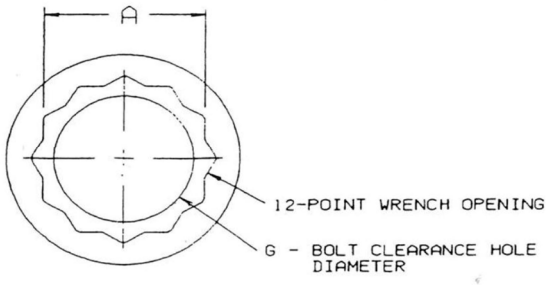


FIGURE 2B – BOLT CLEARANCE HOLE REQUIREMENT

TABLE 2 - BOLT CLEARANCE HOLE REQUIREMENTS

	A	G	K
WRENCH OPENING NOMINAL	ACROSS FLATS	BOLT CLEARANCE DIAMETER MIN.	BOLT CLEARANCE LENGTH MIN.
3/16	0.1875	0.157	0.342
7/32	0.2188	0.190	0.357
1/4	0.2500	0.190	0.393
9/32	0.2812	0.250	0.429
5/16	0.3125	0.250	0.464
11/32	0.3438	0.313	0.515
3/8	0.3750	0.313	0.515
7/16	0.4375	0.375	0.595
1/2	0.5000	0.438	0.650
9/16	0.5625	0.500	0.655
5/8	0.6250	0.563	0.760
11/16	0.6875	0.625	0.833
3/4	0.7500	0.688	0.965
25/32	0.7813	0.688	0.995
13/16	0.8125	0.688	1.025
7/8	0.8750	0.750	1.129
15/16	0.9375	0.813	1.179
1	1.0000	0.875	1.230
1-1/16	1.0625	0.938	1.250
1-1/8	1.1250	1.000	1.280
1-3/16	1.1875	1.063	1.290
1-1/4	1.2500	1.063	1.310
1-5/16	1.3125	1.125	1.340
1-3/8	1.3750	1.188	1.400
1-7/16	1.4375	1.250	1.450
1-1/2	1.5000	1.313	1.500
1-9/16	1.5625	1.375	1.550
1-5/8	1.6250	1.438	1.600
1-11/16	1.6875	1.500	1.650
1-3/4	1.7500	1.563	1.700

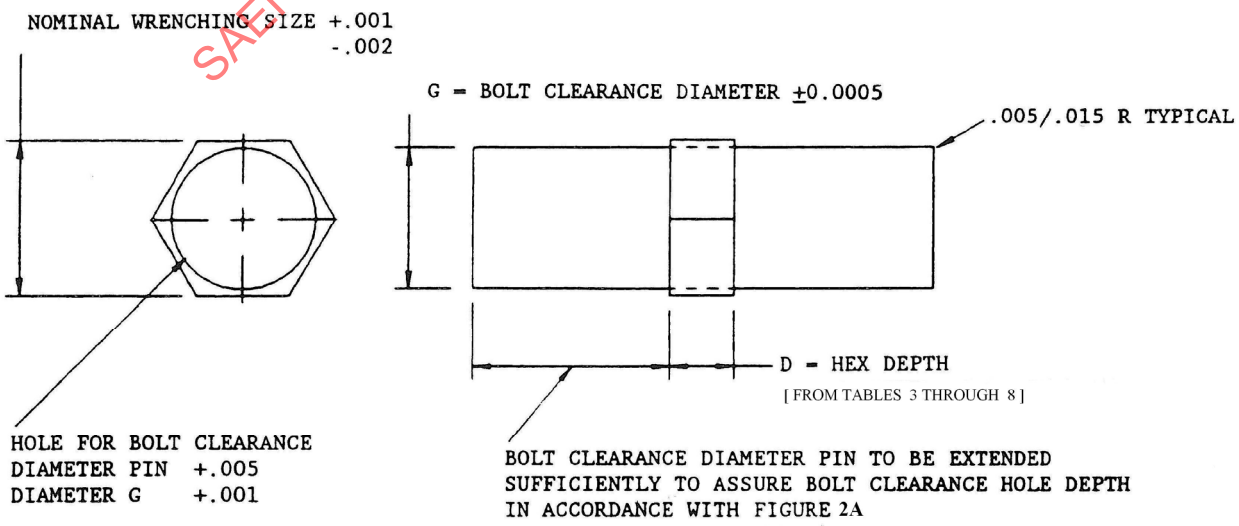


FIGURE 2C - BOLT CLEARANCE HOLE GAGE

3.9 Type I, Class 2, Universal Sockets

In addition to the requirements of 3.4, universal sockets shall be provided with a friction type device which will hold the drive end and the socket end in any set position with a force adequate to hold the universal joint against gravity. The hinge pin shall be solid and not extend beyond the periphery of the universal joint. The universal joint shall be capable of rotation in a complete arc when the angular deviation of either end member from the common centerline is 40 degrees. A bolt clearance hole and other universal socket dimensions shall conform to Figures 7 and Table 7, and Figure 8 and Table 8. A "web" within the bolt clearance hole is acceptable provided all dimensional requirements are met.

