



**Society of Automotive Engineers, Inc.**  
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

# AEROSPACE STANDARD

## AS 954A

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### REVERSIBLE RATCHET HANDLES AND SOCKETS FLEXIBLE SOCKETS, BOX WRENCHES, TORQUE ADAPTERS, 12-POINT, HIGH STRENGTH, THIN WALL

#### 1. SCOPE AND CLASSIFICATION

- 1.1 **Scope:** This Aerospace Standard (AS) covers reversible ratchet handles and high strength thin wall commercial sockets, flexible sockets, box wrenches and torque adapters designed for general usage which possess the strength, clearances, and an internal wrenching design so configured that, when mated with 12-point fasteners conforming to the requirement of AS 870, they shall transmit torque to the fastener without bearing on the outer 5% of the fastener's wrenching points.
- 1.2 **Classification:** This AS covers only a limited number of sizes and combinations of sizes of the aforementioned items for which an aerospace engine need has been demonstrated and for which the commercial item manufacturers can meet all requirements of this AS.

#### 2. APPLICABLE DOCUMENTS

- 2.1 The following documents, of the issue in effect on the date of invitations for bids or request for proposal, form a part of this AS to the extent specified herein:
- 2.1.1 **Federal Standards:** Available from Commanding Officer Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.
- FED-STD-346 - Gauges, Wrench Openings
- 2.2 **Other Publications:** The following documents form a part of this AS to the extent specified herein. Unless a specific issue is identified, the issue in effect on the date of invitation for bids or request for proposal shall apply:
- 2.2.1 **American Society for Testing and Materials (ASTM) Standard:** Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
- E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials, Standard Methods of Test For.
- 2.2.2 **American National Standards Institute (ANSI), Inc., Standards:** Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
- B46.1 - Surface Texture.  
B107.4 - Driving and Spindle Ends for Portable Hand, Air and Electric Tools.
- 2.2.3 **SAE Publications:** Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.
- AS 478 - Identification - Marking Methods  
AS 870 - Wrenching Configuration, Double Hexagon (12-Point) for Threaded Fasteners

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### 3. REQUIREMENTS

- 3.1 Illustrations: The illustrations shown herein are descriptive and not restrictive and are included for the convenience of requisitioning and purchasing officers and manufacturers, and are not intended to preclude the purchase of sockets, flexible sockets, box wrenches, torque adapters and reversible ratchet handles which are otherwise in accordance with this standard.
- 3.2 Materials: Unless otherwise specified hereinafter, the materials used in the manufacture of the sockets, flexible sockets, box wrenches, torque adapters and reversible ratchet handles 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.
- 3.3 Marking: The sockets, flexible sockets, box wrenches, torque adapters and reversible ratchet handles shall be marked in a permanent manner with the manufacturer's name, or with a trademark of such known character that the source of manufacture may be readily determined. In addition, the tools shall be marked in a permanent manner with the nominal wrench opening (except for reversible ratchet handles). Marking requirement shall be in accordance with AS 478.
- 3.4 Manufacture and Design:
- 3.4.1 Drive End Dimensions: Male and female drive and dimensions shall conform to ANSI B107.4.
- 3.4.1.1 Male Drive Tangs: Male drive tangs shall be designed for square drive. The drive tangs shall have a smooth machined engaging surface. Each male drive tang shall be provided with a spring-loaded steel ball permanently staked in place and arranged to hold the mating sockets and attachments. Each male drive tang shall be shouldered at the flats to provide a positive stop for the tang.
- 3.4.1.2 Female Drive Opening: All female drive openings shall be broached or punched in a smooth and well defined manner. Tools having female drive openings shall be firmly attachable to corresponding size male drive tangs by the following methods:
- 3.4.1.2.1 On 3/8 In. and Larger Drive Openings: One or more faces of the female drive opening shall be drilled or recessed so that any recess or drilled hole shall engage the spring-loaded steel ball on the corresponding male drive. If only one or two faces of the female opening are recessed, the sockets shall be marked indicating the face of the opening which is recessed.
- 3.4.1.2.2 On 1/4 In. Drive Openings: One or more faces of the female drive opening may or may not be drilled or recessed, however, the minimum force required to remove tang as specified in ANSI B107.4 shall be met.
- 3.4.2 Edges and Corners: All edges and corners, capable of causing injury, not otherwise covered herein, shall have sharp edges removed by rounding, chamfering, or other means. The inside edges of the wrench opening shall be chamfered.
- 3.4.3 Tang Engagement and Disengagement: The detachable sockets, flexible sockets, torque adapters and reversible ratchet handles shall be so designed that male tangs can be inserted into the corresponding female 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 tang as specified in applicable tables of ANSI B107.4. Binding between surfaces and corners shall not be evident.
- 3.5 Hardness: Unless otherwise specified herein, sockets, flexible sockets, box wrenches, torque adapters and ratchet handles shall be hardened throughout to a Rockwell hardness of not less than 40 nor more than 54 on the "C" scale, except for ratchet drive tang which need not be hardened over more than the dimension "CM" as in Table X of ANSI B107.4. Hardness definitions, nomenclature and procedures used herein can be found in ASTM E18.

