

ASME B18.16.6-2008

# Nylon Insert Locknuts (Inch Series)

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AN AMERICAN NATIONAL STANDARD



The American Society of  
Mechanical Engineers



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Date of Issuance: November 24, 2008

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# FOREWORD

ASME B18.16.6-2008 was balloted and approved by the B18 Standards Committee and B18 Subcommittee 16 on April 29, 2008. The proposal was submitted to the American National Standards Institute and designated as an American National Standard on August 25, 2008.

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The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

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The request for an interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
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# NYLON INSERT LOCKNUTS (INCH SERIES)

## 1 INTRODUCTION

### 1.1 Scope

This Standard covers the complete general, dimensional, mechanical, and performance data for carbon steel, inch series nylon insert locknuts of property grades NE2, NE5, and NE8 designated as American National Standard.

The inclusion of dimensional data in this Standard is not intended to imply that all of the locknut sizes in conjunction with the various options described herein are stock items. Consumers should consult with suppliers concerning lists of stock production nylon insert locknuts.

### 1.2 Comparison to ISO Standards

There is no ISO inch standard for these products at this time.

## 2 REFERENCE STANDARDS

The following is a list of publications referenced in this Standard. Unless otherwise specified, the reference standard(s) shall be the most recent issue at the time of order placement.

- ASME B1.1, Unified Inch Screw Threads
- ASME B1.3, Screw and Thread Gaging Systems for Dimensional Acceptability—Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)
- ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series)
- ASME B18.12, Glossary of Terms for Mechanical Fasteners
- ASME B18.18.1, Inspection and Quality Assurance for General Purpose Fasteners
- ASME B18.18.2M, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners
- ASME B18.22.1, Plain Washers
- Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2300, Fairfield, NJ 07007-2300
- ASTM B 117, Standard Practice for Operating Salt Spray (Fog) Apparatus
- ASTM E 18, Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

- ASTM F 436, Hardened Steel Washers
- ASTM F 812, Surface Discontinuities of Nuts (Inch Series)
- ASTM F 1941, Electrodeposited Coatings on Threaded Fasteners [Unified Inch Screw Threads (UN/UNR)]
- Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959
- SAE J121, Decarburization in Hardened and Tempered Unified Threaded Fasteners
- SAE J409, Product Analysis — Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel
- Publisher: Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001

## 3 TERMINOLOGY

For definitions of other terms relating to fasteners or component features thereof used in this Standard, refer to ASME B18.12.

## 4 DIMENSIONS

Unless otherwise specified, all dimensions in this Standard are inches and shall be as specified in Table 1 and sections 6 through 9. All dimensions apply before plating or coating is specified. When plating or coating is specified, the finished product dimensions shall be agreed upon between the supplier and purchaser.