3.10 Type II Wrenches, Type III Torque Adaptors

3.10.1 Type II, Class 1 Box Wrench, Angled End

The angled end box wrenches shall be 12 point, double hexagon double-head design, shall possess the wrenching design of 3.8.1 and shall conform to Figures 9 and 11.

3.10.2 Type II, Class 2, Style A & B Box Wrench, Modified Offset

The modified offset box wrenches shall be 12-point, double hexagon double-head design, shall possess the wrenching design of 3.8.1 and shall conform to Figures 9 and 12.

3.10.3 Type II, Class 3, Style A & B Box Wrench, Deep Offset

The deep offset box wrenches shall be 12-point, double hexagon double-head design, shall possess the wrenching design of 3.8.1, and shall conform to Figures 9 and 13.

3.10.4 Type II, Class 4, Style A & B Box Wrench, Combination

The combination box and open end wrenches shall have a box wrench head on one end and an open end wrench on the other end. The box wrench head shall be 12-point, double hexagon with the wrenching design of 3.8.1 and shall conform to Figure 9 and Table 9. The open end wrench head shall conform to ASME B107.6 Type III in B107.100. The combination wrench shall conform to Figure 14.

3.10.5 Type III Torque Adaptor

Torque adaptors shall have a square drive at one end and a 12-point double hexagon box wrench with the wrenching design of 3.8.1 at the other end. One side of the square drive shall be within 3 degrees of parallel to a line drawn from the center of the drive through the center of the wrench opening. Torque adaptors shall conform to Figure 10 and Table 10.

3.11 Workmanship

All items covered herein shall be free from fins, burrs, external sharp or rough edges, corners, or surfaces and other defects which may impair their serviceability or durability. The inside edges of the sockets, box wrenches, and torque adaptors shall be chamfered.

3.11.1 Foreign Object Damage

It is important to avoid damage to aircraft due to foreign objects. Rips, tears, broaching slugs, burrs, slivers, plating peel and/or any material which could be removed during gaging, load testing, or normal use and/or any indications of rust shall be unacceptable.

4. NOTES

4.1 Revision Indicator

A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

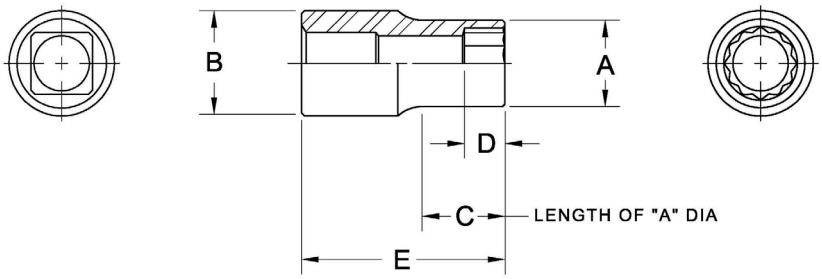


FIGURE 3 - TYPE I, CLASS I SOCKET STYLE A & B

TABLE 3 - TYPE I, CLASS 1 SOCKETS - 1/4 SQUARE DRIVE

NOMINAL WRENCH OPENING	DIA. A MAX.	DIA. B MAX.	DEPTH D MIN.	STYLE A REGULAR LENGTH		STYLE B LONG LENGTH		TORQUE REQUIREMENTS	
				C MIN.	E MAX.	C MIN.	E MIN.	CYCLIC LOAD (IN - LBS)	PROOF LOAD (IN - LBS)
3/16	0.315	0.440	0.175	0.175	1.270	0.175	1.930	140	200
7/32	0.343	0.440	0.190	0.190	1.270	0.190	1.930	150	225
1/4	0.380	0.440	0.205	0.205	1.270	0.205	1.930	210	300
9/32	0.430	0.440	0.215	0.215	1.270	0.215	1.930	260	375
5/16	0.470	0.470	0.250	- - - -	1.270	- - - -	1.930	310	450
11/32	0.500	0.500	0.265	- - - -	1.270	- - - -	1.930	360	525
3/8	0.550	0.550	0.265	- - - -	1.270	- - - -	1.930	420	600
7/16	0.635	0.635	0.345	- - - -	1.270	- - - -	1.930	420	600
1/2	0.687	0.687	0.350	- - - -	1.270	- - - -	1.930	420	600
9/16	0.750	0.750	0.355	- - - -	1.270	- - - -	1.930	420	600

