ASME B18.16M-2004

Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts

Revision and Consolidation of ASME B18.16.1M, B18.16.2M, and B18.16.3M

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Three Park Avenue • New York, NY 10016

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretation of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://www.asme.org/codes as they are issued.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

American National Standards Committee B18 for the standardization of bolts, screws, nuts, rivets, and similar fasteners was organized in March 1922 as Sectional Committee B18 under the aegis of the American Engineering Standards Committee (later the American Standards Association, the United States of America Standards Institute and, as of October 6, 1969, the American National Standards Institute, Inc.) with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors. Subcommittee 16 was established in 1961 and charged with the responsibility for technical content of standards covering prevailing-torque nuts.

In 1972 the International Organization for Standardization published standards ISO 2320 and ISO 2358, covering the mechanical and performance properties and dimensions of metric series hexagon prevailing-torque type nuts, respectively.

In December 1974, Committee B18 directed Subcommittee 16 to discontinue work on standards for inch series prevailing-torque type hex nuts and to develop standards for metric series nuts.

As a result, ASME B18.16.1M-1979, ASME B18.16.2M-1979, and ASME B18.16.3M-1982 were approved. B18.16.3M was revised in 1998 to better meet the needs of conformance with Public Law 100-592. The revision defined those dimensions or characteristics which should be certified to assure product fit, form, and function. Other dimensions given would only be examined in the event of a dispute. Additionally, the Subcommittee removed the bearing surface finish requirement from the dimensional tables. It was felt that the torque at tension requirements of B18.16.2M-1979 adequately addressed the functional need for this characteristic.

This Standard, ASME B18.16M-2004, is a revision and consolidation of ASME B18.16.1M-1979, ASME B18.16.2M-1979, and ASME B18.16.3M-1998.

This Standard was approved as an American National Standard on September 9, 2004.

ASME B18 STANDARDS COMMITTEE
Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B18 Standards Committee
The American Society of Mechanical Engineers
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Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

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.

Interpretations. Upon request, the B18 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B18 Standards Committee.

The request for 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.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings which are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The B18 Standards Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B18 Standards Committee.

PREVAILING-TORQUE TYPE STEEL METRIC HEX NUTS AND HEX FLANGE NUTS

1 SCOPE

This Standard covers the complete general, dimensional, mechanical, and performance data for metric prevailing-torque hex nuts and hex flange nuts of property classes 5, 9, and 10 as defined in ASTM A563M.

The inclusion of dimensional data in this Standard is not intended to imply that all of the nut sizes in conjunction with the various options described herein are stock items. Consumers should consult with suppliers concerning lists of stock production prevailing-torque hex and hex flange nuts.

2 COMPARISON WITH ISO STANDARDS

2.1 Coordination With ISO Standards

Hex and hex flange nuts as covered in this Standard have been coordinated to the extent possible with ISO 2320, ISO 7040, ISO 7041, ISO 7042, ISO 7043, ISO 7044, ISO 7719, and ISO 7720. The dimensional differences are few, except those of the M10 size. None affect the functional interchangeability of nuts manufactured to the requirements of either. The clamp torque values in Table 4 of this Standard are significantly different compared to the applied torques in ISO 2320 Annex C. ISO 2320 does not make any coating distinctions.

2.2 Letter Symbols

Letter symbols designating dimensional characteristics are in accord with those used in ISO standards, except that capitals have been used instead of lower case letters used in ISO standards.

2.3 ISO Width Across Flats

M10 hex and hex flange nuts with 15 mm width across flats are currently being produced and used in the U.S. and many other countries. This width across flats is not ISO standard for hex nuts, but is ISO standard for hex flange nuts. The ISO standard for M10 hex nuts specifies 16 mm width across flats. Unless M10 hex nuts with 15 mm width across flats are specifically ordered, M10 hex nuts with 16 mm width across flats shall be furnished.

3 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 B1.3M, Screw Thread Gaging Systems for Dimensional Acceptability — Inch and Metric Screw Threads (UN, UNR, UNJ, M and MJ)
ASME B1.13M, Metric Screw Threads — M Profile
ASME B18.2.3.1M, Metric Hex Cap Screws
ASME B18.12, Glossary of Terms for Mechanical Fasteners
ASME B18.18.1, Inspection and Quality Assurance for General Purpose Fasteners
ASME B18.18.2, Inspection and Quality Assurance for High Volume Machine Assembly Fasteners
ASME B18.24, Part Identifying Number (PIN) Code System Standard for B18 Fastener Products
ASME Y14.5M, Dimensioning and Tolerancing
Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900

ASTM A563M, Carbon and Alloy Steel Nuts (Metric)
ASTM B487, Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM F467M, Nonferrous Nuts for General Use [Metric]
ASTM F586M, Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F812/F812M, Surface Discontinuities of Nuts
ASTM F836M. Style 1 Stainless Steel Metric Nuts
ASTM F1137, Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners
Publisher: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ISO 2320, Prevailing torque type steel hexagon nuts — Mechanical and performance properties
ISO 7040, Prevailing torque type hexagon nuts (with non-metallic insert), style 1 — Property classes 5, 8 and 10
ISO 7041, Prevailing torque type nuts (with non-metallic insert), style 2 — Property classes 9 and 12

ISO 7042, Prevailing torque all-metal hexagon nuts, style 2 — Property classes 5, 8, 10 and 12

ISO 7043, Prevailing torque type hexagon nuts with flange (with non-metallic insert) — Product grades A and B

ISO 7044, Prevailing torque type all-metal hexagon nuts with flange — Product grades A and B

ISO 7719, Prevailing torque type all-metal hexagon nuts, style 1 — Property classes 5, 8 and 10

ISO 7720, Prevailing torque type all-metal hexagon nuts, style 2 — Property class 9

Publisher: International Organization for Standardization (ISO), 1 rue de Varembé, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse

SAE J121M, Decarburization in Hardened and Tempered Metric Threaded Fasteners

Publisher: Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001

4 TERMINOLOGY

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

Unless otherwise noted, all references to nuts in this Standard mean prevailing-torque hex nuts and hex flange nuts.

5 DIMENSIONS

Unless otherwise stated, all dimensions in this Standard are in millimeters (mm), and apply before any plating or coating. When a plating or coating is specified, the finished product dimensions shall be as agreed upon between supplier and purchaser.

Symbols specifying geometric characteristics are in accord with ASME Y14.5M.

