SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J995

REV. JUL1999

Issued 1967-08
Revised 1999-07

Superseding J995 JUN79

Submitted for recognition as an American National Standard

(R) Mechanical and Material Requirements for Steel Nuts

1. ***Scope—***This SAE Standard covers the mechanical and material requirements for three grades of steel nuts suitable for use in automotive and related engineering applications, in sizes 1/4 to 1-1/2 in, inclusive, and with dimensions conforming with the requirements of the latest issue of ASME B18.2.2 or ASME B18.6.3, as applicable.

1.1 This document does not include limits for surface discontinuities. Where usage requires such control, limits may be specified separately. For sizes 1/4 through 1 in, this may be done by the statement: "Surface discontinuities shall not exceed the limits specified in SAE J122."

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 version shall apply.

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

SAE J122—Surface Discontinuities on Nuts
SAE J409—Product Analysis—Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel
SAE J417—Hardness Test and Hardness Number Conversions

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

ASME B18.2.2—Square and Hex Nuts (Inch Series)
ASME B18.6.3—Machine Screws and Machine Screw Nuts

3. ***Designation—***The three grades of nuts are designated Grades 2, 5, and 8.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

4. Material—Nuts shall be made of steel conforming to the chemical composition limits specified in Table 1.

TABLE 1—CHEMICAL COMPOSITION REQUIREMENTS(1)

Nut Grade	C Max	Mn Min	P Max	S Max
2	0.47	—	0.12(2)	0.15(3)
5	0.55	0.30	0.05(4)(5)	0.15(3)(5)
8	0.55	0.30	0.04	0.05(6)

1. All values are for ladle analysis (percent by weight) and are subject to standard variations for check analysis as given in SAE J409.
2. Resulfurized and rephosphorized material is not subject to rejection based on check analysis for sulfur.
3. If agreed between purchaser and producer, sulfur content may be 0.23 max.
4. Phosphorus content may be 0.13 max for acid bessemer steel only.
5. If agreed between purchaser and producer, sulfur content may be 0.35 max and phosphorus content may be 0.12 max provided that manganese content is 0.70 min.
6. If agreed between purchaser and producer, sulfur content may be 0.33 max provided that manganese content is 1.35 min.

5. Mechanical Requirements

5.1 Proof Load—Nuts described in this document shall withstand the proof load stress specified in Table 2 for the nut grade, size, and thread series.

TABLE 2—PROOF LOAD REQUIREMENTS FOR NUTS(1)

Nut Grade Nut Size Thread Series Nut Type	2(2) 1/4 thru 1-1/2 UNC and 8UN Proof Load Stress, psi(1)	5 1/4 thru 1 UNC and 8UN Proof Load Stress, psi(1)	5 1/4 thru 1 UNF, 12 UN and Finer Proof Load Stress, psi(1)	5 Over 1 thru 1-1/2 UNC and 8UN Proof Load Stress, psi(1)	5 Over 1 thru 1-1/2 UNF, 12UN and Finer Proof Load Stress, psi(1)	8 1/4 thru 1-1/2 UNC and 8UN Proof Load Stress, psi(1)	8 1/4 thru 1-1/2 UNF, 12UN and Finer Proof Load Stress, psi(1)
Hex	—	120 000	109 000	105 000	94 000	150 000	150 000
Hex Flange	—	120 000	109 000	105 000	94 000	150 000	150 000
Hex Jam(3)	—	72 000	65 000	63 000	57 000	90 000	90 000
Heavy Hex Jam(3)	—	72 000	65 000	63 000	57 000	90 000	90 000
Hex Slotted(3)	—	96 000	87 000	84 000	75 000	120 000	120 000
Heavy Hex(3)	—	133 000	120 000	116 000	105 000	165 000	150 000
Hex Thick(3)	—	133 000	120 000	116 000	105 000	165 000	150 000
Heavy Hex Slotted(3)	—	105 000	96 000	92 000	84 000	132 000	120 000
Hex Thick Slotted(3)	—	105 000	96 000	92 000	84 000	132 000	120 000
Square(2)	90 000	—	—	—	—	—	—

1. The proof load in pounds for a nut is computed by multiplying the proof load stress, in psi (lbf/in^2), for the nut grade, size, thread series, and type, as shown in Table 2, and the stress area, in sq in (in^2), for the applicable size and thread series shown in Table 3. (See Appendix A, Table A1 for computed values for some products.)
2. Grade 2 is normally applicable to square nuts only, and square nuts are normally available in Grade 2 only.
3. Proof load stress values for hex jam, heavy hex jam, hex slotted, heavy hex, hex thick, heavy hex slotted, and hex thick slotted nuts are based on requirements for hex nuts. Primarily, each value is derived from the ratio of minimum thickness of the product involved to the minimum thickness of hex or square machine screw nuts and hex nuts (see ASME B18.2.2 and ASME B18.6.3) of the same size—and adjusted to compensate for differences in width across flats, width and depth of slots, and depth of countersink.

