SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

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Mechanical and Quality Requirements for Tapping Screws

RATIONALE

Current requirements for Tapping Screws are contained in ASME B18.6.3 - Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series) and SAE J2596 - Fastener Part Standard - Tapping Screws and Metallic Drive Screws (Inch Dimensioned). SAE J933 contains useful information and may have current users.

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1. Scope

1.1 This SAE Recommended Practice covers the mechanical and quality requirements for steel tapping screws used in automotive and related industries. It does not apply to corrosion resistant (stainless) steel screws. (Dimensional requirements for most types of screws mentioned herein are covered in ASME B 18.6.4, 'Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws'.)

1.2 The primary objective of the specification is to insure that screws form or cut mating threads in materials of construction into which they are normally driven, without deforming their own thread and without breaking during assembly or service.

NOTE—Certain limitations on basic material and manufacturing processes have been incorporated because the size and configuration of the parts under consideration make them vulnerable to relatively small variations in chemistry, heat treatment, etc., and because experience has shown that in processing it is difficult to keep these variables consistently "in balance." Until improved performance tests are developed, these limitations will supplement the "performance" features of the specification.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J423—Methods of Measuring Case Depth

2.1.2 ASME PUBLICATIONS

Available from ASME International, Three Park Avenue, New York, NY 10016-5990

ASME B 18.6.4—Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

3. Performance Requirements

3.1 General

In cases where screws are plated subsequent to delivery to the purchaser (or where plating of screws is otherwise under the control of the purchaser), the screw producer is not responsible for failures due to plating. In such cases, additional screws from the same lot shall be stripped of plating, baked, lubricated with machine oil, and retested in the plain finish condition.

3.2 Drive Test for Types A, B, C, D, F, G, T, AB, and BP[1]

Sample screws (coated or uncoated, as received) shall, without deforming their own thread, form a mating thread in test plate described as follows until a thread of full diameter is completely through the test plate.

The test plate shall be made of low-carbon cold-rolled steel, having hardness of Rockwell B70-85 or equivalent, and thickness as specified in Table 1A. Test holes shall be drilled or punched and redrilled, or reamed, to ±0.001 in of nominal diameter specified in Table 1B for type and size screw being tested.

[1] This test does not apply to Types BF, BG, and BT screws.

TABLE 1A—STANDARD TEST PLATE THICKNESSES AND HOLES SIZES FOR DRIVE TEST INSPECTION OF TAPPING SCREWS[1]—THICKNESS

Nominal Screw Size	Types AB, A, B, BP, and C Gage	Types AB, A, B, BP, and C Max	Types AB, A, B, BP, and C Min	Types D, F, G, and T Max	Types D, F, G, and T Min
2	18	0.0500	0.0460	0.0800	0.0760
3	18	0.0500	0.0460	0.0960	0.0920
4	18	0.0500	0.0460	0.1110	0.1070
5	18	0.0500	0.0460	0.1110	0.1070
6	14	0.0770	0.0730	0.1425	0.1385
7	14	0.0770	0.0730	—	—
8	14	0.0770	0.0730	0.1420	0.1380
10	1/8	0.1270	0.1230	0.1905	0.1845
12	1/8	0.1270	0.1230	0.1905	0.1845
14	1/8	0.1270	0.1230	—	—
1/4	3/16	0.1905	0.1845	0.2530	0.2470
16	3/16	0.1905	0.1845	—	—
18	3/16	0.1905	0.1845	—	—
5/16	3/16	0.1905	0.1845	0.3155	0.3095
20	3/16	0.1905	0.1845	—	—
24	3/16	0.1905	0.1845	—	—
3/8	3/16	0.1905	0.1845	0.3780	0.3720
7/16	3/16	0.1905	0.1845	—	—
1/2	3/16	0.1905	0.1845	—	—

1. Requirements shown in each column of Tables 1A and 1B, expressed in inches, are applicable also to screws which have thread-forming characteristics similar to the type(s) designated in the column heading.