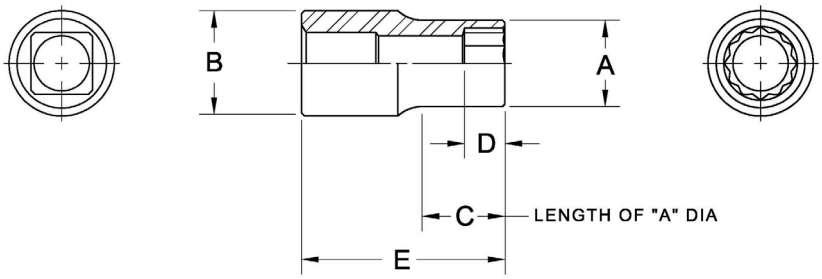


FIGURE 4 - TYPE I, CLASS I SOCKET STYLE A & B

TABLE 4 - TYPE I, CLASS 1 SOCKETS - 3/8 SQUARE DRIVE

NOMINAL WRENCH OPENING	DIA. A MAX.	DIA. B MAX.	DEPTH D MIN.	STYLE A REGULAR LENGTH		STYLE B LONG LENGTH		TORQUE REQUIREMENTS	
				C MIN.	E MAX.	C MIN.	E MIN.	CYCLIC LOAD (IN - LBS)	PROOF LOAD (IN - LBS)
1/4	0.400	0.690	0.205	0.205	1.270	0.205	1.930	210	300
9/32	0.435	0.690	0.215	0.215	1.270	0.215	1.930	260	375
5/16	0.470	0.690	0.250	0.265	1.270	0.265	1.930	310	450
11/32	0.499	0.690	0.265	0.265	1.270	0.265	1.930	470	675
3/8	0.550	0.690	0.265	0.265	1.520	0.265	1.930	630	900
7/16	0.660	0.690	0.345	0.345	1.520	0.345	1.930	870	1250
1/2	0.730	0.730	0.350	- - - -	1.780	- - - -	1.930	1680	2400
9/16	0.812	0.812	0.355	- - - -	1.780	- - - -	1.930	1750	2500
5/8	0.880	0.880	0.460	- - - -	1.780	- - - -	2.000	1750	2500
11/16	0.960	0.960	0.500	- - - -	1.780	- - - -	2.125	1750	2500
3/4	1.055	1.055	0.590	- - - -	1.780	- - - -	2.125	1750	2500
25/32	1.070	1.070	0.620	- - - -	1.780	- - - -	2.125	1750	2500
13/16	1.130	1.130	0.650	- - - -	1.780	- - - -	2.180	1750	2500
7/8	1.195	1.195	0.700	- - - -	1.780	- - - -	2.180	1750	2500
15/16	1.250	1.250	0.720	- - - -	1.780	- - - -	2.250	1750	2500
1	1.312	1.312	0.730	- - - -	1.780	- - - -	2.250	1750	2500