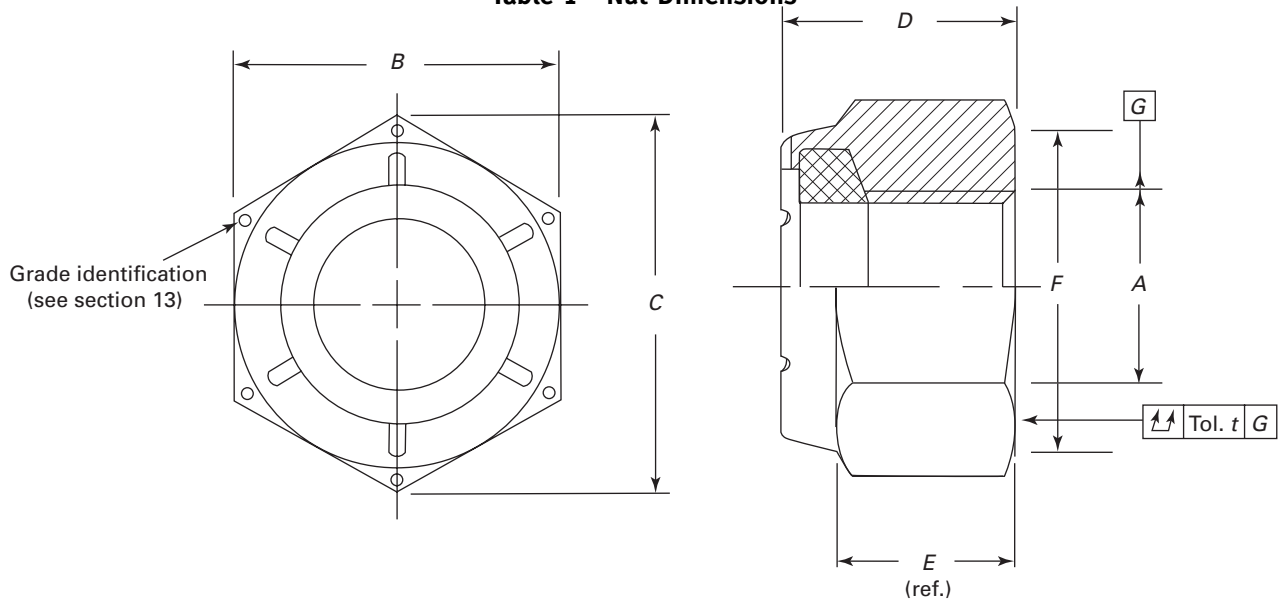
## 5 NUT DESIGNS AND PROPERTY GRADES

This Standard covers top insert, two-piece construction nuts that derive their prevailing-torque characteristics from an insert, usually a full ring of nonmetallic material, located and retained in the nut at its top surface. These are designated as property grade NE2, NE5, and NE8 meeting the mechanical and performance requirements of Table 2 or 3.

## 6 WIDTH ACROSS FLATS

The width across flats shall be the distance measured perpendicular to the axis of the nut between two opposite wrenching flats.



**Table 1 Nut Dimensions**

Nominal Size, A	Width Across Flats, B		Minimum Width Across Corners, C	Height, D		Minimum Hex Height (Ref.), E	Minimum Bearing Surface Diameter, F	Maximum Total Runout of Bearing Surface, FIM
	Max.	Min.		Max.	Min.			
1/4	0.439	0.430	0.488	0.328	0.298	0.225	0.416	0.010
5/16	0.502	0.489	0.557	0.359	0.329	0.250	0.475	0.011
3/8	0.564	0.551	0.628	0.468	0.438	0.335	0.534	0.012
7/16	0.627	0.616	0.698	0.468	0.438	0.324	0.597	0.013
1/2	0.752	0.736	0.840	0.609	0.579	0.464	0.712	0.014
9/16	0.877	0.861	0.982	0.656	0.626	0.469	0.830	0.015
5/8	0.940	0.922	1.051	0.765	0.735	0.593	0.890	0.016
3/4	1.064	1.052	1.191	0.890	0.860	0.742	1.033	0.018
7/8	1.252	1.239	1.403	0.999	0.969	0.790	1.230	0.020
1	1.440	1.427	1.619	1.078	1.016	0.825	1.418	0.022
1 1/8	1.627	1.614	1.833	1.203	1.141	0.930	1.605	0.025
1 1/4	1.815	1.801	2.046	1.422	1.360	1.125	1.793	0.028
1 3/8	2.008	1.973	2.259	1.609	1.547	1.282	1.962	0.031
1 1/2	2.197	2.159	2.473	1.640	1.578	1.313	2.148	0.034

## 7 CORNER FILL

A rounding or lack of fill at the junction of hex corners with the chamfer shall be permissible, provided the width across corners is within specified limits at and beyond a distance equal to 17.5% of the nominal thread diameter from the chamfered face.

## 8 HEIGHT

The locknut height shall be the overall distance, measured parallel to the axis of the locknut, from the top of the locknut to the bearing surface.

## 9 HEX HEIGHT

The hex height is the distance, measured at a corner of the hex, from the bearing surface.

## 10 THREADS

Threads shall be unified coarse or fine thread series (UNC or UNF series Class 2B) in accordance with ASME B1.1. Inspection shall be based on System 21 of ASME B1.3.

