SAE Aerospace
An SAE International Group

METRIC AEROSPACE STANDARD

SAE MA4535 | REV. A

Issued 1995-08
Reaffirmed 2004-01
Stabilized 2013-02

Superseding MA4535

Wrenches, Box and Open End Combination Twelve Point, High Strength, Thin Wall, Metric

RATIONALE

Standard was rolled into the AS955 standard. This standard should be used only for historical purposes.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE EG-1B Hand Tools Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE:

This SAE Metric Aerospace Standard (MA) provides dimensional, performance, testing and other requirements for high strength, thin wall, double head box and combination wrenches which possess an internal wrenching design so configured that, when mated with hexagon (6 point) fasteners, they shall transmit torque to the fastener without bearing on the apex of the fastener's wrenching points. This standard provides additional requirements beyond ANSI B107.9 appropriate for aerospace use.

Inclusion of dimensional data in this document is not intended to imply all of the products described therein are stock production sizes. Consumers are requested to consult with manufacturers concerning lists of stock production sizes.

1.1 Classification:

Box and combination wrenches covered by this document shall be of the following types, classes, and styles as specified.

a. Type I: Box Wrench, Double Head:

(1) Class 1: 15° offset each end

(a) Style 1: Regular length

(b) Style 3: Long length

1.1 (Continued):

(2) Class 2: Deep offset each end

(a) Style 1: Regular length

(3) Class 3: Modified offset each end

(a) Style 1: Regular length

(b) Style 2: Short length

b. Type III: Combination Wrench, Open End and 15° Offset Box Opening:

(1) Regular length

(2) Short length

(3) Long length

(4) Extra short length

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS478 Identification - Marking Methods

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 754	Coating Thickness by X-ray Fluorescence, Standard Test Method for
ASTM B 487	Measurement of Metal and Oxide Coating Thickness, Examination of a Cross Section
ASTM B 499	Measurement of Coating Thickness by the Magnetic Method, Standard Test Method for
ASTM B 504	Measurement of Thickness of Metallic Coatings by the Coulometric Method, Standard Test Method for
ASTM B 530	Measurement of Coating Thickness by the Magnetic Method: Electrodeposited Nickel Coatings of Magnetic and Nonmagnetic Substrates, Standard Test Method for
ASTM B 568	Measurement of Coating Thickness by X-ray Spectrometry, Standard Test Method for
ASTM B 571	Adhesion of Metallic Coatings, Standard Test Methods for
ASTM B 748	Measurement of Thickness of Metallic Coatings by Measurement of Cross Section with a Scanning Electron Microscope, Standard Test Method for
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials, Standard Methods of Test of

2.3 ANSI Publications:

Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI B107.9	Wrenches, Box, Open End, Combination and Flare Nut (Metric Series)
ANSI B107.17M	Gages, Wrench Openings, Reference

2.4 Reference Publications:

AS954	Wrenches, Hand, Twelve Point, High Strength, Thin Wall
ISO 272-1982 (E)	Fasteners - Hexagon Products - Widths Across Flats
ISO 1085-1986 (E)	Assembly Tools for Screws and Nuts - Double-Ended Wrenches - Size Pairing
ISO 1711-1975 (E)	Hand Operated Wrenches and Sockets - Technical Specifications
ISO 3318-1990 (E)	Assembly Tools for Screws and Nuts - Double-Headed Open-Ended Wrenches, Double-Headed Ring Wrenches and Combination Wrenches - Maximum Width of Heads
ISO 7738-1990 (E)	Spanners and Wrenches - Combination Wrenches - Minimum Length and Thickness of Heads
ISO 10103-1990 (E)	Assembly Tools for Screws and Nuts - Double-Headed, Flat and Offset, Box Wrenches
ISO 10104-1990 (E)	Assembly Tools for Screws and Nuts - Double-Headed, Deep Offset and Modified Offset, Box Wrenches

3. REQUIREMENTS:

3.1 General:

Unless otherwise specified herein, all dimensions and attributes shall be in conformance with ANSI B107.9.

3.2 Materials:

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 wrenches conforming to the physical requirements specified herein. Powdered metal or cast steel shall not be used.

3.3 Marking:

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

3.4 Hardness:

Unless otherwise specified herein, wrenches 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.

3.5 Test Loads:

When tested as specified, wrenches shall withstand the applicable cyclic and proof test loads specified in Table 1 without failure or permanent deformation (set) which might affect the durability or serviceability of the wrenches.

3.6 Wrench Opening:

Wrench opening tolerance shall be in accordance with ANSI B107.17M.