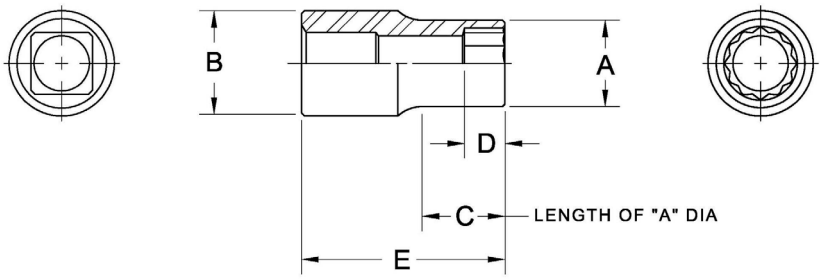


FIGURE 5 - TYPE I, CLASS I SOCKET STYLE A & B

TABLE 5 - TYPE 1, CLASS 1 SOCKETS 1/2" SQUARE DRIVE

NOMINAL WRENCH OPENING	DIA. A MAX.	DIA. B MAX.	DEPTH D MIN.	STYLE A REGULAR LENGTH		STYLE B LONG LENGTH		TORQUE REQUIREMENTS	
				C MIN.	E MAX.	C MIN.	E MIN.	CYCLIC LOAD (IN - LBS)	PROOF LOAD (IN - LBS)
3/8	0.580	0.880	0.265	0.265	1.780	0.265	2.930	840	1200
7/16	0.680	0.940	0.345	0.345	1.780	0.345	2.930	1190	1700
1/2	0.740	0.940	0.350	0.350	1.780	0.350	2.930	1680	2400
9/16	0.818	0.940	0.355	0.355	1.780	0.355	2.930	2520	3600
5/8	0.892	0.940	0.460	0.460	1.780	0.460	2.930	2800	4000
11/16	0.960	0.960	0.500	- - - -	1.780	- - - -	2.930	3850	5500
3/4	1.055	1.055	0.590	- - - -	1.780	- - - -	2.930	4200	6000
25/32	1.070	1.070	0.620	- - - -	1.780	- - - -	2.930	4200	6000
13/16	1.130	1.130	0.650	- - - -	1.780	- - - -	2.930	4200	6000
7/8	1.200	1.200	0.700	- - - -	1.850	- - - -	2.930	4200	6000
15/16	1.300	1.300	0.720	- - - -	1.900	- - - -	2.930	4200	6000
1	1.370	1.370	0.730	- - - -	1.950	- - - -	2.930	4200	6000
1-1/16	1.440	1.440	0.750	- - - -	1.970	- - - -	2.930	4200	6000
1-1/8	1.510	1.510	0.780	- - - -	2.000	- - - -	2.930	4200	6000
1-3/16	1.550	1.550	0.790	- - - -	2.030	- - - -	2.930	4200	6000
1-1/4	1.580	1.580	0.810	- - - -	2.050	- - - -	2.930	4200	6000
1-5/16	1.650	1.650	0.840	- - - -	2.070	- - - -	2.930	4200	6000

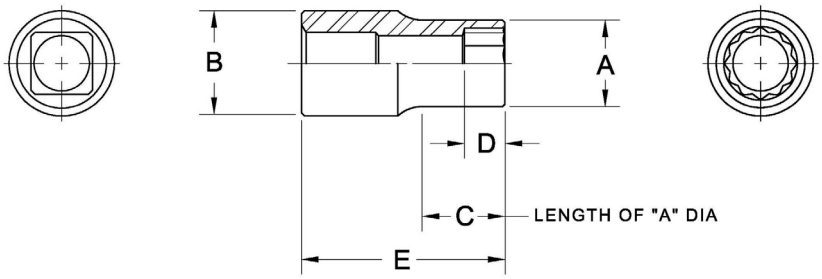
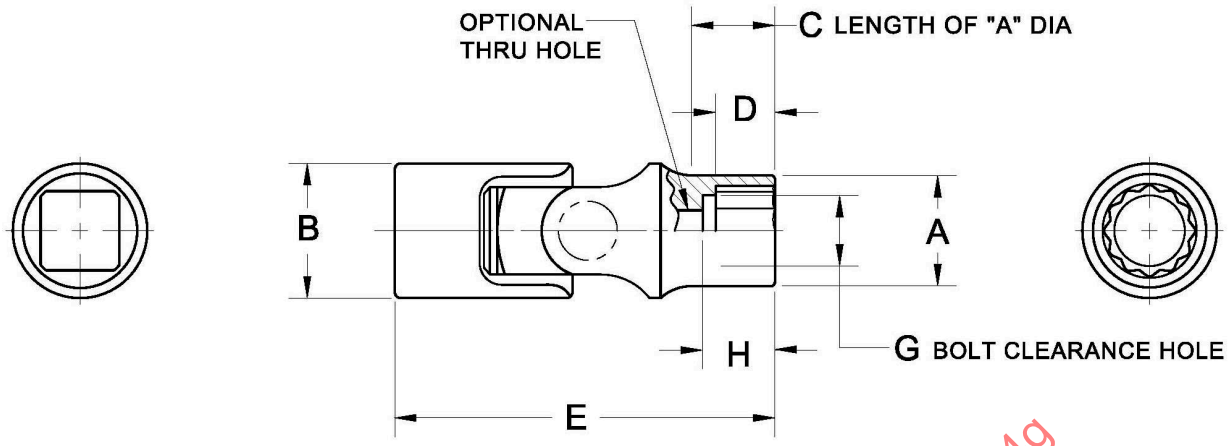