3.6 Finish:

3.6.1 Surface Roughness: All external surfaces shall be free from pits, nodules, forge flash, burrs, cracks, and other detrimental defects. The external forge flash shall be completely removed to 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 adapters and from that portion of the handle which shall be essentially straight and uniform in section dimensions. Maximum surface roughness values shall be determined by microinch values. Determination of microinch value shall be taken on a representative surface. Areas that are ground and buffed, or otherwise finished by an equivalent method, and provided with a coating finish of chromium shall have a uniform bright finish with a maximum roughness in microinches using a 0.030 in. roughness width cutoff on the surface measuring instrument, conforming to chart no. 1. Definitions and nomenclature used herein can be found in ANSI B46.1.

3.6.2 Coatings: The coatings shall be adherent, smooth, continuous and free from pits, blisters, nodules, and any other defects which would interfere with their protective value and serviceability. The maximum thickness of the coating shall be as specified in 3.6.2.1 on all external visible surfaces which can be touched by a ball 0.750 in. in diameter.

3.6.2.1 Chromium Plate: The coating shall be electrodeposited metals consisting of nickel, followed by chromium the minimum thickness of which shall be 0.0002 in. for nickel or iron-nickel and 0.00001 in. for chromium.

3.7 Test Loads: The items covered herein shall withstand the test load specified in the applicable tables without injury or permanent deformation (set) which might affect the durability or serviceability of the tools.

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 V. The OD of the hexagonal mandrel shall be reduced by 0.05H as shown on Fig. 1 to ensure that wrench lobe does not transmit torque on mandrel points. Mandrels shall be hardened to show a Rockwell hardness of not less than 55 on the "C" scale and shall have smoothly finished wrench engagement surfaces.

3.7.2 Test Plug:

3.7.2.1 Sockets: A square test plug of suitable strength and complying with the minimum dimensional requirements of the male drive tang specified in ANSI 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 a mandrel to a maximum depth in accordance with Table V. 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 Flexible Sockets: A test plug as in 3.7.3.1 shall be used except that a means shall be provided to keep flexible socket parts in the axes about which the load is applied.

3.7.3 Qualification Test:

3.7.3.1 Sockets, Flexible Sockets, Box Wrenches, Torque Adapters: Each sample tool tested shall be capable of withstanding 2000 applications of the minimum torque endurance load specified in the applicable table, and then the associated proof load when engaged per 3.7.1. After 250 applications on the mandrel, the tool shall be indexed 30 degrees.

3.7.3.2 Reversible Ratchet Handles: The ratchet mechanism shall withstand a cyclic test of 100,000 cycles, as specified in Table IV, without failure of the ratchet mechanism or loosening of screws or other parts of the handle. Following cyclic test, ratchet handle shall then be subjected to the proof load specified in Table IV and 3.12.2.