3.7 Finish:

Finish shall be as specified in ANSI B107.9 except for the following coating requirements. Two types of protective finish are covered. Nickel-chromium plate will be furnished unless otherwise specified.

3.7.1 Nickel-Chromium Plate: The nickel thickness shall be a minimum 0.005 mm. The chromium thickness shall be a minimum 0.00018 mm. No other undercoating shall be substituted for nickel. Visible contact marks resulting from electroplating operations shall be confined to the interior surface of the wrenching opening.

3.7.2 Black Oxide or Phosphate Treatment: The wrenches shall be coated with a chemically produced oxide or phosphate coating followed with a coating of rust preventive. All external surfaces shall have a maximum roughness height value of 0.0063 mm.

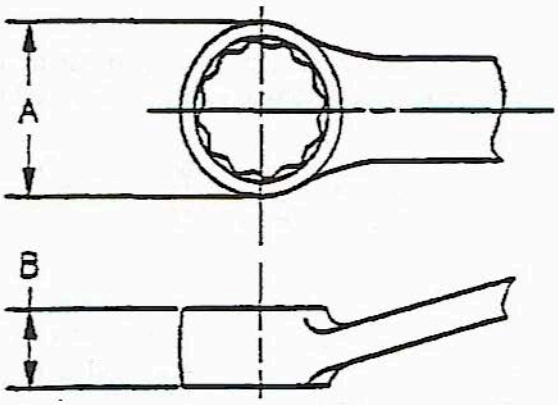

TABLE 1 - Box End Dimensional and Strength Requirements
(Dimensions in Millimeters, Torque in Newton-Meters)

Nominal Wrench Opening	Type I A max	Type I B max	Type III A max	Type III B max	Type I Test Load Cyclic min	Type I Test Load Proof min	Type III Test Load Cyclic min	Type III Test Load Proof min
6	10.5	6.6	11.0	6.4	14	20	17	24
7	11.8	6.8	12.5	6.5	19	27	23	33
8	13.5	7.3	14.0	7.2	21	30	32	45
9	14.0	8.1	15.5	7.8	28	40	42	60
10	15.7	8.9	16.5	8.3	50	71	52	75
11	17.9	9.3	18.3	8.8	57	80	66	95
12	18.3	9.8	19.8	9.0	64	91	84	120
13	19.5	10.0	20.7	9.2	80	115	102	145
14	23.0	10.8	23.0	9.6	110	158	126	180
15	24.4	11.3	24.5	10.1	140	200	150	215
16	25.4	12.0	25.4	10.9	174	248	175	250
17	27.0	12.7	27.2	11.5	187	267	196	280
18	27.7	13.0	28.2	11.8	213	304	217	310
19	28.5	13.7	29.1	12.4	226	323	238	340
20	31.0	14.1	31.5	13.0	243	347	252	360
21	32.3	14.3	32.7	13.5	260	372	273	390
22	33.4	14.5	34.0	14.3	285	408	305	435
23	34.1	14.7	35.3	14.7	318	455	336	480
24	34.9	15.0	36.6	15.2	356	509	371	530
25	--	--	38.9	16.1	391	559	410	585
26	--	--	40.7	16.4	425	608	448	640
27	40.4	16.5	42.0	17.0	470	671	490	700
28	--	--	43.4	17.5	497	710	532	760
30	44.0	17.7	46.0	18.8	556	795	623	890
32	47.8	19.0	48.3	19.2	633	905	728	1040

3.8 Wrench Design:

The internal wrenching design of all wrenches shall be so configured that, when mated with hexagon (6 point) fasteners they shall transmit torque to the fastener as indicated in Figure 1.