FIGURE 6 - TYPE I, CLASS I SOCKET STYLE A

TABLE 6 - TYPE I, CLASS 1 SOCKETS - 3/4 SQUARE DRIVE

NOMINAL WRENCH OPENING	DIA. A MAX.	DIA. B MAX.	DEPTH D MIN.	STYLE A REGULAR LENGTH		TORQUE REQUIREMENTS	
				C MIN.	E MAX.	CYCLIC LOAD (IN - LBS)	PROOF LOAD (IN - LBS)
3/4	1.200	1.500	0.590	0.737	2.300	7350	10500
13/16	1.295	1.500	0.650	0.813	2.300	7700	11000
7/8	1.340	1.500	0.700	0.875	2.300	10500	15000
15/16	1.420	1.500	0.720	0.900	2.300	11900	17000
1	1.510	1.575	0.730	0.938	2.300	12600	18000
1-1/16	1.575	1.575	0.750	- - - -	2.300	12600	18000
1-1/8	1.635	1.635	0.780	- - - -	2.350	12600	18000
1-3/16	1.700	1.700	0.790	- - - -	2.350	12600	18000
1-1/4	1.825	1.825	0.810	- - - -	2.400	12600	18000
1-5/16	1.920	1.920	0.840	- - - -	2.700	12600	18000
1- 3/8	1.980	1.980	0.900	- - - -	2.700	12600	18000
1-7/16	2.075	2.075	0.950	- - - -	2.700	12600	18000
1-1/2	2.135	2.135	1.000	- - - -	2.700	12600	18000
1-9/16	2.200	2.200	1.050	- - - -	2.700	12600	18000
1-5/8	2.270	2.270	1.100	- - - -	2.700	12600	18000
1-11/16	2.400	2.400	1.150	- - - -	3.200	12600	18000
1-3/4	2.510	2.510	1.200	- - - -	3.200	12600	18000

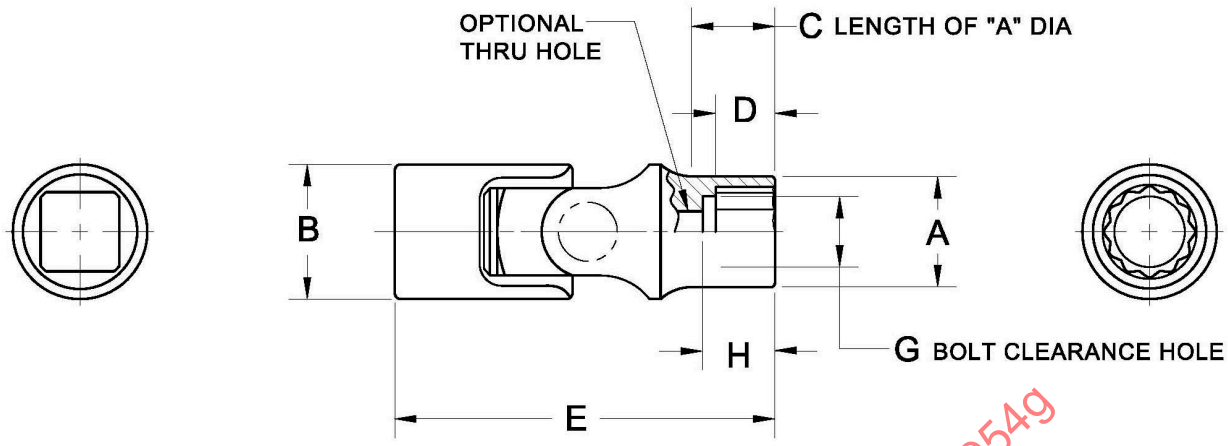


Refer to Table 2 for Bolt Clearance Hole Diameter

FIGURE 7 - TYPE I, CLASS 2 UNIVERSAL SOCKETS

TABLE 7 - TYPE 1, CLASS 2 UNIVERSAL SOCKETS - 1/4 SQUARE DRIVE

Nominal Wrench Opening	Nut End DIA A MAX.	Drive End DIA B MAX.	LENGTH C MIN.	DEPTH OPENING NUT END D MIN.	Overall Length E MAX.	BOLT CLEARANCE LENGTH H MIN.	CYCLIC TORQUE LOAD (IN - LBS) MIN.	PROOF TORQUE LOAD (IN - LBS) MIN.
1/4	0.385	0.515	0.205	0.205	1.312	0.330	210	300
5/16	0.470	0.515	0.250	0.250	1.437	0.408	310	450
3/8	0.540	0.540	0.265	0.265	1.500	0.437	350	500
7/16	0.625	0.540	0.345	0.345	1.625	0.545	350	500
1/2	0.687	0.540	0.350	0.350	1.688	0.550	350	500



