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SURFACE VEHICLE STANDARD

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An American National Standard

MECHANICAL AND QUALITY REQUIREMENTS FOR MACHINE SCREWS

***Foreword*—**This Document has also changed to comply with the new SAE Technical Standards Board format.

***1. Scope*—**This SAE Standard covers the mechanical and quality requirements for two grades of carbon steel, slotted, and recessed, 82 degrees flat countersunk, 82 degrees oval countersunk, pan, fillister, hex, and hex washer head machine screws in sizes No. 4 through 3/4 in for use automotive and related industries. The dimensions of these screws are covered in ASME B18.6.3.

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

SAE J409—Product Analysis—Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

2.1.2 ASME PUBLICATION—Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900.

ASME B18.6.3

***3. Designations*—**The two grades of machine screws are designated Grade 60M and Grade 120M, indicating 60 000 and 120 000 psi minimum tensile strength, respectively.

4. Materials and Processes

4.1 Steel Characteristics—Machine screws shall be made of steel conforming to the description and chemical composition requirements specified in Table 1 for the applicable grade.

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TABLE 1—CHEMICAL COMPOSITION REQUIREMENTS(1)

Grade	Material and Treatment	Element, % C min	Element, % C max	Element, % P, max	Element, % S, max
60M	Carbon steel	—	0.30	0.048	0.058
120M	Carbon steel, quenched and tempered	0.15	0.55	0.048	0.058

1. All values are for check analysis (percent by weight). For ladle analysis, use standard permissible variations as shown in SAE J409.

4.2 Heading Practice—Machine screws shall be cold headed and/or extruded, unless other methods are permitted by special agreement of the purchaser.

4.3 Threading Practice—Machine screws shall be roll threaded, except by special agreement of purchaser.

4.4 Heat Treatment Practice—Grade 60M machine screws need not be heat treated. When specified by purchaser, Grade 60M screws shall be stress relieved. Grade 120M machine screws shall be heat treated, oil or water quenched and tempered at a minimum tempering temperature of 343 °C (650 °F).

4.5 Finish—Unless otherwise specified, machine screws shall be supplied with a natural (as processed) finish unplated or uncoated. Plated and coated finishes shall be supplied in accordance with requirements of the purchaser.

NOTE—Class 2A allowance in sizes No. 8 and smaller may not accommodate a commercial thickness of 0.00015 in minimum. To accommodate this commercial thickness on these smaller size screws, the before-plating size may have to be reduced. Any such reduction will affect strength properties. When necessary to maintain Class 2A limits after plating of any size screw, Class 2AG shall be specified.

5. Mechanical Requirements

5.1 Hardness—Machine screws shall have a hardness not in excess of the maximum specified in Table 2. Screws which are excepted from tensile testing in accordance with 5.2.1 and 5.2.2 shall have a hardness not less than the minimum and not more than the maximum specified in Table 2.

TABLE 2—MECHANICAL REQUIREMENTS

Grade	Tensile Strength, min, psi	Hardness Rockwell min	Hardness Rockwell max
60M	60 000	B70	B100
120M	120 000	C25	C38

5.2 Tensile Strength

5.2.1 HEX AND HEX WASHER HEAD MACHINE SCREWS—No. 4 and No. 5 hex and hex washer head machine screws which are shorter than 0.50 in are not subject to tensile testing. No. 4 and No. 5 hex and hex washer head machine screws 0.50 in and longer shall meet the tensile load requirements specified in Table 3 when axially tensile tested in accordance with 6.2.

TABLE 3—TENSILE LOAD REQUIREMENTS FOR MACHINE SCREWS

Nominal Size or Basic Major Dia of Thread and Threads per in		Stress Area, in^2	Tensile Strength,(1) lb, min Grade 60M	Tensile strength,(1) lb, min Grade 120M
No. 4-40	0.112	0.00604	360	720
4-48	0.112	0.00661	390	780
5-40	0.125	0.00796	470	940
5-44	0.125	0.00830	490	980
6-32	0.138	0.00909	550	1 100
6-40	0.138	0.01015	600	1 200
8-32	0.164	0.0140	850	1 700
8-36	0.164	0.01474	880	1 750
10-24	0.190	0.0175	1 050	2 100
10-32	0.190	0.0200	1 200	2 400
12-24	0.216	0.0242	1 450	2 900
12-28	0.216	0.0258	1 550	3 100
1/4-20	0.250	0.0318	1 900	3 800
1/4-28	0.250	0.0364	2 200	4 350
No. 5/16-18	0.312	0.0524	3 150	6 300
5/16-24	0.312	0.0580	3 500	6 950
3/8-16	0.375	0.0775	4 650	9 300
3/8-24	0.375	0.0878	5 250	10 500
7/16-14	0.438	0.1063	6 400	12 800
7/16-20	0.438	0.1187	7 100	14 200
1/2-13	0.500	0.1419	8 500	17 000
1/2-20	0.500	0.1599	9 600	19 200
9/16-12	0.562	0.182	10 900	21 800
9/16-18	0.562	0.203	12 200	24 400
5/8-11	0.625	0.226	13 600	27 100
5/8-18	0.625	0.256	15 400	30 700
3/4-10	0.750	0.334	20 100	40 100
3/4-16	0.750	0.373	22 400	44 800