TABLE 3—TENSILE STRESS AREAS (TEST BOLT OR MANDREL)

Coarse Thread Series UNC Nominal Size and Threads Per Inch	Coarse Thread Series UNC Tensile Stress Area, sq in	Fine Thread Series UNF Nominal Size and Threads Per Inch	Fine Thread Series UNF Tensile Stress Area, sq in	8–Thread Series 8 UN Nominal Size and Threads Per Inch	8–Thread Series 8 UN Tensile Stress Area sq in
1/4 – 20	0.0318	1/4 – 28	0.0364	—	—
5/16 – 18	0.0524	5/16 – 24	0.0580	—	—
3/8 – 16	0.0775	3/8 – 24	0.0878	—	—
7/16 – 14	0.1063	7/16 – 20	0.1187	—	—
1/2 – 13	0.1419	1/2 – 20	0.1599	—	—
9/16 – 12	0.182	9/16 – 18	0.203	—	—
5/8 – 11	0.226	5/8 – 18	0.256	—	—
3/4 – 10	0.334	3/4 – 16	0.373	—	—
7/8 – 9	0.462	7/8 – 14	0.509	—	—
1 – 8	0.606	1 – 12	0.663	1 – 8	0.606
1-1/8 – 7	0.763	1-1/8 – 12	0.856	1-1/8 – 8	0.790
1-1/4 – 7	0.969	1-1/4 – 12	1.073	1-1/4 – 8	1.000
1-3/8 – 6	1.155	1-3/8 – 12	1.315	1-3/8 – 8	1.233
1-1/2 – 6	1.405	1-1/2 – 12	1.581	1-1/2 – 8	1.492

5.2 Hardness—Nuts shall have a hardness within the limits specified in Table 4.

TABLE 4—HARDNESS REQUIREMENTS FOR NUTS

Nut Grade	Nominal Nut Size	Hardness
2	1/4 thru 1-1/2	32 HRC max
5	1/4 thru 1-1/2	32 HRC max
8	1/4 thru 5/8	24 – 32 HRC
8	Over 5/8 thru 1	26 – 34 HRC
8	Over 1 thru 1-1/2	26 – 36 HRC

6. Test Methods

6.1 Proof Load Test—The nut shall be assembled on a test bolt or on a hardened and threaded mandrel, as described in the following and illustrated in Figure 1. The specified proof load for the nut shall be applied against the nut in an axial direction. (See footnote 1 of Table 2 for method for computing the proof load in pounds for a nut.) The nut shall resist this load without failure by stripping or rupture, and shall be removable from the test bolt or mandrel by the fingers after the load is released.

NOTE—Occasionally it may be necessary to use a manual wrench or other means to start the nut in motion. Use of such means is permissible, providing the nut is removable by the fingers following an initial loosening of not more than one-half turn of the nut.

If the threads of the test bolt or mandrel are damaged during the test, the test shall be discarded.

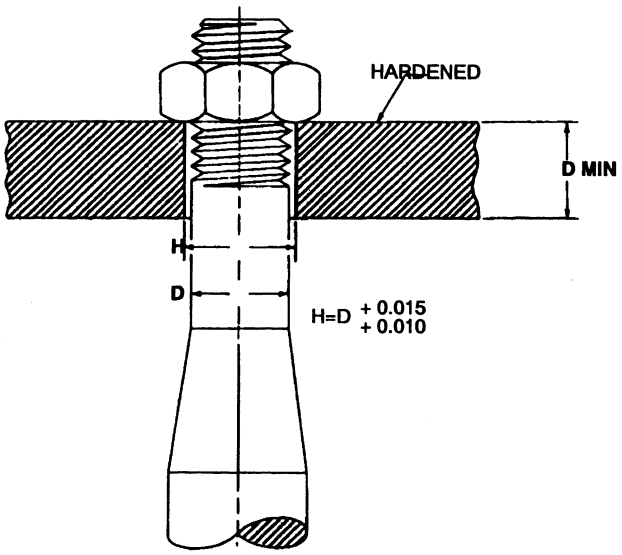

FIGURE 1—PROOF LOAD TEST

Test bolts shall have threads conforming to Class 2A tolerances and shall have a yield strength in excess of the specified proof load of the nut being tested.