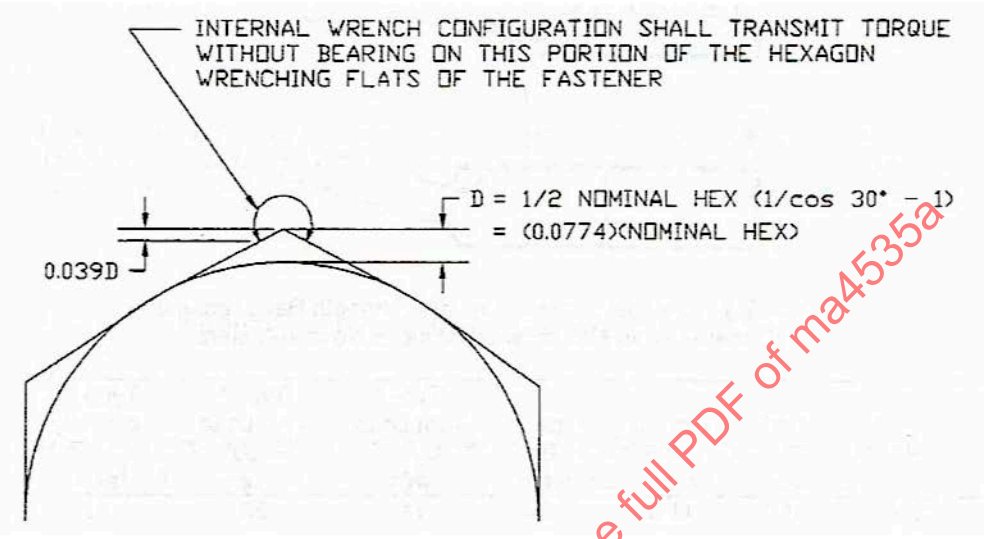

FIGURE 1 - Internal Wrench Engagement

3.9 Type I, Box Wrench Double Head:

Each end of Class 1, Class 2, and Class 3 box wrenches shall be 12 point, double hexagon design and shall possess the wrenching design of 3.8 and shall conform to the maximum head diameter and head thickness requirements of Table 1.

3.9.1 Type I, Class 1, 15° Offset, Box Wrenches: The 15° offset, angled end box wrenches shall conform to the overall length requirement of Table 2.

3.9.2 Type I, Class 2, Deep Offset, Box Wrench: The deep offset box wrenches shall conform to the minimum offset dimensions and the overall length requirements of Table 3.

3.9.3 Type I, Class 3, Modified Offset, Box Wrench: The modified offset box wrenches shall conform to the minimum offset dimensions and the overall length requirements of Table 4.

3.10 Type III, Combination Wrench:

The combination box and open end wrenches shall have a box wrench head on one end and an open end wrench head on the other end. The box wrench head shall be 12 point, double hexagon with the wrenching design of 3.8 and shall conform to the maximum head diameter and head thickness requirements of Table 1. Combination wrenches shall conform to the overall length requirements of Table 5.

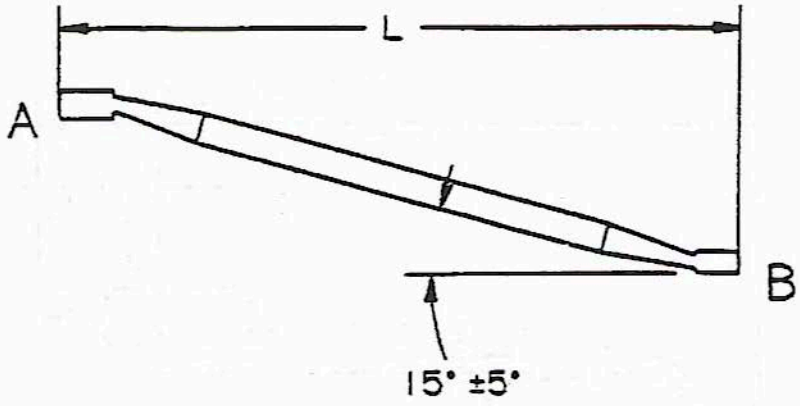

TABLE 2 - Type I, Class 1, Angled Box Wrench
(Dimensions in Millimeters)

Wrench Opening Small End A	Wrench Opening Large End B	Style 1 (Reg) L min	Style 1 (Reg) L max	Style 3 (Long) L min	Style 3 (Long) L max
6	7	160	175	190	205
8	9	173	188	215	230
10	11	189	215	240	255
12	13	208	223	270	285
13	14	--	--	285	300
13	15	240	255	--	--
14	15	230	245	305	320
15	16	--	--	330	345
16	18	255	270	--	--
17	19	275	290	350	365
20	22	300	325	--	--
21	23	320	358	--	--
22	24	330	345	--	--
27	30	390	405	--	--
30	32	425	440	--	--

