

TABLE 1—GRADES AND PROPERTIES

Grade	Tensile Properties of Hot Rolled Rod or Bar from which Rivets are Produced		Chemical Composition Ladle Analysis, % Max	Heat Treatment of Rivets
	Tensile strength, psi Yield point, Min, psi Elongation in 8 in., Min, %			
0	40,000—55,000 23,000 27		P —0.040 S —0.050	7/16 in. dia and under are furnished annealed to Rockwell B 65 max <sup>a</sup>
1	52,000—62,000 28,000 24		P —0.040 S —0.050	7/16 in. dia and under are furnished annealed to Rockwell B 85 max <sup>a</sup>
2 <sup>b</sup>	55,000—70,000 29,000 22		C —0.28 Mn—0.30—0.90 P —0.040 S —0.050 Si —0.25	Not specified
3 <sup>b</sup>	68,000—82,000 38,000 20		C —0.30 Mn—1.65 P —0.040 S —0.050	Not specified

<sup>a</sup>Hardness to be taken in accordance with SAE Information Report, Hardness Tests and Hardness Number Conversions—SAE J417.

<sup>b</sup>Grades 2 and 3 intended for hot driving only. The tensile requirements of grade 3 are met by heating to 1450 F, holding at this temperature for not less than 30 min and cooling slowly in the furnace.

## MECHANICAL AND QUALITY REQUIREMENTS FOR TAPPING SCREWS—SAE J933 JUN79

## SAE Recommended Practice

Report of the Iron and Steel Technical Committee, approved July 1965, last revised September 1969, reaffirmed with editorial change June 1979.

### 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 SAE J478.)

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. Performance Requirements

2.1 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.

2.2 Drive Test for Types A, B, C, D, F, G, T, AB, and BP<sup>1</sup>—Sample screws (coated or uncoated, as received) shall, without deforming their own thread, form a mating thread in test plate described below 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 1. Test holes shall be drilled or punched and re-drilled, or reamed, to  $\pm 0.001$  in. of nominal diameter specified in Table 1 for type and size screw being tested.

2.3 Torsional Strength Test—Shank of sample screw (coated or uncoated, as received) shall be securely clamped in a mating, split, blind-hole die (Fig. 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 breakage

<sup>1</sup>This test does not apply to Types BF, BG, and BT screws.

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.

2.4 Ductility Test—Not required at this time; under development.

### 3. Material and Processing Requirements

3.1 Material—Screws shall be made from cold heading quality, killed steel wire, conforming to the composition limits shown below:

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

<sup>a</sup>Ladle analyses are shown for informational purposes. Check analyses are mandatory and refer to individual determinations on uncarburized or core portion of screws.

3.2 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.

3.3 Total Case Depth—Shall conform to the following, as measured at thread flank midpoint between crest and root:

Size	Thickness, in.
No. 4 thru 6	0.002–0.007
No. 8 thru 12	0.004–0.009
1/4 and larger	0.005–0.011

3.4 Surface Hardness After Tempering—Shall be equivalent to Rockwell C45 minimum. For routine quality control purposes (where case depth and geometry of screws permit), measurements may be made on end, shank,

TABLE 1—STANDARD TEST PLATE THICKNESSES AND HOLE SIZES FOR DRIVE TEST INSPECTION OF TAPPING SCREWS<sup>a</sup>

Nominal Screw Size	Thickness					Hole Size											
	Types AB, A, B, BP and C			Types D, F, G and T		Type A		Types AB, B and BP		Type C				Types D, F, G, and T			
	Gage	Max	Min	Max	Min	Drill Size	Hole Dia	Drill Size	Hole Dia	Coarse Thread		Fine Thread		Coarse Thread		Fine Thread	
										Drill Size	Hole Dia	Drill Size	Hole Dia	Drill Size	Hole Dia	Drill Size	Hole Dia
2	18	0.0500	0.0460	0.0800	0.0760	No. 48	0.0760	No. 48	0.0760	No. 48	0.0760	No. 48	0.0760	No. 49	0.0730	—	—
3	18	0.0500	0.0460	0.0960	0.0920	No. 46	0.0810	No. 46	0.0810	No. 44	0.0860	No. 43	0.0890	No. 46	0.0810	—	—
4	18	0.0500	0.0460	0.1110	0.1070	No. 44	0.0860	No. 44	0.0860	No. 41	0.0960	No. 40	0.0980	No. 41	0.0960	—	—
5	18	0.0500	0.0460	0.1110	0.1070	No. 36	0.1065	No. 36	0.1065	No. 35	0.1100	No. 35	0.1100	No. 37	0.1040	—	—
6	14	0.0770	0.0730	0.1425	0.1385	No. 32	0.1160	No. 32	0.1160	No. 31	0.1200	1/8	0.1250	No. 31	0.1200	—	—
7	14	0.0770	0.0730	—	—	No. 30	0.1285	No. 30	0.1285	—	—	—	—	—	—	—	—
8	14	0.0770	0.0730	0.1420	0.1380	No. 29	0.1360	No. 29	0.1360	No. 27	0.1440	No. 26	0.1470	No. 26	0.1470	—	—
10	1/8	0.1270	0.1230	0.1905	0.1845	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	1/8	0.1270	0.1230	0.1905	0.1845	3/16	0.1875	3/16	0.1875	No. 11	0.1910	No. 10	0.1935	No. 8	0.1990	—	—
14	1/8	0.1270	0.1230	—	—	5.5mm	0.2165	—	—	—	—	—	—	—	—	—	—
1/4	3/16	0.1905	0.1845	0.2530	0.2470	—	—	5.5mm	0.2165	7/32	0.2188	1	0.2280	—	0.2280	A	0.2340
16	3/16	0.1905	0.1845	—	—	B	0.2380	—	—	—	—	—	—	—	—	—	—
18	3/16	0.1905	0.1845	—	—	G	0.2610	—	—	—	—	—	—	—	—	—	—
5/16	3/16	0.1905	0.1845	0.3155	0.3095	—	—	—	—	—	—	—	—	—	—	—	—
20	3/16	0.1905	0.1845	—	—	L	0.2900	—	—	—	—	—	—	—	—	—	—
24	3/16	0.1905	0.1845	—	—	11/32	0.3438	—	—	—	—	—	—	—	—	—	—
3/8	3/16	0.1905	0.1845	0.3780	0.3720	—	—	21/64	0.3281	R	0.3390	11/32	0.3438	T	0.3580	T	0.3580
7/16	3/16	0.1905	0.1845	—	—	—	—	13/32	0.4062	10mm	0.3937	—	—	—	—	—	—
1/2	3/16	0.1905	0.1845	—	—	—	—	15/32	0.4688	29/64	0.4531	—	—	—	—	—	—