1. Tensile strength values for Grade 60M and Grade 120M are based on 60 000 and 120 000 psi, respectively.

Hex and hex washer head machine screws in sizes No. 6 to 3/4 in inclusive, which are shorter than either 0.50 in or 3D (where D is nominal screw size in inches) are not subject to tensile testing. Hex and hex washer head machine screws in these sizes and with a length that is both equal to or longer than 0.50 in, and also at least 3D, shall meet the tensile load requirements specified in Table 3 when wedge tensile tested in accordance with 6.3.

5.2.2 OTHER MACHINE SCREWS—Machine screws with head styles other than hex or hex washer head which are shorter than 0.50 in, are not subject to tensile testing. Such machine screws 0.50 in and longer shall meet the tensile load requirements specified in Table 3 when axially tensile tested in accordance with 6.2.

6. Methods of Test

6.1 Hardness—The hardness shall be determined at mid-radius of a transverse section through the screw taken at a distance of one diameter from the end of the screw. For screws smaller than No. 10 size, a referee test may be made at mid-radius using microhardness measurement techniques.

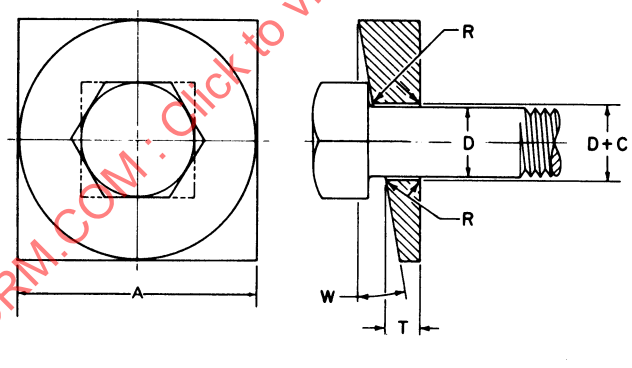
6.2 Axial Tensile Strength—Screws shall be assembled in a tensile testing machine with a minimum of six threads exposed, and an axial load applied against the bearing surface until failure occurs. The speed of testing as determined with a free-running cross head shall not exceed 1 in/min. The grips of the testing machine shall be self-aligning to avoid side thrust on the specimen.

To meet the requirements of 5.2.1 and 5.2.2, the load at failure shall not be less than the tensile load given in Table 3 for the applicable size and grade.

6.3 Wedge Tensile Strength—Screws shall be installed in a tensile testing machine with a 6 degrees wedge inserted under the head, as illustrated in Figure 1 and tensile tested to failure as described in 6.2. The wedge shall be so placed that no corner of the hexagon screw head takes the bearing load; that is, a flat of the head shall be aligned with the direction of uniform thickness of the wedge.

To meet the requirements of 5.2.1, the load at failure should not be less than the tensile load given in Table 3 for the applicable size and grade. In addition, failure shall occur in the body or threads with no fracture at the junction of the head and shank or failure due to any portion of the shank being pulled out of the head.

6.3.1 Wedge may be either circular or square. (See Figure 1.) Recommended outside dimension is 1.25 in for screw sizes No. 4 through No. 12 and 1.75 in for larger sizes. Thickness of wedge at thin size of hole shall be equivalent to one-half the nominal diameter of the screw but not less than 0.12 in. Hole shall be 0.020 in over the nominal diameter of the screw for sizes No. 4 through No. 12, 0.030 in over for sizes 1/4 through 1/2 in, and 0.050 in over for sizes 9/16 through 3/4 in. Top and bottom edges of the hole shall be rounded or chamfered, with radius and depth of chamfer as follows: 0.020 in for sizes No. 4 through No. 12, 0.030 in for sizes 1/4 through 1/2 in, and 0.060 in for sizes 9/16 through 3/4 in. The wedge shall have a minimum hardness of Rockwell C45.



A = WEDGE OUTSIDE DIMENSIONS (SEE PARAGRAPH 6.3.1)
C = CLEARANCE HOLE (SEE PARAGRAPH 6.3.1)
D = DIAMETER OF SCREW
R = RADIUS OR CHAMFER (SEE PARAGRAPH 6.3.1)
T = THICKNESS AT THIN SIDE OF HOLE (SEE PARAGRAPH 6.3.1)
W = WEDGE ANGLE (6 DEG)

FIGURE 1—WEDGE TEST DETAILS

7. Marking—Machine screws need not be marked to identify grade or manufacturer.