6 NUT DESIGNS AND PROPERTY CLASSES

There are three basic designs for prevailing-torque nuts.

(*a*) all-metal, one-piece construction nuts which derive their prevailing-torque characteristics from controlled distortion of the nut thread and/or body

(*b*) metal nuts which derive their prevailing-torque characteristics from the addition or fusion of a nonmetallic insert, plug, or patch in their threads

(*c*) top insert, two-piece construction nuts which 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

The two nut designs defined in paras. 6(a) and (b) have the same dimensional requirements and are designated "all-metal type" in Tables 1 and 2. Nut design 6(c) is designated "top insert type" in Tables 1 and 2.

Property classes 5, 9, and 10 nuts have mechanical and performance properties as specified in Table 3.

7 WIDTH ACROSS FLATS

The width across flats shall be the distance, measured perpendicular to the axis of the nut, between two opposite wrenching flats. The maximum width across flats may be exceeded by 0.05 mm to allow for nut deformation caused by introduction of the prevailing-torque feature. The width across flats and width across corners may be less than the specified minimum in the deformed portion of the nut containing the prevailing-torque feature.

At maximum material condition the axis of the hexagon shall be located at true position with respect to the axis of the thread pitch diameter within a tolerance zone having a diameter equivalent to 4% of the maximum width across flats.

8 THICKNESS

The nut thickness shall be the overall distance, measured parallel to the axis of the nut, from the top of the nut to the bearing surface of hex nuts, and to the plane of the bearing circle diameter of hex flange nuts. Raised identification markings, if present, shall be excluded.

9 WRENCHING HEIGHT

The wrenching height is the distance, measured at a corner of the hex, from the bearing surface of hex nuts, and from the junction of the hex portion with the flange of hex flange nuts to the last plane of full formed hex, i.e., the plane perpendicular to the nut axis that is closest to the top of the nut and at which the width across corners is within its specified limits. Wrenching height for hex nuts is dimension M_1 in Table 1, and is subject to measurement. Wrenching height for hex flange nuts is dimension T_a in Table 2 and is controlled by the gaging requirement specified in para. 10.

10 GAGING OF HEX PORTION OF HEX FLANGE NUTS

The nut shall be gaged using two plain ring gages, A and B, to demonstrate the coincidental acceptability of hex height, wrenching height, and width across corners. (See figure above Table 2.) Gage A shall be placed over the hex and shall seat on the flange. Gage B shall be placed on the top of the nut normal to the nut axis. The two gages shall not be in contact.

NOTE: The minimum inside diameter of Gage A equals the maximum width across corners; the maximum inside diameter of Gage B equals the minimum width across corners minus 0.01 mm; the maximum thickness of Gage A was computed to be equal to or greater than the wrenching height necessary to provide sufficient driveability to develop two times the torsional strength of the properly mated, externally threaded component.