<sup>a</sup>Requirements shown in each column of Tables 1 and 2 are applicable also to screws which have thread forming characteristics similar to the type(s) designated in the column heading.

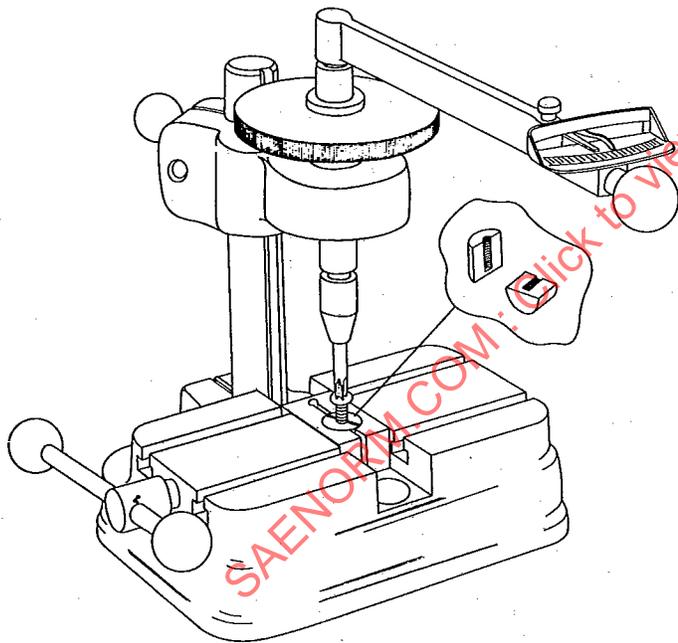


FIG. 1

or head using Rockwell 15 N. As an alternate, or where this method is not applicable, a microhardness instrument with a Knoop or diamond pyramid indenter and a 500 gram load may be used. In such cases, measurements shall be made on the thread profile of a properly prepared longitudinal metallographic specimen.

**3.5 Core Hardness After Tempering**—Shall be Rockwell C28–38<sup>2</sup>, as determined at mid-radius of a transverse section through the screw taken at a distance sufficiently behind the point of the screw to be through the full minor diameter.

**3.6 Microstructure**—Shall show no band of free ferrite between case and core, as determined by metallographic examination.

<sup>2</sup>Hardness shall not exceed maximum shown and preferably should be no higher than Rockwell C36 to insure against failure in assembly and service.

TABLE 2—TORSIONAL STRENGTH REQUIREMENTS FOR TAPPING SCREWS<sup>a</sup>

Nominal Screw Size	Minimum Torsional Strength, lb-in.					
	Type A	Types AB, B, BF, BG, BP and BT	Type C		Types D, F, G and T	
			Coarse Thread	Fine Thread	Coarse Thread	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	—	—	—	—	—	—

<sup>a</sup>Requirements shown in each column of Tables 1 and 2 are applicable also to screws which have thread forming characteristics similar to the type(s) designated in the column heading.

**4. Testing Requirements**

4.1 The requirements of this specification shall be met in continuous mass production for stock, and the producer shall make sample inspections to insure that the product is controlled within the specified limits. Additional tests of individual shipments are not ordinarily contemplated. Individual heats of steel are not identified in the finished product, and testing on a heat basis is not feasible.

When specified on purchase order or engineering drawing, the manufacturer shall furnish a report certified to be the latest set of test results for the following tests for each stock size in each shipment: Core Hardness, Torsional Strength Test, and Drive Test (in case of self-drilling screws, both Drill and Drive Tests).

Strength Test, and Drive Test.

Chemical and metallurgical tests (material analysis, surface hardness, case depth, metallographic examination of cross section) are not inspected fre-