TABLE 1B—STANDARD TEST PLATE THICKNESSES AND HOLES SIZES FOR DRIVE TEST INSPECTION OF TAPPING SCREWS[1]—HOLE SIZE

Nominal Screw Size	Type A Drill Size	Type A Hole Dia	Types AB, B, and BP Drill Size	Types AB, B, and BP Hole Dia	Type C Coarse Thread Drill Size	Type C Coarse Thread Hole Dia	Type C Fine Thread Drill Size	Type C Fine Thread Hole Dia	Types D, F, G, and T Coarse Thread Drill Size	Types D, F, G, and T Coarse Thread Hole Dia	Types D, F, G, and T Fine Thread Drill Size	Types D, F, G, and T Fine Thread Hole Dia
2	No. 48	0.0760	No. 48	0.0760	No. 48	0.0760	No. 48	0.0760	No. 49	0.0730	—	—
3	No. 46	0.0810	No. 46	0.0810	No. 44	0.0860	No. 43	0.0890	No. 46	0.0810	—	—
4	No. 44	0.0860	No. 44	0.0860	No. 41	0.0960	No. 40	0.0980	No. 41	0.0960	—	—
5	No. 36	0.1065	No. 36	0.1065	No. 35	0.1100	No. 35	0.1100	No. 37	0.1040	—	—
6	No. 32	0.1160	No. 32	0.1160	No. 31	0.1200	1/8	0.1250	No. 31	0.1200	—	—
7	No. 30	0.1285	No. 30	0.1285	—	—	—	—	—	—	—	—
8	No. 29	0.1360	No. 29	0.1360	No. 27	0.1440	No. 26	0.1470	No. 26	0.1470	—	—
10	No. 21	0.1590	No. 21	0.1590	No. 19	0.1660	11/64	0.1719	No. 17	0.1730	No. 16	0.1770
12	3/16	0.1875	3/16	0.1875	No. 11	0.1910	No. 10	0.1935	No. 8	0.1990	—	—
14	5.5 mm	0.2165	—	—	—	—	—	—	—	—	—	—
1/4	—	—	5.5 mm	0.2165	7/32	0.2188	1	0.2280	1	0.2280	A	0.2340
16	B	0.2380	—	—	—	—	—	—	—	—	—	—
18	G	0.2610	—	—	—	—	—	—	—	—	—	—
5/16	—	—	1	0.2720	J	0.2770	L	0.2900	L	0.2900	M	0.2950
20	L	0.2900	—	—	—	—	—	—	—	—	—	—
24	11/32	0.3438	—	—	—	—	—	—	—	—	—	—
3/8	—	—	21/64	0.3281	R	0.3390	11/32	0.3438	T	0.3580	T	0.3580
7/16	—	—	13/32	0.4062	10 mm	0.3937	—	—	—	—	—	—
1/2	—	—	15/32	0.4688	29/64	0.4531	—	—	—	—	—	—

1. Requirements shown in each column of Tables 1A and 1B, expressed in inches, are applicable also to screws which have thread-forming characteristics similar to the type(s) designated in the column heading.

3.3 Torsional Strength Test

Shank of sample screw (coated or uncoated, as received) shall be securely clamped in a mating, split, blind-hole die (Figure 1) or other means, such that the clamped portion of the threads is not damaged and at least two full threads project above the clamping device and at least two full form threads exclusive of point, flute(s), or end slot are held within the clamping device. (A blind hole may be used in place of the clamping device, providing the hole depth is such as to insure that the breakage will occur beyond the point, or the full length of the flute(s) or end slot.) By means of a suitably calibrated torque measuring device, apply torque to the screw until failure occurs. The torque required to cause failure shall equal or exceed the minimum value shown in Table 2 for the type and size of screw being tested.