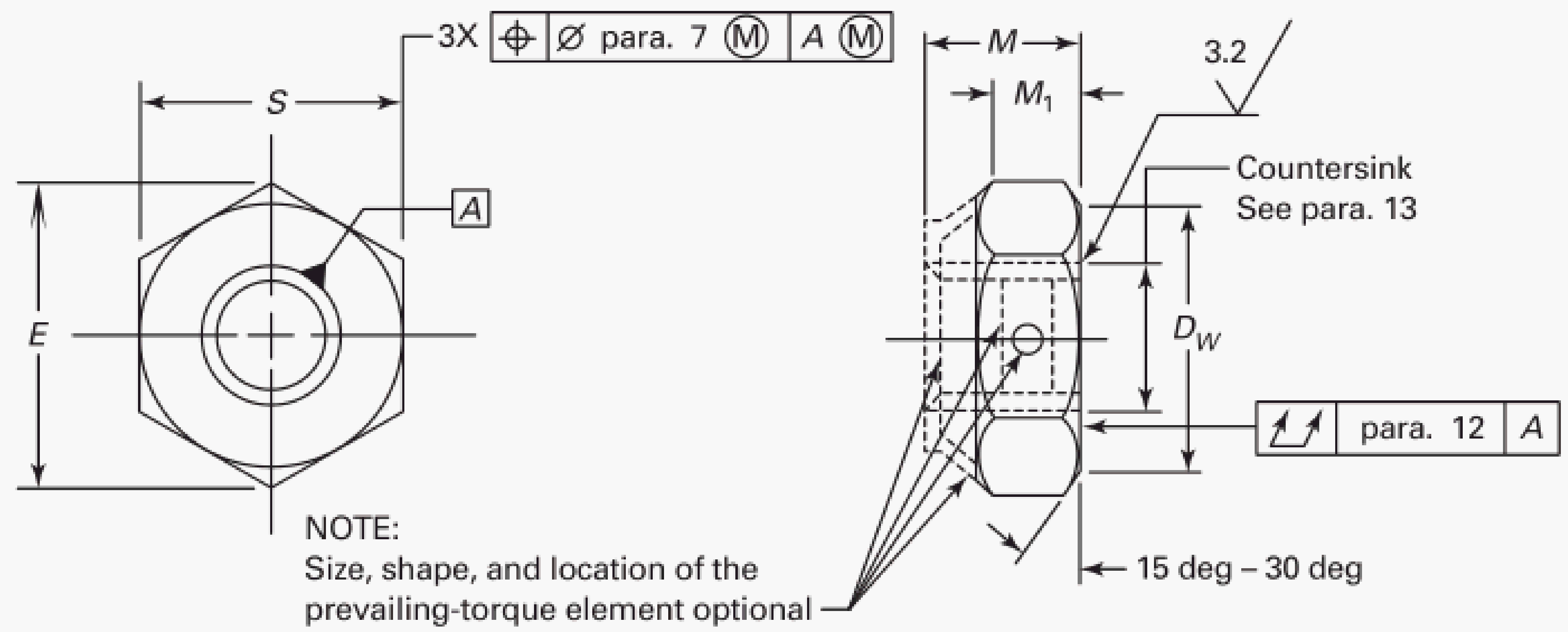
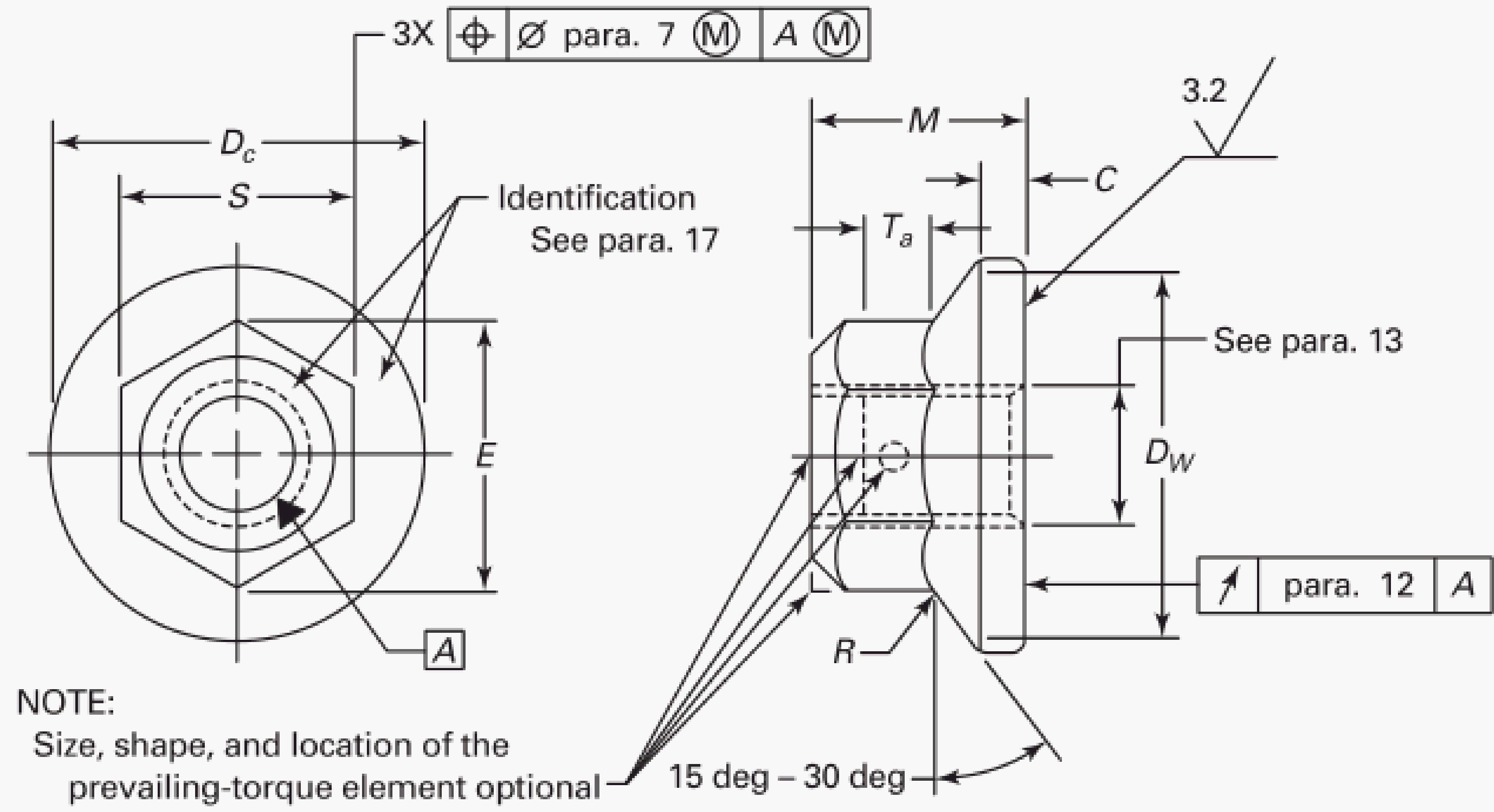


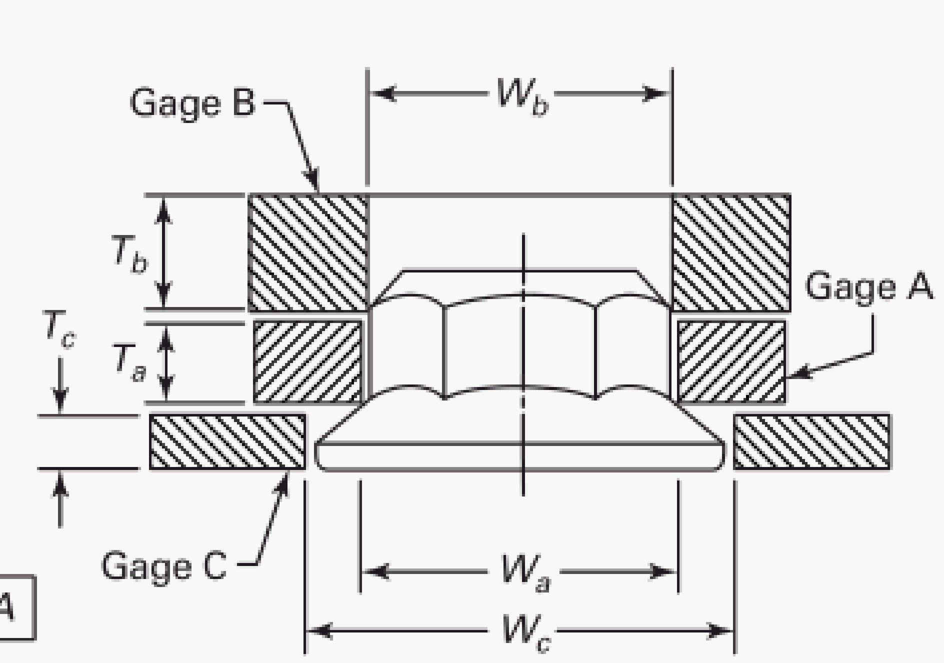
Table 1 Dimensions of Prevailing-Torque Hex Nuts—Property Classes 5, 9, and 10