Mandrels shall have a minimum hardness of 45 HRC; and shall be threaded to Class 3A tolerance, except that the major diameter shall be the minimum major diameter with a tolerance of +0.002 in.

For referee purposes, the proof load test shall be conducted using a hardened mandrel.

6.2 Hardness Test—Rockwell hardness shall be determined on the top or bottom nut face halfway between the major diameter of the thread and one corner, or, if applicable, on a wrench face one-third of the distance from corner to the center of the wrench face. In preparing the surface, sufficient material shall be removed to assure elimination of any decarburization or other surface irregularities.

Hardness tests shall be conducted in accordance with SAE J417.

7. Marking—Three “styles” of grade marking are acceptable. Style A is applicable to all types and sizes of nuts. Style B is applicable to hex nuts of sizes 5/8 in and larger; but may be used for smaller sizes or other types of nuts only when authorized by the purchaser. Style C is applicable to nuts which are fabricated by cutting from hex bar.

Marking for source (manufacturer or private label distributor) identification shall be by the manufacturer’s or private label distributor’s mark.

Markings shall not project beyond the height or width across flats of the nuts. No more than 10% of the nut top surface area may be used for grade and source markings. In the case of double chamfer nuts, one face only is considered a top surface.

Style A marking shall be depressed on the top surface of the nut on a circular line or path approximately midway between hole diameter and hex flat diameter, or, for hex flange nuts at the supplier’s option, raised or depressed on top of the flange, and shall consist of: a single circumferential line for Grade 2 nuts; two circumferential lines 120 degrees apart for Grade 5 nuts; and two circumferential lines 60 degrees apart for Grade 8 nuts. The circumferential lines shall conform to the following dimensions (inch, nominal): (See Table 5.)

TABLE 5—MARKING DIMENSIONS

Nut Size	Marking Lines[(1)] Width	Marking Lines(1) Length	Marking Line(1) Depth
1/4 and 5/16	0.015	0.05	0.010
3/8 thru 9/16	0.020	0.06	0.010
5/8 thru 7/8	0.030	0.08	0.010
1 and larger	0.030	0.12	0.010

1. For hex flange nuts, lines on the top of the flange may be up to two times the dimensions shown.

Style B marking shall be raised or depressed on the chamfer surface of the top of the nut corners, and shall consist of: one circumferential line on one corner for Grade 2 nuts; one circumferential line on each of two corners 120 degrees apart for grade 5 nuts; and one circumferential line on each of two corners 60 degrees apart for Grade 8 nuts.

Style C marking shall consist of notches at the hexagon corners, one notch at each corner for Grade 5 nuts, and two notches at each corner for Grade 8 nuts.

7.1 Grade 2 nuts are not required to be marked for grade or source identification, unless specified by the purchaser. If marked, Grade 2 nuts shall be marked with grade and source identification marks.

7.2 Grade 5 and Grade 8 hex and hex flange nuts, sizes 1/4 through 1-1/2, shall be marked for grade identification and for source identification. Grade 5 and Grade 8 hex jam, heavy hex jam, hex slotted, heavy hex slotted, hex thick slotted, hex thick, and heavy hex nuts are not required to be marked for grade or source identification, unless specified by the purchaser. If marked, Grade 5 and Grade 8 hex jam, heavy hex jam, hex slotted, heavy hex slotted, hex thick slotted, hex thick, and heavy hex nuts shall be marked with grade and source identification marks.

8. Testing Requirements

8.1 Manufacturer's Responsibility—During the manufacture of products to the requirements of this specification, the manufacturer shall make periodic tests to ensure that the properties of the product are being maintained within specified limits. For all Grade 8 nuts, and for Grade 5 hex and hex flange nuts, each lot shall be tested. Such tests shall be conducted in accordance with a sampling plan, preferably the sampling plan given in 8.3, and the test results shall be recorded in a test report. When requested in writing by the purchaser, the manufacturer shall furnish a copy of the test report certified to be a report of the results of the lot for Grade 8 nuts or Grade 5 hex or hex flange nuts, or, for other nuts, of the last completed set of tests for the specific type, size, and grade of product.

8.2 Purchaser's Options—If the purchaser requires that additional tests be performed by the manufacturer to determine that the properties of products in an individual lot or shipment are within specified limits, or if the purchaser requires that a sampling plan different from that given in 8.3 shall be used when determining the acceptability of a lot, or shipment, of products, the purchaser shall specify the complete testing requirements, including sampling plan and basis of acceptance, in the original inquiry and purchase order.