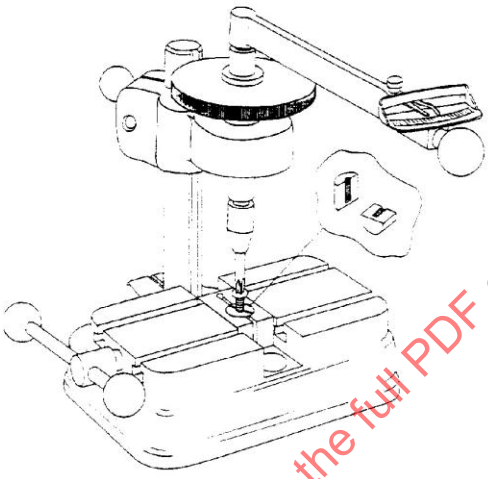

FIGURE 1—TORQUE MEASURING DEVICE

TABLE 2—TORSIONAL STRENGTH REQUIREMENTS FOR TAPPING SCREWS[1]
(MINIMUM TORSIONAL STRENGTH, lb-in)

Nominal Screw Size	Type A	Types AB, B, BF, BG, BP, and BT	Type C Coarse Thread	Type C Fine Thread	Types D, F, G, and T Coarse Thread	Types D, F, G, and T Fine Thread
2	4	4	5	6	5	6
3	9	9	9	10	9	10
4	12	13	13	15	13	15
5	18	18	18	20	18	20
6	24	24	23	27	23	27
7	30	30	—	—	—	—
8	39	39	42	47	42	47
10	48	56	56	74	56	74
12	83	88	93	108	93	108
14	125	—	—	—	—	—
1/4	—	142	140	179	140	179
16	152	—	—	—	—	—
18	196	—	—	—	—	—
5/16	—	290	306	370	306	370
20	250	—	—	—	—	—
24	492	—	—	—	—	—
3/8	—	590	560	710	560	710
7/16	—	—	—	—	—	—
1/2	—	—	—	—	—	—

1. Requirements shown in each column of Tables 1A, 1B, and 2 are applicable also to screws which have thread-forming characteristics similar to the type(s) designated in the column heading.

4. *Material and Processing Requirements*

4.1 Material

Screws shall be made from cold heading quality, killed steel wire, conforming to the composition limits shown in Table 3:

TABLE 3—CHEMICAL COMPOSITION

Tapping Screw Size (dia)	Analysis[1]	Chemical Composition, % by weight Carbon	Chemical Composition, % by weight Manganese
No. 4 and smaller	Ladle	0.13–0.25	0.60–1.65
	Check	0.11–0.27	0.57–1.71
No. 5 thru 1/2 in	Ladle	0.15–0.25	0.70–1.65
	Check	0.13–0.27	0.64–1.71

1. Ladle analyses are shown for informational purposes. Check analyses are mandatory and refer to individual determinations on uncarburized or core portion of screws.

4.2 Heat Treatment

Shall be in carbonitriding or gas carburizing system. Screws shall be quenched in a liquid medium and then tempered by reheating to 650 °F min.

Cyaniding systems may be approved by a purchaser when the producer shows that a continuous flow (no batch) quenching process is employed which consistently produces uniform case and core.

4.3 Total Case Depth

Shall conform to the tabulation as shown in Table 4, as measured at thread flank midpoint between the crest and root:

TABLE 4—CASE DEPTH REQUIREMENTS

Nominal Screw Size	Total Case Depth (in) Max.	Total Case Depth (in) Min
4 and 6	0.007	0.002
8 through 12	0.009	0.004
1/4 and larger	0.011	0.005

Case depth is to be checked in the hardened condition in accordance with SAE J423, 6.3.1, using a magnification of 100x. For referee purposes, the screws must meet all performance requirements as defined in Tables 1A, 1B, and 2, and the hardness at the maximum case depth shall not exceed 42 HRc when read with a microhardness instrument and a 500-g load converting the results to HRc. This is required to ensure that the total case does not exceed the maximum specified depth.