Nominal Nut Thread Diameter and Thread Pitch	Width Across Flats, *S*		Width Across Corners, *E*		Thickness, *M*: Property Classes 5 and 10 Nuts: All Metal Type [Note (1)]		Property Classes 5 and 10 Nuts: Top Insert Type		Property Class 9 Nuts: All Metal Type		Property Class 9 Nuts: Top Insert Type		Wrenching Height, M_1: Property Classes 5 and 10 Nuts	Wrenching Height, M_1: Property Class 9 Nuts	Bearing Face Diameter, D_w	Total Runout of Bearing Surface FIM
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Min.	Min.	Max.
M3 × 0.5	5.50	5.32	6.35	6.01	3.10	2.65	4.50	3.90	3.10	2.65	4.50	3.90	1.4	1.4	4.6	—
M3.5 × 0.6	6.00	5.82	6.93	6.58	3.50	3.00	5.00	4.30	3.50	3.00	5.00	4.30	1.7	1.7	5.1	—
M4 × 0.7	7.00	6.78	8.08	7.66	4.00	3.50	6.00	5.30	4.00	3.50	6.00	5.30	1.9	1.9	5.9	—
M5 × 0.8	8.00	7.78	9.24	8.79	5.30	4.80	6.80	6.00	5.30	4.80	7.20	6.40	2.7	2.7	6.9	0.30
M6 × 1	10.00	9.78	11.55	11.05	5.90	5.40	8.00	7.20	6.70	5.40	8.50	7.70	3.0	3.0	8.9	0.33
M8 × 1.25	13.00	12.73	15.01	14.38	7.10	6.44	9.50	8.50	8.00	7.14	10.20	9.20	3.7	4.3	11.6	0.36
M10 × 1.5	16.00	15.73	18.48	17.77	9.00	8.04	11.90	10.90	10.50	8.94	12.80	11.80	4.8	5.6	14.6	0.39
M12 × 1.75	18.00	17.73	20.78	20.03	11.60	10.37	14.90	13.90	13.30	11.57	16.10	15.10	6.7	7.7	16.6	0.42
M14 × 2	21.00	20.67	24.25	23.35	13.20	12.10	17.00	15.80	15.40	13.40	18.30	17.10	7.8	8.9	19.6	0.45
M16 × 2	24.00	23.67	27.71	26.75	15.20	14.10	19.10	17.90	17.90	15.70	20.70	19.50	9.1	10.5	22.5	0.48
M20 × 2.5	30.00	29.16	34.64	32.95	19.00	16.90	22.80	21.50	21.80	19.00	25.10	23.80	10.9	12.7	27.7	0.56
M24 × 3	36.00	35.00	41.57	39.55	23.00	20.20	27.10	25.60	26.40	22.60	29.50	28.00	13.0	15.1	33.2	0.64
M30 × 3.5	46.00	45.00	53.12	50.85	26.90	24.30	32.60	30.60	31.80	27.30	35.60	33.60	15.7	18.2	42.7	0.76
M36 × 4	55.00	53.80	63.51	60.79	32.50	29.40	38.90	36.90	38.50	33.10	42.60	40.60	19.0	22.1	51.1	0.89
M10 × 1.5 [Note (2)]	15.00	14.73	17.32	16.64	9.70	8.70	12.50	11.50	11.20	9.60	13.50	12.50	5.6	6.2	13.6	0.39
Refer to para.	7		9		6, 8								9		12	12

NOTES:
(1) Also includes metal nuts with nonmetallic inserts, plugs, or patches in their threads.
(2) See para. 2.3.



NOTE:
Size, shape, and location of the prevailing-torque element optional



Gaging of hex flange nut
See paras. 9, 10, and 11

Table 2 Dimensions of Prevailing-Torque Hex Flange Nuts—Property Classes 5, 9, and 10

Nominal Nut Thread Diameter and Thread Pitch	Width Across Flats, S		Width Across Corners, E		Thickness, M (All Nut Property Classes)				Flange Diameter, D_c	Bearing Circle Diameter, D_w	Flange Edge Thickness, C	Circular Runout of Bearing Circle-FIM	Flange Top Fillet Radius, R	Gage A				Gage B			Gage C			
					All Metal Type [Note (1)]		Top Insert Type							Inside Diameter, W_a		Thickness, T_a		Inside Diameter, W_b		Thickness, T_b	Inside Diameter, W_c		Thickness, T_c	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	Max.	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.	Min.
M6 × 1	10.00	9.78	11.55	11.05	7.30	5.70	8.80	8.00	14.2	12.2	1.1	0.34	0.4	11.56	11.55	3.10	3.09	11.04	11.03	4.0	14.40	14.30	1.19	1.18
M8 × 1.25	13.00	12.73	15.01	14.38	9.40	7.60	10.70	9.70	17.9	15.8	1.2	0.38	0.5	15.02	15.01	4.50	4.49	14.37	14.36	4.0	18.10	18.00	1.31	1.30
M10 × 1.5	15.00	14.73	17.32	16.64	11.40	9.60	13.50	12.50	21.8	19.6	1.5	0.43	0.6	17.33	17.32	5.50	5.49	16.63	16.62	5.0	22.00	21.90	1.81	1.80
M12 × 1.75	18.00	17.73	20.78	20.03	13.80	11.60	16.10	15.10	26.0	23.8	1.8	0.50	0.7	20.79	20.78	6.70	6.69	20.02	20.01	5.0	26.20	26.10	2.20	2.19
M14 × 2	21.00	20.67	24.25	23.35	15.90	13.30	18.20	17.00	29.9	27.6	2.1	0.55	0.9	24.26	24.25	7.80	7.79	23.34	23.33	6.0	30.10	30.00	2.55	2.54
M16 × 2	24.00	23.67	27.71	26.75	18.30	15.30	20.30	19.10	34.5	31.9	2.4	0.61	1.0	27.72	27.71	9.00	8.99	26.74	26.73	6.0	34.70	34.60	2.96	2.95
M20 × 2.5	30.00	29.16	34.64	32.95	22.40	18.90	24.80	23.50	42.8	39.9	3.0	0.76	1.2	34.65	34.64	11.10	11.09	32.94	32.93	6.0	43.00	42.90	3.70	3.69
Refer to para.	7		10		6, 8				11		12	11	12	9, 10				10			11			

NOTE:
(1) Also includes metal nuts with nonmetallic inserts, plugs, or patches in their threads.