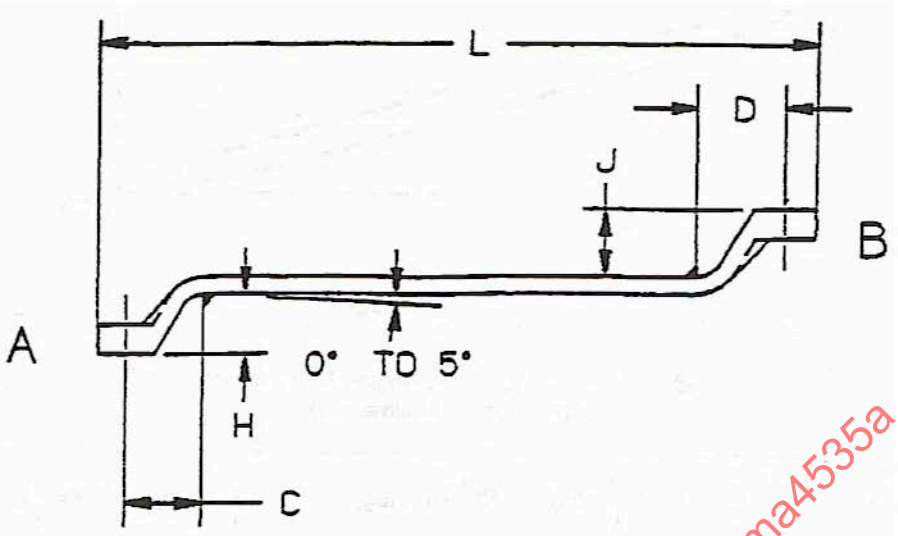

TABLE 3 - Type I, Class 2, Deep Offset Box Wrench
(Dimensions in Millimeters)

Small End A	Large End B	C	H min	D	J min	Style 1 (Reg) L min	Style 1 (Reg) L max
8	9	16	11.6	18	12.4	145	170
10	11	20	13.2	22	13.9	175	195
12	13	24	14.7	26	15.5	195	210
13	15	26	15.5	30	17.1	215	230
14	15	28	16.3	30	17.1	220	240
16	17	32	17.9	34	18.7	240	260
16	18	32	17.9	36	19.4	245	265
17	19	34	18.7	38	20.2	255	270
18	19	36	19.4	38	20.2	265	285
20	22	40	21.0	44	22.6	290	315
21	23	42	21.8	46	23.3	305	320
24	27	48	24.9	54	29.7	355	370

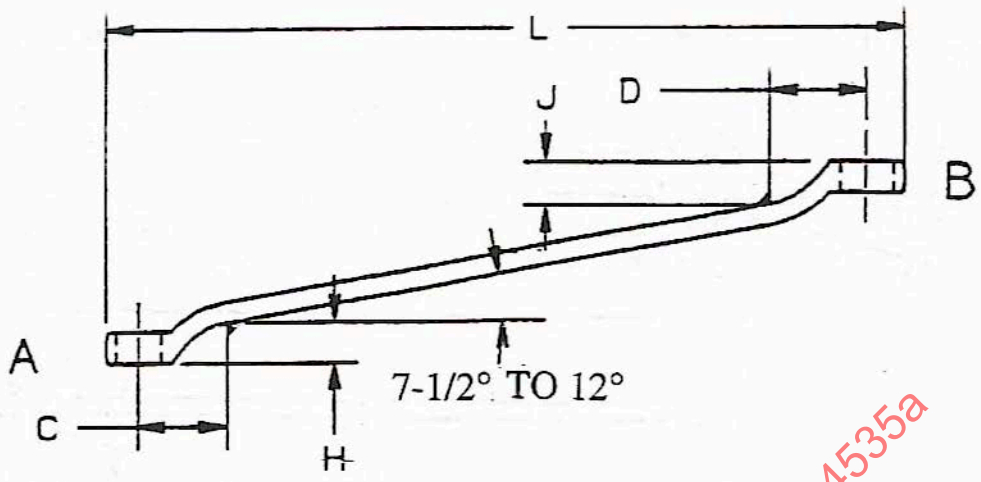

TABLE 4 - Type I, Class 3, Modified Offset Box Wrench
(Dimensions in Millimeters)

Small End A	Large End B	C	H min	D	J min	Style 1 (Reg) L min	Style 1 (Reg) L max	Style 2 (SHT) L min	Style 2 (SHT) L max
6	7	12	5.0	14	5.8	110	151	80	90
7	8	14	5.8	16	6.5	150	165	--	--
8	9	16	6.5	18	7.3	160	175	100	110
8	10	16	6.5	20	8.1	175	190	--	--
10	11	20	8.1	22	8.8	180	205	115	125
10	13	20	8.1	26	10.4	195	220	--	--
11	13	22	8.8	26	10.4	205	225	--	--
12	13	24	9.6	26	10.4	208	230	135	145
13	14	26	10.4	28	11.2	--	--	140	150
13	15	26	10.4	30	11.9	225	245	--	--
14	15	28	11.2	30	11.9	235	250	150	160
15	16	30	11.9	32	12.7	--	--	160	170
15	18	30	11.9	36	14.2	255	270	--	--
16	17	32	12.7	34	13.5	255	270	--	--
16	18	32	12.7	36	14.2	255	280	--	--
17	19	34	13.5	38	15.0	265	290	195	205
18	19	36	14.2	38	15.0	275	290	--	--
18	21	36	14.2	42	16.5	295	310	--	--
19	22	38	15.0	44	17.3	305	320	--	--
20	22	40	15.8	44	17.3	310	325	--	--
21	22	42	16.5	44	17.3	312	327	--	--
21	23	42	16.5	46	18.1	315	341	--	--
21	24	42	16.5	48	18.8	325	345	--	--
24	27	48	18.8	54	21.2	360	300	--	--
27	30	54	21.2	60	23.5	390	410	--	--
27	32	54	21.2	64	25.0	420	445	--	--
30	32	60	23.5	64	25.0	430	485	--	--