**Table 2 Proof Loads, Clamp Loads, and Prevailing-Torques for Coarse Thread Series  
Grades NE2, NE5, and NE8 Nuts**

Nut Size and Threads Per Inch	Grade NE2		Grade NE5		Grade NE8		Prevailing-Torque		
	Proof Load, lb	Clamp Load, lb	Proof Load, lb	Clamp Load, lb	Proof Load, lb	Clamp Load, lb	Maximum First Install, in.-lb	Minimum First Removal, in.-lb	Minimum Fifth Removal, in.-lb
$\frac{1}{4}$ -20	2,900	1,300	3,800	2,000	4,750	2,850	40	5.0	1.5
$\frac{5}{16}$ -18	4,700	2,150	6,300	3,350	7,850	4,700	80	8.0	2.5
$\frac{3}{8}$ -16	7,000	3,200	9,300	4,950	11,600	6,950	110	12.0	4.0
$\frac{7}{16}$ -14	9,550	4,400	12,800	6,800	15,900	9,600	135	17.0	5.0
$\frac{1}{2}$ -13	12,800	5,850	17,000	9,050	21,300	12,800	204	22.0	7.5
$\frac{9}{16}$ -12	16,400	7,550	21,800	11,600	27,300	16,400	300	30.0	10.0
$\frac{5}{8}$ -11	20,300	9,300	27,200	14,500	33,900	20,300	420	39.0	12.5
$\frac{3}{4}$ -10	30,000	13,800	40,100	21,300	50,100	30,100	540	58.0	20.0
$\frac{7}{8}$ -9	41,600	12,400	55,400	29,500	69,300	41,600	840	88.0	30.0
1-8	54,500	15,000	72,700	38,700	90,900	54,600	1,080	120.0	40.0
$1\frac{1}{8}$ -7	68,700	18,900	80,100	42,100	115,000	69,000	1,200	150.0	50.0
$1\frac{1}{4}$ -7	87,200	24,000	101,700	53,500	145,000	87,000	1,320	188.0	60.0
$1\frac{3}{8}$ -6	104,000	28,700	121,300	63,800	173,000	104,000	1,620	220.0	70.0
$1\frac{1}{2}$ -6	126,000	34,800	147,500	77,600	211,000	127,000	1,800	260.0	90.0

**Table 3 Proof Loads, Clamp Loads, and Prevailing-Torques for Fine Thread Series  
Grades NE2, NE5, and NE8 Nuts**

Nut Size and Threads Per Inch	Grade NE2		Grade NE5		Grade NE8		Prevailing-Torque		
	Proof Load, lb	Clamp Load, lb	Proof Load, lb	Clamp Load, lb	Proof Load, lb	Clamp Load, lb	Maximum First Install, in.-lb	Minimum First Removal, in.-lb	Minimum Fifth Removal, in.-lb
$\frac{1}{4}$ -28	3,300	1,500	4,350	2,300	5,450	3,250	40	5.0	1.5
$\frac{5}{16}$ -24	5,200	2,400	6,950	3,700	8,700	5,200	60	8.0	2.5
$\frac{3}{8}$ -24	7,900	3,600	10,500	5,600	13,200	7,900	110	12.0	4.0
$\frac{7}{16}$ -20	10,700	4,900	14,200	7,550	17,800	10,700	135	17.0	5.0
$\frac{1}{2}$ -20	14,400	6,550	19,200	10,200	24,000	14,400	204	22.0	7.5
$\frac{9}{16}$ -18	18,300	8,350	24,400	13,000	30,400	18,300	300	30.0	10.0
$\frac{5}{8}$ -18	22,900	10,500	30,700	16,300	38,400	23,000	420	39.0	12.5
$\frac{3}{4}$ -16	33,600	15,400	44,800	23,800	56,000	33,600	540	58.0	20.0
$\frac{7}{8}$ -14	45,800	12,600	61,100	32,400	76,400	45,800	840	88.0	30.0
1-14	61,100	16,800	81,500	43,300	101,900	61,100	1,080	120.0	40.0
1-12	59,700	16,400	79,600	42,300	99,500	59,700	1,080	120.0	40.0
$1\frac{1}{8}$ -12	76,900	21,200	89,900	47,500	128,000	76,800	1,200	150.0	50.0
$1\frac{1}{4}$ -12	96,600	26,600	113,000	59,700	161,000	96,600	1,320	188.0	60.0
$1\frac{3}{8}$ -12	118,000	32,500	138,000	72,900	197,000	118,000	1,620	220.0	70.0
$1\frac{1}{2}$ -12	142,000	39,100	166,000	87,700	237,000	142,000	1,800	260.0	90.0

**Table 4 Chemical Composition Requirements**

Nut Grade	C, Max.	Mn, Min.	P, Max.	S, Max.
NE2	0.47	...	0.12 [Note (1)]	0.15 [Note (2)]
NE5	0.55	0.30	0.05 [Notes (3),(4)]	0.15 [Notes (2),(4)]
NE8	0.55	0.30	0.04	0.05 [Note (5)]

GENERAL NOTE: All values are for ladle analysis (percent by weight) and are subject to standard variations for check analysis as given in SAE J409.