Table 3 Proof Loads, Clamp Loads, and Prevailing Torques for Nuts

Nominal Nut Dia. and Thread Pitch	Proof Load, kN			Clamp Load, kN [Note (1)]			Prevailing-Torque, N·m					
							Classes 5 and 9			Class 10		
	Class 5	Class 9	Class 10	Class 5	Class 9	Class 10	First Installation, max. [Note (2)]	First Removal, min.	Fifth Removal, min.	First Installation, max.	First Removal, min.	Fifth Removal, min.
M3 × 0.5	2.62	4.53	5.23	1.43	2.45	3.13	0.43	0.12	0.08	0.6	0.15	0.10
M4 × 0.7	4.57	7.90	9.13	2.50	4.28	5.47	0.90	0.18	0.12	1.2	0.22	0.15
M5 × 0.8	8.23	13.0	14.8	4.05	6.92	8.84	1.6	0.29	0.20	2.1	0.35	0.24
M6 × 1	11.7	18.4	20.9	5.73	9.80	12.5	3.0	0.45	0.30	4.0	0.55	0.40
M8 × 1.25	21.6	34.4	38.1	10.4	17.8	22.8	6.0	0.85	0.60	8.0	1.15	0.80
M10 × 1.5	34.2	54.5	60.3	16.5	28.3	36.1	10.5	1.5	1.0	14	2.0	1.4
M12 × 1.75	51.4	80.1	88.5	24.0	41.1	52.5	15.5	2.3	1.6	21	3.1	2.1
M14 × 2	70.2	109	121	32.8	56.1	71.6	24	3.3	2.3	31	4.4	3.0
M16 × 2	95.8	149	165	44.8	76.5	97.5	32	4.5	3.0	42	6.0	4.2
M20 × 2.5	154	225	260	69.8	110	152	54	7.5	5.3	72	10.5	7.0
M24 × 3	222	325	374	101	159	220	80	11.5	8.0	106	15	10.5
M30 × 3.5	353	516	595	94.5	252	349	108	16	12	140	19	14
M36 × 4	515	752	866	138	368	509	136	21	16	180	24	17.5

NOTES:

(1) The clamp loads for class 5 nuts are equal to 75% of the proof load of property class 5.8 bolts for diameters M3 through M24, and 75% of the proof load of property class 4.6 bolts for diameters larger than M24. The clamp loads for class 9 nuts are equal to 75% of the proof load of property class 9.8 bolts for diameters M3 through M16, and 75% of the proof load of property class 8.8 bolts for diameters larger than M16. The clamp loads for class 10 nuts are equal to 75% of the proof load of property class 10.9 bolts. Proof loads of bolts are given in ASTM F586M.

(2) The prevailing torques for first installation apply for all-metal nuts only. For nuts with nonmetallic insert the maximum torques for the first installation shall be 50% of these values.

11 FLANGE

The top surface of the flange of hex flange nuts shall be conical or slightly rounded (convex). The flange periphery shall be round within the specified maximum flange diameter and a tolerance of minus 5%.

The contour of the edge at the flange periphery shall be optional provided the minimum flange thickness is maintained at the minimum bearing circle diameter.

The flange shall be gaged using two plain ring gages, A and C, to demonstrate the coincidental acceptability of flange diameter and thickness. Gage C shall be seated on a flat surface and the nut placed in it. Gage A shall be placed over the hex portion. The nut shall seat within Gage C. Gages A and C shall not be in contact. (See figure above Table 2.)

12 BEARING SURFACE

Hex nuts shall be corner chamfered and have a flat bearing surface. The diameter of the bearing surface shall not exceed the width across flats nor be less than the bearing face diameter specified in Table 1. The bearing surface shall be flat and perpendicular to the axis of the thread within the total runout limit specified in Table 1.

The bearing surface of hex flange nuts shall be flat to concave to a maximum of 1.5 deg from the plane formed by the bearing circle diameter. The bearing circle shall be perpendicular to the axis of the thread pitch diameter within the circular runout, full indicator movement (FIM), specified in Table 2, when measured at diameter D_w.

13 COUNTERSINK

The tapped hole shall be countersunk on the bearing face, and may be countersunk on the top face. The countersink included reference angle shall be 90 deg to 120 deg. The maximum countersink diameter shall be 1.15 times the nominal thread diameter (major diameter) for nuts M4 and smaller, the nominal thread diameter plus 0.75 mm for M5 through M8 nuts, and 1.08 times the nominal thread diameter for M10 and larger nuts. The minimum countersink diameter shall be the nominal thread diameter.

14 THREADS

Threads, prior to introduction of the prevailing-torque feature, shall be metric coarse threads with class 6H tolerances in accordance with ASME B1.13M.

Nuts M10 and smaller shall assemble a minimum of one-half turn, and nuts M12 and larger shall assemble a minimum of one full turn by hand on a basic GO thread plus gage. The plug gage shall be without a chip groove, and shall have a point with dimensions conforming to those for the point on metric hex cap screws given in ASME B18.2.3.1M.

15 MATERIAL, MECHANICAL, AND PERFORMANCE PROPERTIES

15.1 Material and Mechanical Properties

Carbon steel nuts shall conform to the requirements for Property Class 5, Property Class 9, or Property Class 10 as specified in ASTM F563M. Case hardening is not allowed for any property class.

Corrosion–resistant stainless steel nuts shall conform to the requirements of ASTM F836M.

Nonferrous metal nuts shall conform to the requirements of ASTM F467M.

The prevailing-torque element of insert design nuts may be made of a material other than steel.

15.2 Performance Requirements

15.2.1 General. All values for performance requirements given in this standard are based on the test conditions specified.

Any changes in these conditions may produce different test values which should be agreed upon prior to purchase, i.e., at time of inquiry. When changes are made to the nut finish to address specific application requirements, nuts should be tested in accordance with the test methods stated in this Standard to determine any changes in test value requirements.

15.2.2 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 class in Table 3 when tested as specified in Prevailing-Torque Test. In addition, the prevailing-torques developed by nuts during their first and fifth removals shall not be less than the removal torques specified in Table 3 when tested as specified in Prevailing-Torque Test.

Prevailing-torque is the torque necessary to rotate the nut on its mating externally threaded component, with the torque being measured while the nut is in motion, and with no axial load in the mating component.

15.2.3 Optional Torque-Tension. On some applications of prevailing-torque nuts, it is desirable to control the amount of developed tension when a specified range of torque has been applied. If torque-tension control is required, performance requirements shall be by agreement between purchaser and supplier utilizing the Torque-Tension Test Procedures. Examples of test clamp torque values have been included in Table 4.

