

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS F-31, Part II
		Former Designation: CEMS A-31 Part II
TITLE: Steel Nuts		CURRENT REV No.: 1402
		DATE: Feb. 2014
WRITTEN/EDITED BY: Materials Engineering	APPROVED BY: Materials Engineering	SUPERSEDES: CEMS A-31 Pt II – Oct. 2012
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<i>This specification may involve hazardous materials, equipment, and procedures. This specification does not purport to address all of the safety issues associated with its use. The user is responsible to consult appropriate safety and health practices and to determine the applicability of regulatory limits prior to use.</i>		
Change Notice: New MPAPS format; editorial changes.		

1.0 APPLICATION

This specification provides guidance to the selection and use of fasteners in Navistar design. Bolted joints are used extensively in the assembly of our products and provide for adjustment, replacement and ease of repair. Material properties of both inch and metric fasteners are covered in this specification.

2.0 SCOPE

This specification covers Navistar's requirements for the material and properties of steel nuts. Dimensional and general specifications for standard nuts are covered in the Engineering Standard Parts (ESP) specifications, Sections E and EM. Nonstandard parts will be covered by engineering drawings which should refer to this specification for material and properties.

2.1 Restricted Chemical Substances

Effective January 1, 2007, all product supplied to the requirements of this specification must comply with the requirements of the MPAPS B-50 specification.

3.0 CONTENTS

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4.0 REFERENCE DOCUMENTS

Unless otherwise specified, the latest issue of all referenced standards shall apply. The following Specifications, Standards, and Regulations are referenced in this specification.

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Quality System Standard ISO 9001 or TS-16949
CFR Title 29, Part 1910
NAVISTAR Manufacturing Std. MS-D-13
NAVISTAR Engineering Design Std A-16
NAVISTAR MPAPS B-50
CEMS A-40

SAE J995
ASMEB18.2.4.2M
ASME B18.2.2
ASME B1.1

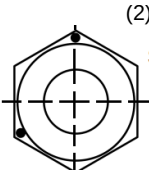
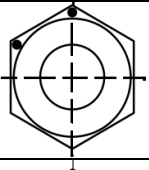
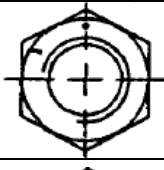
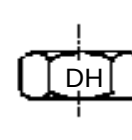
ASTM A563
ASTM E18
ISO 898-2
ISO 965

5.0 GRADE CLASSIFICATION AND NUT IDENTIFICATION

This specification covers inch and metric steel nut material types classified as shown in Tables I and Ia. Increasing Type and Class numbers represent increasing material tensile strengths.

Requirements for marking and identification of nuts are shown in Tables I and Ia. Identification symbols may be either raised or depressed markings. Raised markings will not project beyond the height or width of the nut. Alternate methods of marking may be used but must be approved by the purchaser.

TABLE I - GRADE CLASSIFICATION AND IDENTIFICATION - INCH NUTS

Navistar Type	Designation			Marking Methods			Corresponding Navistar Bolt Type
	Obsolete IH Type	Approx SAE J995 Grade	Approx ASTM A 563 Grade				
1	-	2	A	Not Required			1
5	2	5	B			-	5
8	4, 4A, 8T	8	D			-	8
9 ⁽¹⁾	-	-	DH ⁽³⁾				9

- (1) These nuts are for special use only. The same restrictions for the usage of the corresponding Navistar bolt type (per A-31 Part I) also applies to these nuts. Approval of Design Analysis and Materials Engineering is required prior to the usage of these nuts.
- (2) Preferred markings: non-preferred and alternate marking methods must be approved by purchaser before using.
- (3) Representative of Type 9 strength levels only with hex thick nut styles.

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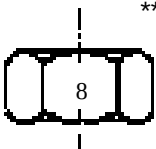
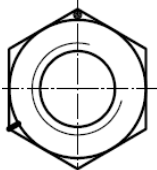
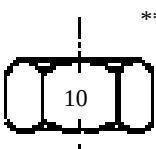
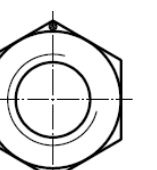
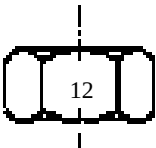
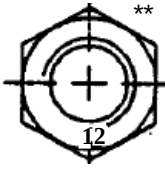
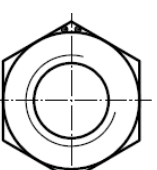


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TABLE Ia. GRADE CLASSIFICATION AND IDENTIFICATION - METRIC NUTS

Designation		Marking Methods				Corresponding Navistar Bolt Class
Navistar Class	Approx ISO 898-2					
5	5					5.8
8	8					8.8
10***	10					10.9
12*	12					12.9

* These nuts are for special use only. The same restrictions for the usage of the corresponding Navistar bolt class (per A-31, Part I) also apply to these nuts. Approval of Design Analysis and Materials Engineering is required prior to the usage of these nuts.