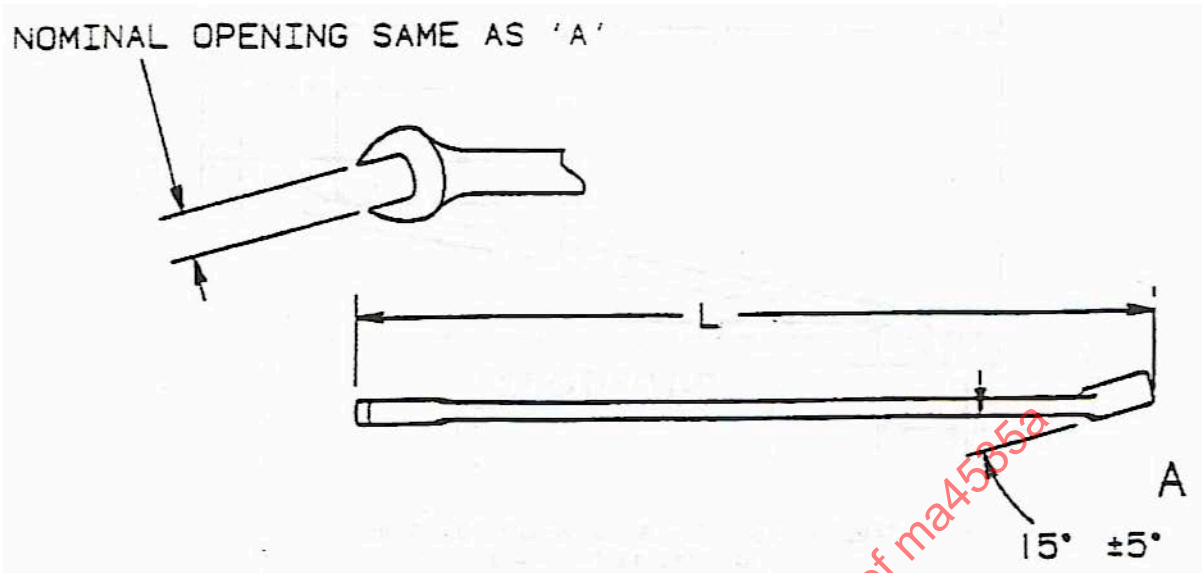

TABLE 5 - Type III, Combination Box and Open End Wrench
(Dimensions in Millimeters)

Wrench Opening A	Style 1 Regular L min	Style 1 Regular L max	Style 2 Short L min	Style 2 Short L max	Style 3 Long L min	Style 3 Long L max	Style 4 Extra Short L min	Style 4 Extra Short L max
6	120	140	90	115	--	--	70	85
7	125	145	94	120	--	--	75	88
8	135	159	100	125	--	--	80	93
9	140	170	105	130	--	--	82	96
10	150	175	115	140	180	195	85	100
11	160	187	125	150	195	210	90	105
12	167	197	135	160	210	225	95	110
13	175	210	140	165	225	240	100	115
14	187	222	150	171	241	260	110	125
15	195	235	155	175	254	275	115	130
16	203	245	160	180	267	290	118	135
17	220	260	165	195	282	310	120	140
18	230	270	170	200	297	325	125	150
19	240	285	175	210	313	340	130	155
20	245	295	180	215	330	360	--	--
21	255	305	185	220	347	370	--	--
22	280	320	190	225	370	390	--	--
23	290	330	195	227	390	410	--	--
24	300	340	200	230	400	420	--	--
25	325	360	--	--	415	435	--	--
26	330	370	--	--	425	450	--	--
27	355	390	--	--	445	470	--	--
28	370	405	--	--	460	490	--	--
30	385	415	--	--	480	510	--	--
32	405	435	--	--	500	530	--	--