Table 4 Examples for Test Clamp Torque Values

Nut Size	Property Class 9 Hex Nut			Property Class 10 Hex Nut			Property Class 9 Hex Flange Nut			Property Class 10 Hex Flange Nut		
	Clamp Load, kN	Clamp Torque, N·m		Clamp Load, kN	Clamp Torque, N·m		Clamp Load, kN	Clamp Torque, N·m		Clamp Load, kN	Clamp Torque, N·m	
		Max.	Min.		Max.	Min.		Max.	Min.		Max.	Min.
M3 × 0.5	2.45	1.3	0.9	3.13	1.7	1.2	...	...	...	...	...	...
M4 × 0.7	4.28	3.0	2.1	5.47	3.8	2.7	...	...	...	...	...	...
M5 × 0.8	6.92	6.0	4.3	8.84	7.6	5.4	...	...	...	...	...	...
M6 × 1	9.80	10	7.1	12.5	13	9.1	9.6	12	8.5	12.5	15	11
M8 × 1.25	17.8	24	17	22.8	30	21	17.8	28	20	22.8	36	25
M10 × 1.5	28.3	45	32	36.1	58	41	28.3	53	38	36.1	68	48
M12 × 1.75	41.1	77	54	52.6	98	69	41.1	89	63	52.5	114	81
M14 × 2	56.1	118	84	71.6	151	107	56.1	137	97	71.6	174	124
M16 × 2	76.5	178	126	97.5	227	161	76.6	204	145	97.5	260	185
M20 × 2.5	110	298	212	152	411	292	110	335	238	152	463	329
M24 × 3	159	478	340	220	661	470	...	...	...	...	...	...
M30 × 3.5	252	834	592	349	1154	821	...	...	...	...	...	...
M36 × 4	368	1262	897	509	1745	1240	...	...	...	...	...	...

GENERAL NOTE: Test clamp torque values were developed with prevailing-torque locknuts having a phosphate and oil finish, test screws having a phosphate and oil finish, and test washers having a plain, clean, and lubricant-free finish.

16 TESTING

16.1 Test Screws for Nut Testing

Test screws shall correspond to the size and strength level of the nut to be tested. Decarburization of the screw threads shall be within the limits defined in SAE J121M, Class 3.4H.

Threads shall conform to ASME B1.13M, Class 6g. The test screw shall have a zinc phosphate and oil finish in accordance with ASTM F1137, Grade 1. After coating, the basic thread size shall not be exceeded when confirmed with a 6h GO ring gage as defined by System 21 of ASME B1.3M. Threads of all screws M24 and smaller shall be rolled. The thread surface shall be clean, free of burrs, additional lubricant, or other contamination that might affect an accurate determination of the performance of the nut.

The test screw shall be pointed in accordance with the dimensional requirements for hex cap screws as given in ASME B18.2.3.1M. The screw length shall be such that a minimum length equivalent of four thread pitches as measured from the end of the bolt will protrude through the nut when the nut is fully seated against the test washer. The thread length shall be such that a minimum of two full threads is within the grip after the nut is fully seated. See Fig. 1.

A new test screw shall be used for testing each nut.

16.2 Test Washer

Test washers shall conform to the dimensional, metallurgical, and mechanical requirements given in Table 5. Optionally, multi-hole plates or strips may be used providing they conform to the requirements for material, hardness, hole diameter, surface texture, and plating as given in Table 5.

A new test washer shall be used for testing each nut.

16.3 Torque Measuring Device

The torque measuring device shall be capable of measuring the torque while the 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 be accurate at the point of measurement within plus or minus 2%. Test equipment may be hand held or electronic, provided that accuracy and speed restrictions as noted in Drive Tool are observed.

16.4 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 screw as the nut is tightened. The device shall be accurate within ±2% of the test clamp load being used. The screw clearance hole in the backing plate behind the washer shall have the same diameter and tolerance as the test washer. See Fig. 1.

16.5 Data Collection Device

The data collection device shall have the capability to simultaneously record torque and tension. The sampling rate and frequency response of the recording system shall be such that at the test speeds (RPM) specified, the measurements of torque and tension shall meet the accuracies specified.

16.6 Drive Tool

The drive tool shall be a fixtured electric power tool or hydraulic motor device capable of meeting the continuous speed requirements and shutoff capabilities as specified. The tools shall be capable of producing torques greater than the requirements of the parts being tested and shall maintain a continuous speed of 100 ±10 RPM for the duration of the test. For parts greater than M16, the speed shall be 30 ±3 RPM.

16.7 Prevailing-Torque Test

The prevailing-torque test shall be conducted at room temperature using a load measuring device. Adjust the grip length of the load measuring device such that when the parts are fully seated, the test screw protrudes through the top of the nut by a length equivalent to four to seven thread pitches. A test screw shall be inserted in the load measuring device, a hardened washer placed on the screw and the sample nut then hand assembled on the screw. Sockets shall not be allowed to contact the test washer during the rundown.

Using the drive tool or torque measuring device, the nut shall be advanced and tightened until a tensile load equal to the clamp load, as specified for the applicable thread size and property class in Table 3, is developed in the screw.