** Preferred markings: non-preferred and other alternate marking methods must be approved by purchaser before using.

*** Class 10 nut is also suitable for a Class 9.8 bolt

6.0 GENERAL REQUIREMENTS

6.1 Chemical Composition

Nuts purchased to this specification will be made from steel conforming to the product analysis limits shown in Tables II and IIa.

TABLE II. CHEMICAL COMPOSITION - INCH NUTS

Navistar Type	Element, Percent *			
	Carbon, max	Manganese, min	Phosphorus, max	Sulfur, max
1	0.55	-	0.12	0.35
5	0.55	0.30	0.05 **	0.15 **
8	0.55	0.30	0.04	0.05 ***
9	0.55	0.45	0.04	0.05

* Alloying elements may be added, if necessary, to develop mechanical properties.

** If agreed upon between purchaser and supplier, sulfur content for Type 5 nuts may be 0.35% max and phosphorus content may be 0.12% max, provided that manganese content is 0.70% min.

*** If agreed between purchaser and supplier, sulfur content for Type 8 nuts may be 0.35% maximum provided that the minimum manganese content is 1.35%.

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**TABLE IIa
CHEMICAL COMPOSITION - METRIC NUTS**

Navistar Type	Element, Percent *			
	Carbon, max	Manganese, min	Phosphorus, max	Sulfur, max
5 **	0.58	-	0.12	0.15
8	0.58	0.25	0.06	0.15
10	0.58	0.30	0.05	0.06
12	0.58	0.45	0.05	0.06

* Alloying elements may be added, if necessary, to develop mechanical properties.

** Nuts of this property class may be manufactured from free-cutting steel unless otherwise agreed between the purchaser and the manufacturer. In such cases, the following maximum sulfur, phosphorus, and lead contents, respectively, are permissible: sulfur 0.34%, lead 0.35%

6.2 Mechanical Properties

Steel nuts purchased to this specification will have mechanical properties as shown in Tables III and IIIa. Refer to "Methods of Test," Section 8.0.

Proof load stress requirements will be determined by multiplying the appropriate proof load stress requirements shown in Tables III and IIIa by the factors given in Table IV. The tensile stress areas are based on the stress areas of the test bolts or mandrels. For convenience, requirements converted to proof load for common sizes of hex and square nuts (proof load stress nut factor = 1.00) are shown in Tables V and Va.

**TABLE III
MECHANICAL PROPERTIES - INCH NUTS***

Designation		Nominal Size, inches	Proof Load Stress, minimum				Hardness, HRC
Navistar Type	Approx SAE Grade		Coarse Threaded Nuts		Fine Threaded Nuts		
			psi	MPa	psi	MPa	
1**	2	All	90000	620	80000	550	32 max
5	5	¼ Thru 1 Over 1 thru 1-1/2	120000 105000	825 725	109000 94000	750 650	32 max 32 max
8	8	Thru 5/8 Over 5/8 thru 1 Over 1 thru 1-1/2	150000	1035	150000	1035	24-32 26-34 26-36
9***	-	1/4 Thru 1-1/2	177000	1220	177000	1220	26-36

* See "Heat Treatment," Section 6.4, for requirements applicable to nuts case hardened to provide resistance to wrenching damage. Tabulated proof load stresses apply to standard hex nuts per the Navistar Standard Parts book, except as otherwise noted.

** Type 1 nuts are normally available only as square nuts in regular sizes and as hex nuts in machine screw sizes.

*** Nuts are restricted to the hex thick style per ASME B18.2.2 and the proof load stresses apply to this style nut.

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**TABLE IIIa
MECHANICAL PROPERTIES - METRIC NUTS***

International Class	Nominal Size, Millimeters	Proof Load Stress, Minimum **		Hardness, HRC
		MPa	psi	
5	Thru 7	580	84100	30 max
	Over 7 thru 10	590	85 600	
	Over 10 thru 16	610	88500	
	Over 16 thru 39	630	91400	
8	Thru 7	810	117500	30 max
	Over 7 thru 10	830	120400	
	Over 10 thru 16	840	122000	
	Over 16 thru 39	920	133400	36 max
10	Thru 10	1040	150800	26-36
	Over 10 thru 16	1050	152300	
	Over 16 thru 39	1060	153700	
12***	All	1220	177000	26-36

* See "Heat Treatment," Section 6.4, for requirements applicable to nuts case hardened to provide resistance to wrenching damage. Tabulated proof load stresses apply to the standard hex nuts per Navistar Standard Parts specifications, except as otherwise noted.