NOTES:

- (1) Resulfurized and rephosphorized material is not subject to rejection based on check analysis for sulfur.
- (2) If agreed between purchaser and producer, sulfur content may be 0.23 max.
- (3) Phosphorus content may be 0.13 max. for acid bessemer steel only.
- (4) 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.
- (5) If agreed between purchaser and producer, sulfur content may be 0.33 max., provided that manganese content is 1.35 min.

**Table 5 Hardness Requirements**

Nut Grade	Locknut Size	Rockwell Hardness
NE2, NE5	$\frac{1}{4}$ – $1\frac{1}{2}$	C28, max.
NE8	$\frac{1}{4}$ – $\frac{5}{8}$	C24–C32
	$\frac{3}{4}$ –1	C26–C34
	$1\frac{1}{8}$ – $1\frac{1}{2}$	C26–C36

## 11 MATERIAL, MECHANICAL, AND PERFORMANCE PROPERTIES

### 11.1 Material and Processes

**11.1.1 Material.** Carbon steel nuts shall conform to the requirements of Table 4. Alternate material may be used if agreed upon with the purchaser. The nylon insert material shall be sufficient to meet the prevailing-torque requirements of Tables 2 and 3 when tested as specified in para. 12.3.

**11.1.2 Heat Treatment.** Grade NE2 nuts shall not be heat treated. Other nut grades may be heat treated as necessary (see Table 5) to meet the mechanical and performance requirements of this Standard, except that they shall not be case hardened.

**11.1.3 Finish.** Nuts may be furnished plain (bare metal) or with a protective coating as specified by the purchaser. The performance of nuts that are furnished with a protective coating shall not deteriorate when nuts are stored indoors for a period of 6 months.

In cases where nuts are given a protective coating or are cleaned following delivery to the purchaser, the nut producer shall not be held responsible for failures of the nut to meet dimensional, mechanical, or performance requirements traceable to plating, coating, or cleaning practice.

**11.1.4 Hydrogen Embrittlement.** Nuts shall not be embrittled. When heat-treated nuts are electroplated or phosphate coated, appropriate plating or coating processes should be employed to avoid hydrogen embrittlement. If necessary, the product shall be suitably treated as soon as practicable after plating or coating to preclude detrimental hydrogen embrittlement.

### 11.2 Mechanical Requirements

**11.2.1 Proof Load.** Nuts shall withstand the proof load specified for the applicable grade and thread series in Table 2 or 3 when tested as specified in para. 12.1.

**11.2.2 Hardness.** Nuts shall have a hardness conforming to the limits specified for the applicable grade in Table 5 when tested as specified in para. 12.2.

### 11.3 Performance Requirements

**11.3.1 Prevailing-Torque.** The prevailing-torque developed by nuts during their first installation, or any subsequent installation or removal, shall not exceed the maximum first installation torque specified for the applicable grade in Table 2 or 3 when tested as specified in para. 12.3. In addition, minimum prevailing-torque generated by nuts during their first and fifth removals shall not be less than the respective removal torques specified for the applicable grade in Table 2 or 3.

## 12 TEST METHODS

### 12.1 Proof Load Test

The test sample nut shall be assembled on a test bolt (see para. 12.1.1) or on a hardened mandrel (see para. 12.1.2) with a minimum of three threads projecting through the nut. The proof load test may be performed prior to the prevailing-torque feature being added to the nut. For referee test purposes, the hardened mandrel shall be used and the prevailing-torque feature present. The maximum prevailing-torque occurring during the assembly of the nut on the test bolt or mandrel shall be recorded.

A load equal to the specified proof load for the nut, as given in Table 2 or 3, shall be applied in tension or compression through the test bolt or mandrel against the nut bearing surface in an axial direction. For referee purposes, the load shall be applied in tension. The nut shall resist this load without thread stripping or rupture. The prevailing-torque necessary to remove the nut from the test bolt or mandrel shall not exceed the maximum torque occurring during assembly.

**12.1.1 Test Bolt.** The bolt used for proof load testing a nut shall have threads conforming to Class 2A tolerances as specified in ASME B1.1. The test bolt shall have a yield strength in excess of the specified proof load of the nut being tested.