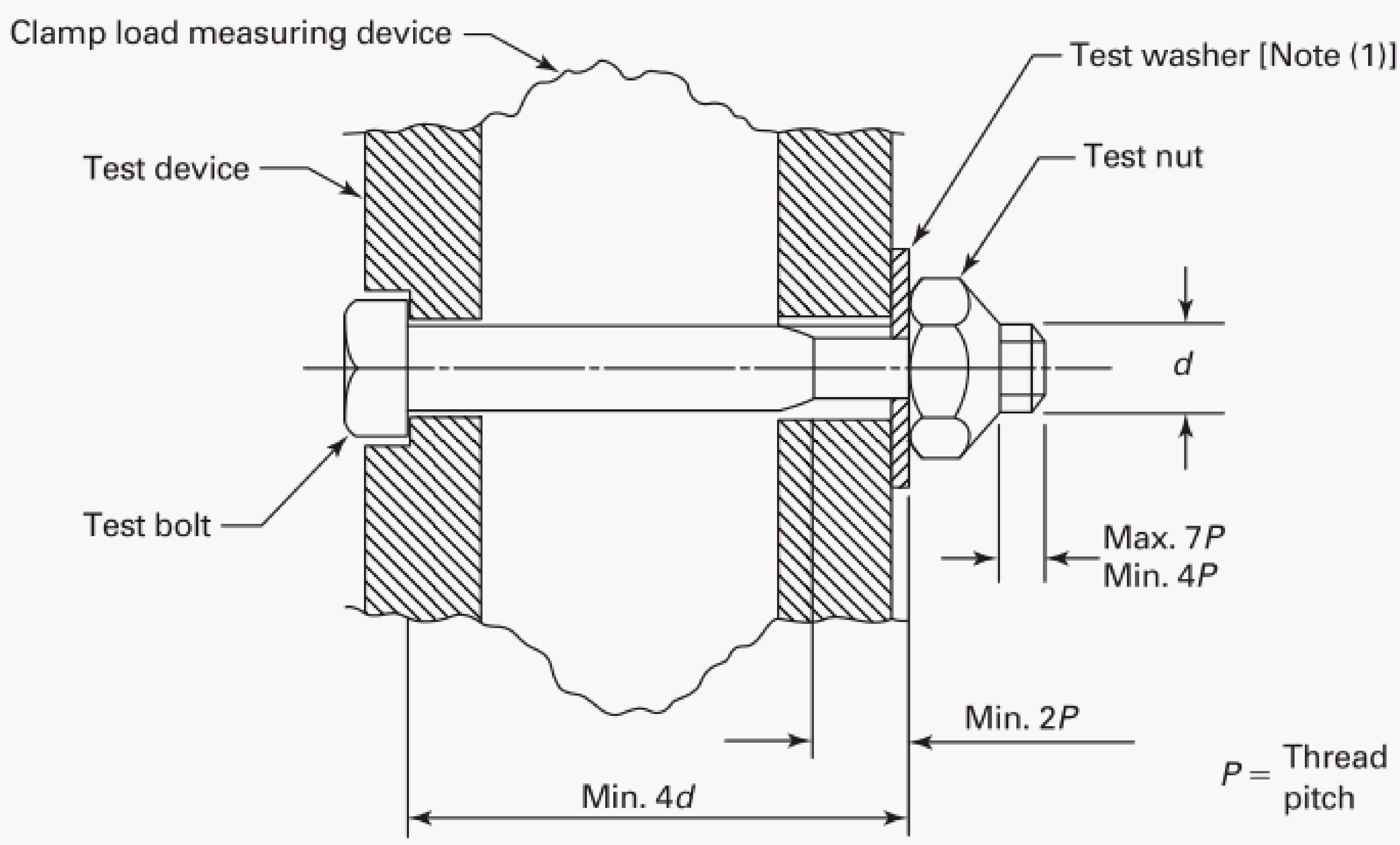
The maximum torque occurring prior to the development of clamp load shall be recorded. This torque shall not exceed the first installation prevailing-torque value as specified for the applicable thread size and property class in Table 3.

The nut shall then be backed off by the application of reverse torque until the tensile load has been reduced to zero and the prevailing torque element is disengaged from the screw. During this backing off, the lowest numerical torque occurring throughout the first 360 deg of rotation after the tensile load in the screw has been reduced to zero shall be recorded. This torque shall not be less than the first removal prevailing-torque value specified in Table 3.

The nut shall be reassembled without developing a tensile load in the screw and removed four more times until the prevailing-torque element has been disengaged from the screw. At no time during these four additional installations and removals shall the prevailing-torque exceed the specified maximum first installation prevailing-torque value in Table 3. During the fifth removal, the lowest numerical torque occurring throughout the first 360 deg of rotation shall be recorded. This torque shall not be less than the specified fifth removal prevailing-torque value in Table 3.

Sufficient time shall elapse between torquing cycles to prevent overheating of the test assembly.

For referee inspection for lot acceptance the speed of installation and removal of the nut shall not exceed 30 RPM.



NOTE:
(1) The washer must be prevented from turning during torque-tension test only.