** Coarse threaded nuts only; fine threaded nuts are not available.

*** Nuts are restricted to style 2 per ASME B18.2.4.2M and the proof load stress applies to the style 2 nut.

For convenience in testing, proof load stress specifications shown in Tables III and IIIa are converted to proof loads in pounds-force (lbf) and kilonewtons (kN) in Tables V and Va, respectively. Proof load requirements for different style nuts may be determined by multiplying those in the table by the appropriate nut factor shown in Table IV. The formulas shown below Tables V and Va may be used for calculating proof loads for nonstandard size nuts.

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TABLE IV
PROOF LOAD STRESS AND PROOF LOAD NUT FACTORS - INCH NUTS

Nut Style	Nut Factor
Hex	1.00
Slotted Hex	0.80
Hex Jam	0.60
Hex Thick:	
Coarse & Fine Threaded Type 5	1.10
Coarse Threaded Type 8	1.10
Fine Threaded Type 8	1.00
Hex Thick Slotted:	
Coarse & Fine Threaded Type 5	0.88
Coarse Threaded Type 8	0.88
Fine Threaded Type 8	0.80
Square	1.00
Crown:	
Low	1.10
High	1.18
Hex Locknuts:	
Type LJ	0.48
Types L & HL	0.80
Types LT & HLT	0.97
Types CL & HO	1.00
Type CLT	1.08
Type Prevailing Torque:	
All Metal:	
Coarse & Fine Threaded	
Types 1 & 8	1.00
Coarse Threaded Type 5	1.00
Fine Threaded Type 5	1.10
With Nonmetallic Component	*

* Requirements are covered in the Engineering Standard Parts specifications, Section E.

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TABLE V
PROOF LOADS FOR HEX AND SQUARE NUTS - INCH NUTS

Nominal Size (in.) and Threads per Inch	Stress Area		Proof Load							
			lbf				kN			
	in ²	mm ²	Type 1	Type 5	Type 8	Type 9	Type 1	Type 5	Type 8	Type 9
Coarse Threaded (UNC) Nuts										
1/4 – 20	0.0318	20.5	2850	3800	4750	5550	12.7	16.9	21.2	24.6
5/16 – 18	0.0524	33.8	4700	6300	7850	9150	21.0	27.9	35.0	40.6
3/8 – 16	0.0775	50.0	7000	9300	11600	13600	31.0	41.2	51.8	60.0
7/16 – 14	0.1063	68.6	9550	12800	15900	18600	42.5	56.6	71.0	82.3
1/3 – 13	0.1419	91.5	12800	17000	21300	24800	56.7	75.5	94.7	110.0
9/16 – 12 *	0.1820	117.4	16400	21800	27300	31900	72.8	96.9	122.0	141.0
5/8 – 11	0.2260	145.8	20300	27100	33900	39600	90.4	120.0	151.0	175.0
3/4 – 10	0.3340	215.5	30100	40100	50100	58500	134.0	178.0	223.0	259.0
7/8 – 9	0.4620	298.1	41600	55400	69300	80900	185.0	246.0	309.0	358.0
1 – 8	0.6060	391.0	54500	72700	90900	106000	242.0	323.0	405.0	469.0
1-1/8 – 7	0.7630	492.3	68700	80100	114000	134000	305.0	357.0	510.0	591.0
1-1/4 – 7	0.9690	625.2	87200	102000	145000	170000	388.0	453.0	647.0	750.0
1-3/8 – 6	1.1550	745.2	104000	121000	173000	202000	462.0	540.0	771.0	894.0
1-1/2 – 6	1.4050	906.4	126000	148000	211000	246000	562.0	657.0	938.0	1088.0
Fine Threaded (UNF) Nuts										
1/4 – 28	0.0364	23.5	3300	3950	5450	6350	14.6	17.6	24.3	28.2
5/16 – 24	0.0580	37.4	5200	6300	8700	10200	23.2	28.0	38.7	44.9
3/8 – 24	0.0878	56.6	7900	9550	13200	15400	35.1	42.4	58.6	67.9
7/16 – 20	0.1187	76.6	10700	12900	17800	20800	47.5	57.4	79.3	91.9
1/2 – 20	0.1599	103.2	14400	17400	24000	28000	64.0	77.4	107.0	124.0
9/16 – 18 *	0.2030	131.0	18300	22100	30400	35500	81.2	98.2	136.0	157.0
5/8 – 18	0.2560	165.2	23000	27900	38400	44800	102.0	124.0	171.0	198.0
3/4 – 16	0.3730	240.6	33600	40700	56000	65300	149.0	180.0	249.0	289.0
7/8 – 14	0.5090	328.4	45800	55500	76400	89100	204.0	246.0	340.0	394.0
1 – 14 **	0.6798	438.6	61200	74100	102000	119000	272.0	329.0	454.0	526.0
1 – 12	0.6630	427.7	59700	72300	99400	116000	265.0	321.0	443.0	513.0
1-1/8 – 12	0.8560	552.3	77000	80500	128000	150000	342.0	359.0	572.0	663.0
1-1/4 – 12	1.0730	692.3	96600	101000	161000	188000	429.0	450.0	717.0	831.0
1-3/8 – 12	1.3150	848.4	118000	124000	197000	230000	526.0	551.0	878.0	1018.0
1-1/2 – 12	1.5810	1020.0	142000	149000	237000	277000	632.0	663.0	1060.0	1224.0