8.3 General—An acceptable sampling plan, with the acceptance criteria of zero nonconformances, is outlined in Table 6.

A lot, for purposes of selecting test specimens, shall consist of a quantity of nuts of one part number manufactured by the same production process from the same coil or heat number of steel and submitted for inspection and testing at one time.

TABLE 6—SAMPLING PLAN

Number of Pieces in Lot	Minimum Number of Specimens to be Tested
50 and under	2
51 to 500	3
501 to 35 000	5
35 001 to 250 000	8

The same test specimens may be used for different tests wherever practical.

If the failure of a test specimen is due to improper preparation of the specimen or to incorrect testing technique, the specimen shall be discarded and another specimen substituted.

9. Notes

9.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE FASTENERS COMMITTEE

APPENDIX A

A.1 See Table A1.

TABLE A1—PROOF LOAD FOR MISCELLANEOUS NUTS,(1) LBF (UNC THREADS ONLY)

Nominal Nut Size and Threads Per Inch	Square Nuts Grade 2	Hex and Hex Flange Nuts Grade 5	Hex and Hex Flange Nuts Grade 8	Hex Jam and Heavy Hex Jam Nuts Grade 5	Hex Jam and Heavy Hex Jam Nuts Grade 8	Hex Slotted Nuts Grade 5	Hex Slotted Nuts Grade 8	Heavy Hex and Hex Thick Nuts Grade 5	Heavy Hex and Hex Thick Nuts Grade 8	Heavy Hex Slotted and Hex Thick Slotted Nuts Grade 5	Heavy Hex Slotted and Hex Thick Slotted Nuts Grade 8
1/4 – 20	2 850	3 800	4 750	2 300	2 850	3 050	3 800	4 250	5 250	3 350	4 200
5/16 – 18	4 700	6 300	7 850	3 750	4 700	5 050	6 300	6 950	8 650	5 500	6 900
3/8 – 16	7 000	9 300	11 600	5 600	7 000	7 450	9 300	10 300	12 800	8 150	10 200
7/16 – 14	9 550	12 800	15 900	7 650	9 550	10 200	12 800	14 100	17 500	11 200	14 000
1/2 – 13	12 800	17 000	21 300	10 200	12 800	13 600	17 000	18 900	23 400	14 900	18 700
9/16 – 12	16 400	21 800	27 300	13 100	16 400	17 500	21 800	24 200	30 000	19 100	24 000
5/8 – 11	20 300	27 100	33 900	16 300	20 300	21 700	27 100	30 100	37 300	23 700	29 800
3/4 – 10	30 100	40 100	50 100	24 000	30 100	32 100	40 100	44 400	55 100	35 100	44 100
7/8 – 9	41 600	55 400	69 300	33 300	41 600	44 400	55 400	61 400	76 200	48 500	61 000
1 – 8	54 500	72 700	90 900	43 600	54 500	58 200	72 700	80 600	100 000	63 600	80 000
1-1/8 – 7	68 700	80 100	114 000	48 100	68 700	64 100	91 600	88 500	126 000	70 200	101 000
1-1/4 – 7	87 200	102 000	145 000	61 000	87 200	81 400	116 000	112 000	160 000	89 100	128 000
1-3/8 – 6	104 000	121 000	173 000	72 800	104 000	97 000	139 000	134 000	191 000	106 000	152 000
1-1/2 – 6	126 000	148 000	211 000	88 500	126 000	118 000	169 000	163 000	232 000	129 000	185 000

1. Computed according to Table 2, Footnote 1, using psi (lbf/in^2) values shown in Table 2.

Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—This SAE Standard covers the mechanical and material requirements for three grades of steel nuts suitable for use in automotive and related engineering applications, in sizes 1/4 to 1-1/2 in, inclusive, and with dimensions conforming with the requirements of the latest issue of ASME B18.2.2 or ASME B18.6.3, as applicable.

This document does not include limits for surface discontinuities. Where usage requires such control, limits may be specified separately. For sizes 1/4 through 1 in, this may be done by the statement: "Surface discontinuities shall not exceed the limits specified in SAE J122."

Reference Section

SAE J122—Surface Discontinuities on Nuts

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

SAE J417—Hardness Tests and Hardness Number Conversions

ASME B18.2.2—Square and Hex Nuts (Inch Series)

ASME B18.6.3—Machine Screws and Machine Screw Nuts

Developed by the SAE Fasteners Committee