**12.1.2 Hardened Mandrel.** The hardened mandrel used for proof load testing a nut shall have threads conforming to Class 3A tolerances as specified in ASME B1.1, except that the major diameter shall be the minimum major diameter with a plus tolerance of 0.002 in. The mandrel shall be heat treated to a hardness of Rockwell C45 to C50.

## 12.2 Hardness Test

The Rockwell hardness of a sample nut shall be determined on the top face of the nut. The top surface of the nut shall be prepared by grinding and removing sufficient material from the top to eliminate the effects of plating, coating, or other surface conditions. Material removal shall also be such as to provide a flat area large enough to allow a hardness test to be made midway between the hex corner and the major diameter of the thread. The bearing surface of the nut shall be prepared parallel to the test surface with removal of plating or coating. Further preparation of the test specimen and the method of performing the test shall conform to ASTM E 18.

For referee purposes, nut hardness shall be taken on a longitudinal section through the nut axis with readings taken as close as possible to the nominal major diameter of the nut thread.

## 12.3 Prevailing-Torque Test

The prevailing-torque test shall be conducted at room temperature using a load measuring device (see para. 12.3.2). A test bolt (see para. 12.3.3) and/or hardened mandrel (see para. 12.1.2) shall be inserted in the load measuring device, and hardened washer (see para. 12.3.4) placed on the bolt or mandrel and the sample nut then assembled on the bolt or mandrel. The nut shall be advanced until a minimum of three and a maximum of five full bolt or mandrel threads protrude through the top of the nut. At that time, the maximum torque shall be recorded. This torque shall not exceed the first installed prevailing-torque value as specified for the applicable grade and thread series in Table 2 or 3. The torque measuring device shall be in accordance with para. 12.3.1.

Tightening shall be continued until the nut is seated against the hardened washer. The length of the test bolt or mandrel should be such that seating of the nut shall occur at or before a length equivalent to a maximum of nine thread pitches of the test bolt or mandrel protruding through the top of the nut, as measured from the end of the bolt or mandrel. The nut shall then be tightened until a tensile load equal to the clamp load, as specified

for the applicable grade and thread series in Table 2 or 3 is developed in the bolt or mandrel. The hardened washer shall be prevented from turning during nut tightening. The nut shall then be backed off by the application of reverse torque until the tensile load in the bolt or mandrel has been reduced to zero. The lowest numerical torque occurring while the nut is being backed off throughout the next 360 deg of rotation shall be recorded as the minimum first removal torque. This minimum torque shall not be less than the first removal prevailing-torque value as specified in Table 2 or 3. The nut shall then be backed off until the prevailing-torque element is disengaged from the bolt or mandrel thread. The nut shall be reassembled and removed four more times. On each reassembly, the nut shall be assembled to the initial first removal position but no clamp load shall be induced in the bolt or mandrel. The test washer shall not be removed during these additional cycles.

At no time during the four additional installations and removals should the prevailing-torque exceed the maximum, first install prevailing-torque value as specified for the applicable grade and thread series in Table 2 or 3. During the fifth removal, the minimum torque occurring while the nut is being backed off throughout the first 360 deg of rotation shall be recorded. The minimum torque shall not be less than the fifth removal value as specified in Table 2 or 3. Sufficient time shall elapse between torquing cycles to prevent overheating of the test assembly.

The speed of installation and removal of the nut shall not exceed 30 rpm and shall be continuous and uniform.

**12.3.1 Torque-Measuring Device.** The torque-measuring device shall be capable of measuring the torque while the test nut is in motion. Test results may be recorded by an analog or digital device that is capable of forming a permanent record. The measuring system shall have a measurement uncertainty at the point of measurement of  $\pm 2\%$ . Test equipment may be handheld or electronic, provided that accuracy and speed restrictions as noted above are observed. A manual wrench and manual recording device may be used if it meets the above calibration criteria.

**12.3.2 Load-Measuring Device.** The load-measuring device used in the prevailing-torque test shall be an instrument capable of measuring the actual tension induced in the test bolt as the nut is tightened. The device shall be accurate within  $\pm 5\%$  of the test clamp load being used. The bolt clearance hole in the backing plate behind the washer shall have the same diameter and tolerance as the test washer.

**12.3.3 Test Bolt.** The test bolt in the prevailing-torque test shall have a zinc phosphate and oil finish (dry to the touch).