* Not recommended for new design.

** 1-14 is the Navistar standard thread (UNS-not UNF). Refer to Navistar Engineering Procedural Standard EPS-61.

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TABLE Va
PROOF LOAD FOR METRIC HEX NUTS, COARSE THREADS

Nominal Thread Diameter, mm	Pitch of Thread, mm	Nominal Stress Area, mm ²	Proof Load							
			kN				lbf			
			Class 5	Class 8	Class 10	Class 12	Class 5	Class 8	Class 10	Class 12
6	1.0	20.1	11.7	16.3	20.9	24.1	2650	3600	4700	5500
7	1.0	28.9	16.8	23.4	30.1	34.7	3800	5300	6800	7800
8	1.25	36.6	21.6	30.4	38.1	43.9	4850	6850	8600	9900
10	1.5	58.0	34.2	48.1	60.3	69.6	7700	10800	13500	15700
12	1.75	84.3	51.4	70.8	88.5	101.0	11600	15900	19900	22900
14	2.0	115.0	70.2	96.0	121.0	138.0	15800	21600	27200	31200
16	2.0	157.0	95.8	132.0	165.0	188.0	21500	29700	37100	42600
18	2.5	192.0	121.0	177.0	204.0	230.0	27200	39700	45700	52100
20	2.5	245.0	154.0	225.0	260.0	294.0	34700	50700	58400	66500
22	2.5	303.0	191.0	279.0	321.0	364.0	42900	62700	72200	85200
24	3.0	353.0	222.0	325.0	374.0	424.0	50000	73000	84100	95800
27	3.0	459.0	289.0	422.0	487.0	551.0	65000	94900	109400	124500
30	3.5	561.0	353.0	516.0	595.0	673.0	79400	116000	133700	152200
33	3.5	694.0	437.0	639.0	736.0	833.0	98300	143500	165400	188200
36	4.0	817.0	515.0	752.0	866.0	980.0	115700	169000	194700	221600
39	4.0	976.0	615.0	898.0	1035.0	1171.0	138200	201900	232700	264700

6.3 Metallurgical Requirements

6.3.1 Surface Discontinuities

The following practice defines, illustrates and specifies the allowable limits for surface discontinuities that may occur during the manufacture and processing of all steel nuts described in this specification.

6.3.1.1 Types of Surface Discontinuities: For the purpose of this specification, surface discontinuities on nuts are classified and defined as follows:

6.3.1.1.1 Cracks - A crack is a clean fracture passing through or across the grain boundaries without inclusion of foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operations or during heat treatment.

6.3.1.1.1.1 Quench Cracks - Quench cracks may occur during heat treatment due to excessively high thermal and transformation stresses. They usually traverse an irregular and erratic course on the surface of the nut. Typical quench cracks are shown in Figure 1.

6.3.1.1.1.2 Forging Cracks - Forging cracks may occur during the cutoff or forging operations and are located on the top and bottom face of the nut, and at the intersection of the face and flat. Typical forging cracks are shown in Figure 2.

6.3.1.1.1.3 Locking Element Cracks - These cracks may occur due to the application of pressure against the nut when introducing the locking element into prevailing torque nuts. Cracks of this type are usually located in the vicinity of the locking element and may either be on the internal or external surface. Typical locking element cracks are shown in Figure 3.

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