- 3.7.3.3 Integrity Test: One sample of each tool shall be loaded to failure. Failure shall not result in fragmentation.
- 3.8 Wrench Opening:
- 3.8.1 Wrenching Design: The internal wrench design of the socket, flexible socket, box wrench or torque adapter shall be so configured that, when mated with 12-point fasteners conforming to the requirements of AS 870, they shall transmit torque to the fastener without bearing on the outer 5% of the fastener's wrenching points. See Fig. 1.
- 3.8.2 Bolt and Nut End Opening Tolerance: Wrench opening tolerance shall be as specified in FED-STD-346.
- 3.9 Sockets: In addition to the requirements of 3.4, a bolt clearance hole shall be provided. The clearance hole length shall be from the base of the 12-point opening to the base of the square drive. The diameter of the bolt clearance hole shall conform to Table I.
- 3.10 Flexible Sockets: In addition to the requirements of 3.4, flexible sockets shall be provided with a friction type tension 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. Hinge pin shall be solid and not extended beyond the periphery of the universal joint. A thru bolt clearance hole shall be provided, the diameter of which shall be as specified in Table IA. The universal joint shall be capable of rotation in a complete arc when the angular deviation of either end member from the common center line is 40 degrees.
- 3.11 Box Wrenches, Torque Adapters:
- 3.11.1 Box Wrenches: The 15-degree and deep offset box wrenches shall be 12-point, double hexagon, double-head design and possess the wrenching design of 3.8.1.
- 3.11.2 Torque Adapters: Torque adapter shall be of the 12-point, double hexagon design with a 3/8 in. female square drive, and possess the wrenching design of 3.8.1. Two sides of square drive shall be parallel to line drawn from center of drive through center of nominal wrench openings.
- 3.12 Reversible Ratchet Handles: The reversible ratchet handles shall meet the unidirectional cyclic test torque of Table IV and 3.7.3.2, the drop test of 3.12.1, and the proof load test of Table IV and 3.12.2. The shifting lever, knob, or button shall be of sufficient strength to assure long life under hard usage and it shall be installed in such a manner that it can only be removed by a deliberate prying action. The ratchet handle shall withstand the test loads specified without permanent angular distortion of more than five degrees and shall show no indication of damage or adverse effect upon the ratcheting mechanism and the handle after removal of the test load. If an opening is provided for lubricating the ratchet mechanism, it shall be constructed in such a manner that dirt will not enter.
- 3.12.1 Drop Test: The reversible ratchet handle shall be dropped on a concrete floor from a height of six feet, a minimum of twelve times in random positions. However, the ratchet (button) mechanism shall strike (first) on the concrete floor at least twice. During this test, all components shall remain properly assembled and the ratchet mechanism shall work satisfactorily after the last drop has been completed.
- 3.12.2 Proof Load Test: The ratchet handles shall withstand the test loads specified without permanent angular distortion of more than five degrees and shall show no indication of damage or adverse effect on the ratcheting mechanism or the handle after removal of the test load.
- 3.13 Workmanship: All details of workmanship shall be in accordance with high grade commercial practices. All items covered herein shall be free from rust, fins, burrs, external sharp or rough edges, corners or surfaces and other defects which may impair their serviceability or durability.

CHART No. 1 - SPECIFIC AREAS OF FINISH

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|--|--|
| <b>SOCKET<br/>FLEXIBLE<br/>SOCKET</b>    | Outer longitudinal surfaces or major diameter thereof shall be bright with 30 microinches maximum, except where knurled or grooved. The remaining exterior longitudinal socket surface shall be 150 microinches maximum.     |
| <b>BOX WRENCH<br/>TORQUE<br/>ADAPTER</b> | 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 have a maximum roughness height value of 30 microinches (arithmetical average (A.A.)) |
| <b>REVERSIBLE<br/>RATCHET<br/>HANDLE</b> | At least 180 degrees of the periphery of the head shall be bright with 30 microinches maximum. The remaining surfaces, except where knurled or grooved, shall be 150 microinches maximum.                                    |

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AEROSPACE PROPULSION SYSTEMS SUPPORT EQUIPMENT

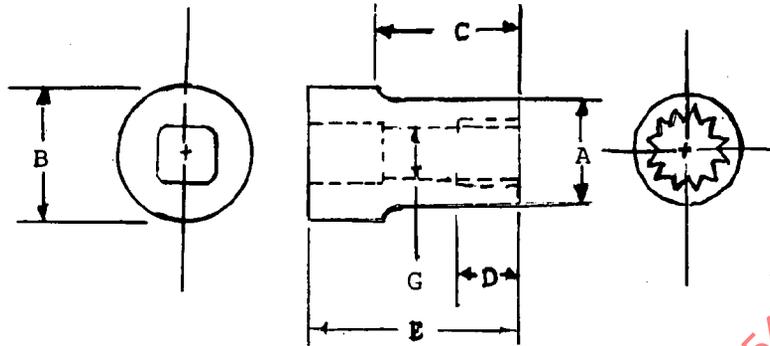
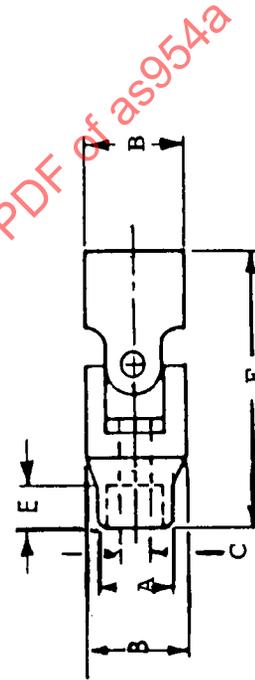


TABLE I - SOCKET DIMENSIONS (INCHES)