Refer to Table 2 for Bolt Clearance Hole Diameter

FIGURE 8 - TYPE I, CLASS 2 UNIVERSAL SOCKETS

TABLE 8 - TYPE 1, CLASS 2 UNIVERSAL SOCKETS - 3/8 SQUARE DRIVE

Nominal Wrench Opening	Nut End DIA A MAX.	Drive End DIA B MAX.	LENGTH C MIN.	DEPTH OPENING NUT END D MIN.	Overall Length E MAX.	BOLT CLEARANCE LENGTH H MIN.	CYCLIC TORQUE LOAD (IN - LBS) MIN.	PROOF TORQUE LOAD (IN - LBS) MIN.
3/8	0.550	0.750	0.265	0.265	2.000	0.437	630	900
7/16	0.660	0.750	0.345	0.345	2.125	0.545	700	1000
1/2	0.730	0.750	0.350	0.350	2.187	0.550	700	1000
9/16	0.812	0.785	0.355	0.355	2.250	0.555	700	1000
5/8	0.880	0.785	0.460	0.460	2.250	0.660	700	1000
11/16	0.960	0.785	0.500	0.500	2.250	0.720	700	1000
3/4	1.055	0.785	0.590	0.590	2.312	0.810	700	1000

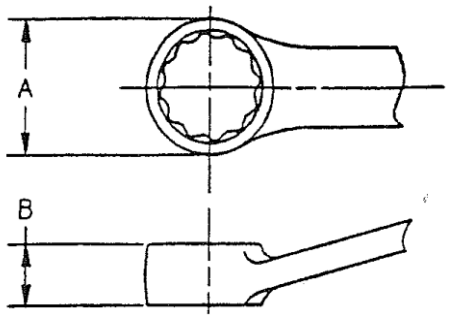


FIGURE 9 - TYPE II BOX WRENCH

TABLE 9 - TYPE II BOX WRENCH

NOMINAL WRENCH OPENING	TYPE II CLASS 1,2, 3		TYPE II CLASS 4		TYPE II TORQUE REQUIREMENTS			
					CLASS 1 & 4		CLASS 2 & 3	
	A MAX.	B MAX.	A MAX.	B MAX.	CYCLIC LOAD (IN LB)	PROOF LOAD (IN LB)	CYCLIC LOAD (IN LB)	PROOF LOAD (IN LB)
3/16	0.345	0.230	0.345	0.230	110	165	110	165
7/32	0.375	0.250	0.375	0.250	120	180	110	165
1/4	0.425	0.250	0.435	0.250	150	220	150	220
9/32	0.445	0.250	0.460	0.250	170	250	170	248
5/16	0.495	0.287	0.560	0.287	190	275	190	275
11/32	0.535	0.300	0.590	0.300	210	300	190	275
3/8	0.578	0.327	0.615	0.327	420	605	420	605
7/16	0.660	0.349	0.710	0.349	520	750	500	715
1/2	0.750	0.386	0.802	0.386	840	1200	710	1020
9/16	0.830	0.428	0.895	0.406	1150	1650	1050	1500
5/8	0.920	0.478	0.986	0.478	1540	2200	1540	2200
11/16	1.010	0.498	1.060	0.498	1840	2640	1840	2640
3/4	1.090	0.538	1.130	0.538	2100	3000	2000	2860
25/32	1.135	0.550	1.180	0.550	2200	3150	2160	3080
13/16	1.180	0.562	1.230	0.562	2310	3300	2310	3300
7/8	1.270	0.594	1.340	0.594	2590	3700	2540	3630
15/16	1.360	0.615	1.420	0.615	3220	4600	3160	4510
1	1.450	0.630	1.530	0.640	3850	5500	3770	5390
1-1/16	1.530	0.660	1.640	0.720	4200	6000	4160	5940
1-1/8	1.610	0.690	1.720	0.780	4620	6600	4540	6490
1-3/16	1.690	0.720	1.790	0.800	5110	7300	4540	6490
1-1/4	1.780	0.750	1.900	0.840	5600	8000	----	----
1-5/16	1.860	0.780	----	----	6300	9000	----	----
1-3/8	1.940	0.810	----	----	6650	9500	----	----
1-7/16	2.020	0.840	----	----	6820	9750	----	----
1-1/2	2.110	0.870	----	----	8400	12000	----	----