The bolt shall have threads conforming to Class 2A tolerances as specified in ASME B1.1. Threads on all

bolts 1 in. in diameter and smaller shall be produced by rolling. In those instances in which a test mandrel is used, the threads may be produced by rolling, cutting, or grinding. Inspection of test bolts shall be conducted using a basic size GO and NO GO thread ring gage set. Bolt length shall be such that a minimum length equivalent to six thread pitches, as measured from the end of the bolt, will protrude through the nut when the nut is seated against the test washer. Thread length shall be such that a minimum of two full threads are within the grip after the nut is seated. The bolt shall be pointed in accordance with the dimensional requirements for hex cap screws as given in ASME B18.2.1. The thread surface shall be free of burrs or other contamination that might affect an accurate determination of the prevailing-torque developed by the nut.

The bolt shall have an ultimate tensile strength not less than the specified proof load of the nut to be tested. The threads of heat-treated bolts shall have a metallurgical surface condition equal to Class B as specified in SAE J121. When test bolts less than  $\frac{3}{4}$  in. in diameter are used, a new bolt shall be used for testing each nut. Bolts  $\frac{3}{4}$  in. and larger in diameter may be reused if upon inspection the thread condition is acceptable. In those instances in which a test mandrel is used, the mandrel may be reused if upon inspection the thread condition is acceptable.

**12.3.4 Test Washer.** Washers or multiple-hole test strips shall be plain finished and hardened to HRC 38 minimum. The washer's outside diameter or strip width shall be larger than the maximum across corners or flange diameter, whichever is greater, of the nuts being tested. The inside diameter of the through hole shall conform to the inside hole diameters specified in either ASME B18.22.1, Type A or ASTM F 436. Washers and strips shall not be used for more than one test per hole side.

### 13 GRADE AND MANUFACTURING MARKING

Grade NE2 nuts are required to be marked for source identification.

Grade NE5 nuts shall be marked with three equally spaced identical symbols on the top side of the nut.

Grade NE8 nuts shall be marked with six equally spaced identical symbols on the top side of the nut (see Table 1 for illustration).

Alternatively, when Grades NE5 and NE8 nuts are machined from bar stock, Grade NE5 nuts may be identified with one set of circumferential notches cut into the corners of the nut and Grade NE8 nuts with two sets of circumferential notches cut into the corners of the nut.

Grades NE5 and NE8 nut shall be marked to identify the manufacturer. The nylon insert color shall identify the manufacturer. Alternatively, the manufacturer's

marking may be additional to the grade markings or an alteration of one or more of the three or six grade marking symbols.

### 14 INSPECTION AND QUALITY ASSURANCE

The manufacturer may utilize any documented quality assurance system that results in the production of products conforming to the requirements of this Standard. If the manufacturer does not have a documented quality assurance system and the purchaser does not specify otherwise in the original inquiry, purchase order, and/or contract, product acceptability shall be determined using ASME B18.18.1.

### 15 DIMENSIONAL CONFORMANCE

(a) If a documented, verifiable, statistically based, in-process inspection system is used by the manufacturer, inspections may be conducted at any point after which that characteristic will not be altered using sample sizes defined by the manufacturer.

If the supplier does not use a quality system as described above, the following designated characteristics shall be inspected for conformance using the sampling plan in ASME B18.18.1.

Characteristic	Inspection Level
Width across corners	C
Thickness	C
Thread acceptability	C

(b) For nondesignated characteristics, the provisions of ASME B18.18.1 shall apply.

(c) The reporting of inspection results shall be agreed upon between the purchaser and supplier in the inquiry, purchase order, and/or contract.

### 16 DESIGNATION

Nylon insert locknuts shall be designated by the following data preferably in the sequence as follows:

- product name
- designation of standard (e.g., ASME B18.16.6)
- nominal diameter and threads per inch
- steel property grade or material identification
- protective coating, if required

EXAMPLE: Nylon insert locknut, ASME B18.16.6,  $\frac{1}{2}$ -13, Grade NE8, zinc plated per ASTM F 1941, Fe/Zn 5C.

### 17 WORKMANSHIP

Nuts shall be free of surface irregularities (e.g., burrs, seams, laps, loose scale) that might affect their serviceability. When control of surface irregularities is important for the application intended, ASTM F 812 shall be specified by the purchaser.

# ASME B18.16.6-2008

ISBN-13 : 978-0-7918-3157-1

ISBN-10 : 0-7918-3157-4



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