Nominal Wrench Opening	A Max	B Max	C Min	D Min Depth	E Min	E Max	G Dia Min	Min Torque Endurance Load (in-lb)	Proof Torque Load (in-lb)	Nom Square Drive Size
7/32	0.343	0.440	0.390	0.190	0.860	1.270	0.140	75	225	0.250
1/4	.380	.440	.390	.205	.860	1.270	.170	100	300	.250
9/32	.430	.440	.390	.215	.860	1.270	.180	125	375	.250
5/16	.478	.460	.390	.235	.860	1.270	.180	150	450	.250
3/8	.550	.697	.420	.270	.900	1.520	.281	300	900	.375
7/16	.660	.697	.420	.270	.900	1.520	.281	400	1250	.375
1/2	.730	.697	.420	.300	.900	1.750	.344	800	2400	.375
9/16	.812	.810	.420	.328	.900	1.780	.406	840	2500	.375
5/8	.892	.940	.734	.375	1.480	1.780	.480	1650	5000	.500
11/16	.960	.960	.840	.465	1.480	1.780	.480	1850	5500	.500
3/4	1.055	1.055	.840	.530	1.480	1.780	.531	2000	6000	.500

TABLE IA - FLEXIBLE SOCKET DIMENSIONS

NOMINAL OPENING	SQUARE DRIVE SIZE	OVERALL LENGTH MAX F	OUTSIDE DIAMETER		DEPTH OPENING NUT END MIN E	BOLT CLEARANCE DIAMETER MIN C	TORQUE ENDURANCE LOAD (IN-LB) MIN	PROOF TORQUE LOAD (IN-LAB) MIN
			NUT END MAX A	DRIVE END MAX B				
1/4	0.250	1.312	0.385	0.515	0.205	0.203	100	300
5/16	.250	1.437	.470	.515	.235	.265	150	450
3/8	.250	1.500	.540	.515	.250	.281	180	550
7/16	.375	2.000	.660	.750	.281	.281	350	1000
1/2	.375	2.125	.740	.750	.328	.344	350	1000
9/16	.375	2.187	.800	.750	.375	.406	350	1000



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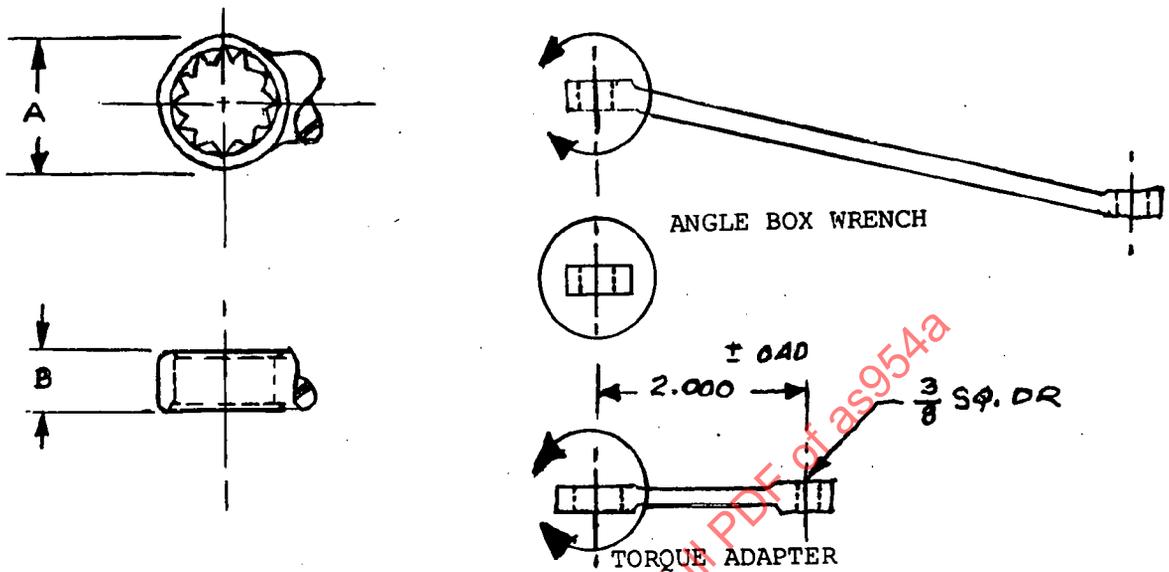


TABLE II - BOX WRENCH AND TORQUE ADAPTER DATA

Nominal Wrench Opening	A Max	B Max	Mini Torque Endurance Load (in-lb)	Proof Torque Load (in-lb)
7/32	0.375	0.250	60	180
1/4	.425	.250	70	220
9/32	.445	.250	85	250
5/16	.480	.266	90	275
3/8	.578	.327	200	605
7/16	.660	.349	250	750
1/2	.750	.359	400	1200
9/16	.830	.406	550	1650
5/8	.920	.468	750	2200
11/16	1.010	.490	880	2640
3/4	1.090	.531	1000	3000