Fig. 1 Load Measuring Device

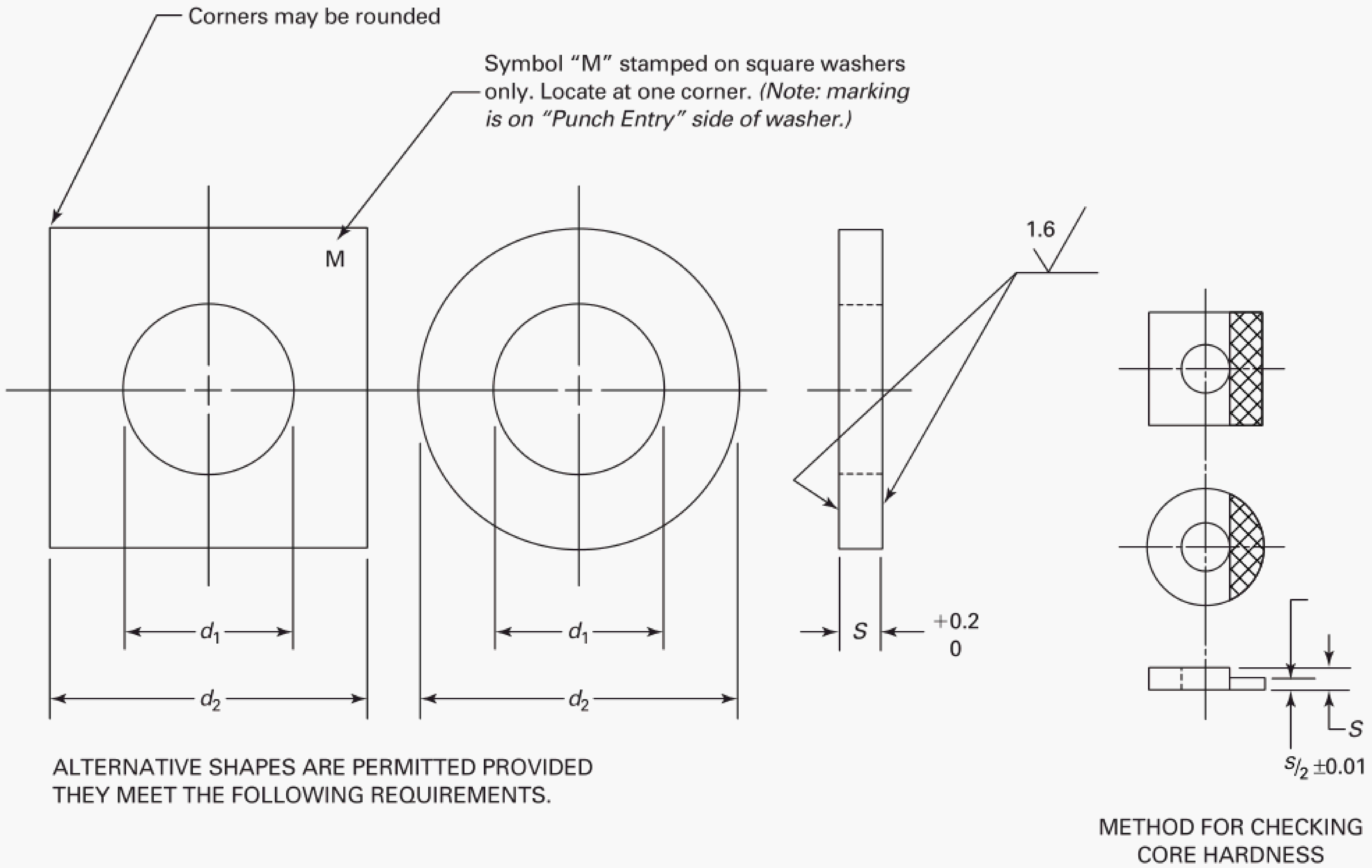


Table 5 Test Washers

Nominal Dia. of Test Bolt	Hole Diameter, d_1		Outside Dia. or Width, d_2, Min.	Thickness, S
	Max.	Min.		
M6 × 1	6.40	6.15	16.4	1.8
M8 × 1.25	8.50	8.25	19.4	1.8
M10 × 1.5	10.50	10.25	22.4	1.8
M12 × 1.75	12.50	12.25	29.0	2.9
M14 × 2	14.50	14.25	32.1	2.9
M16 × 2	16.50	16.25	35.8	2.9
M20 × 2.5	21.00	20.75	42.3	3.9
M24 × 3	25.00	24.75	55.2	3.9

GENERAL NOTES:
(a) All dimensions are in millimeters.
(b) Square washers are preferred.
(c) Material shall be carbon steel with a chemical composition of C 0.48% to 0.60%, Mn 0.60% to 1.50%, P 0.035% max., and S 0.045% max., quenched and tampered, cleaned and degreased, with a surface hardness of 85 to 88 HR15N (500 to 600 HV 2.5) and a core hardness of 73 HRA min. (450 HV 30 min.).
(d) Washers shall be plain, clean, and lubricant free or electrodeposited zinc plated to a coating thickness of 5 to 10 μm. As soon as practicable following plating, washers shall be baked for 1 hr at 190°C ± 15°C. Plating thickness shall be checked in accordance with ASTM B487.
(e) Washers shall be free from burrs and sharp edges.
(f) For sizes not listed, purchasers and suppliers shall agree on the washer size. The hole diameter of the washer selected should be as small as practical in order to reduce test variance.

16.8 Torque-Tension Test

When required, the torque-tension test shall be conducted with the same test set-up as specified in Prevailing-Torque Test. In the event of dispute, the hardened test washer shall be placed such that its punch entry side is placed against the test specimen. New components shall be used for each test.

Set the drive tool to shut off at a tension value approximately 1.0% greater than the specified clamp load. Alternatively, set the drive tool to shut off at a torque approximately 2.0% greater than the maximum estimated torque at the specified clamp load.

Tighten the joint with the drive tool at the appropriate speed for the sample being tested. Sockets shall not be allowed to contact the test washer during the rundown. Unless otherwise specified, sample size shall be as specified in ASME B18.18.1. Both torque and tension shall be recorded during the rundown and shall meet the requirements as agreed between purchaser and supplier.

17 IDENTIFICATION SYMBOLS

Carbon steel nuts shall be marked to identify the property class and the manufacturer in accordance with requirements specified in ASTM A563M. Insert-type nuts may be property class identified by the number of insert retaining stake marks, class 5 nuts with two equally spaced stake marks, class 9 nuts with three equally spaced stake marks, and class 10 nuts with four equally spaced stake marks. The manufacturer's identification symbol shall be of his design. For insert-type nuts, the color of the insert is an acceptable manufacturer's identification.

Nuts for which no standard for identification exists shall be marked as agreed between purchaser and supplier.

18 FINISH

Nuts may be furnished plain (bare metal) or with a protective coating (electrodeposited plating and/or chemical conversion coating) as specified by the user.

All nuts shall be provided with a supplementary lubricant if necessary to meet the stated performance requirements without galling. The lubricant shall be clean and dry to the touch, shall not be irritating to normal skin, nor emit an unpleasant odor during nut assembly.

The performance of nuts which are furnished with a protective coating shall not deteriorate when the 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 failure of the nut to meet dimensional, mechanical, or performance requirements traceable to plating, coating, or cleaning practice.

18.1 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.

19 WORKMANSHIP

Nuts shall be free of surface irregularities that might affect their serviceability, such as burrs, seams, laps, loose scale, and other irregularities. When control of surface discontinuities is important for the application intended, ASTM F812/F812M should be specified.

20 OPTIONS

Options, where specified, shall be at the discretion of the manufacturer unless otherwise agreed between supplier and purchaser.

21 INSPECTION AND QUALITY ASSURANCE

Nuts shall be inspected for dimensional, material, mechanical, and performance requirements of this Standard. The dimensional requirements of Tables 1 and 2, and the performance requirements of Table 3 shall be inspected in accordance with ASME B18.18.2. Alternative inspection procedures shall be used only on agreement between the purchaser and the supplier.

22 DESIGNATION

Prevailing-torque hex nuts and hex flange nuts shall be designated by the following data, preferably in the sequence shown: product name and designation of the standard, nominal diameter and thread pitch, 15 mm width across flats (WAF) for size M10 if applicable, steel property class or material identification, protective coating if required, prevailing-torque design, and torque-tension requirements if applicable.

NOTE: It is common practice in ISO standards to omit thread pitch from the product designation when threads are the metric coarse series, e.g., M10 is M10 × 1.5.

EXAMPLES: Prevailing-torque hex nut, ASME B18.16, M10 × 1.5, 15 mm WAF, ASTM A563M Class 9, phosphate/oil per ASTM F1137 Grade I, all-metal, 32-45 N·m at 28.3 kN, zinc test washer.

Prevailing-torque hex flange nut, ASME B18.16, M12 × 1.75, ASTM A563M Class 10, oiled, top insert.

For a recommended part number (PIN) system for prevailing-torque nuts, see ASME B18.24.

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