AMERICAN NATIONAL STANDARD

Metric Heavy Hex Bolts

ANSI B18.2.3.6M - 1979

REAFFIRMED 1995

FOR CURRENT COMMITTEE PERSONNEL
PLEASE SEE ASME MANUAL AS-11

REAFFIRMED 2001

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Government Key Words:
Bolt, Heavy Hex — Metric

SECRETARIAT

SOCIETY OF AUTOMOTIVE ENGINEERS
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center 345 East 47th Street New York, N. Y. 10017

ACCEPTANCE NOTICE

This non-Government document was adopted on 26 April 1979 and is approved for use by the DoD and Federal Agencies. Metric heavy hex bolts shall conform to this document and Appendix III, which establishes standard items for Government application. Appendix III, Table 4 shall be used for item selection in accordance with the part numbering system and size information contained therein. The indicated industry group has furnished the clearances required by existing regulations. Copies of the document are stocked by DoD Single Stock Point, Naval Publications and Forms Center, Philadelphia, PA, 19120, for issue to DoD activities and Federal Agencies only. Contractors and industry groups must obtain copies directly from:

The American Society of Mechanical Engineers
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The American National Standards Institute
1430 Broadway, New York, NY 10018

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NOTICE: When reaffirmation, amendment, revision, or cancellation of this standard is initially proposed, the industry group responsible for this standard shall inform the Military Coordinating Activity of the proposed action and request their participation.

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ERRATA

to

ANSI B18.2.4.6M-1979
METRIC HEAVY HEX NUTS

Title Page, *for* Government Key Words, *change to read* Nuts, Heavy Hex – Metric.

Page 6, *for* MATERIAL AND FINISH CODE A *and* B, *change* 0.005 mm *to read* 5.1 μm

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
345 East 47 Street, New York, N.Y. 10017

April 1981

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, then the United States of American 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 2 was subsequently established and charged with the responsibility for technical content of standards covering wrench head bolts and nuts.

At its meeting on December 4, 1974, Committee B18 authorized preparation of a series of standards for metric fasteners. Subcommittee 2 was assigned responsibility for developing standards for metric hex bolts, screws and nuts.

At a meeting on September 22, 1976, Subcommittee 2 organized the contents of a standard covering eight different hex head screw and bolt products. Actual drafting was postponed until ISO/TC2 could reach final decisions relating to basic dimensions and characteristics of hex bolts, screws and nuts. At ISO/TC2 meetings held in April 1977, final actions were taken. Committee B18 affirmed the TC2 decisions at a meeting on June 29, 1977 and drafting of this standard was started.

In February 1978, Committee B18 established a cooperative program with the Department of Defense to draft American National Standards for metric fasteners in such a way that they could be used directly by the Government for procurement purposes. The Department of Defense requested that each of the eight products be covered in separate standards, and Subcommittee 2 accepted this approach at its meeting on June 27, 1978.

This standard was approved by letter ballot of Committee B18 on September 15, 1978, and was subsequently approved by the secretariat and submitted to the American National Standards Institute for designation as an American National Standard. This was granted on April 26, 1979.

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CONTENTS

AMERICAN NATIONAL STANDARD

METRIC HEAVY HEX BOLTS

GENERAL DATA

1. Scope

1.1 This standard covers the complete general and dimensional data for metric heavy hex bolts recognized as "American National Standard."

1.2 The inclusion of dimensional data in this standard is not intended to imply that all of the sizes in conjunction with the various options described herein are stock production items. Consumers are requested to consult with manufacturers concerning lists of stock production heavy hex bolts.

1.3 Heavy hex bolts purchased for Government use shall conform to this standard, and additionally to the requirements of Appendix III.

2. Comparison With ISO Standards

2.1 ISO has not yet initiated development of an ISO standard for heavy hex bolts. However, nominal diameters and thread pitches, body diameters, widths across flats, head heights, thread lengths, thread dimensions and nominal lengths are in accord with ISO standards for related hex screws and bolts.

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

3. Dimensions

3.1 All dimensions in this standard are in millimeters, unless stated otherwise.

3.2 Symbols specifying geometric characteristics are in accord with American National Standard, Dimensioning and Tolerancing, ANSI Y14.5-1973.

4. Availability. Heavy hex bolts in sizes M12 thru M24 are standard only in lengths longer than 150 mm or 10D, whichever is shorter. When shorter lengths of these sizes are ordered, heavy hex screws in conformance with ANSI B18.2.3.3M are normally supplied. Heavy hex bolts in sizes M30 and M36 are standard in all lengths, however, at manufacturer's option, heavy hex screws may be substituted for any diameter-length combination.

5. Surface Condition. Bolts need not be finished on any surface except the threads.

6. Top of Head. The top of head shall be full form and chamfered or rounded. The diameter of the chamfer circle or the start of rounding shall be equal to the maximum width across flats within a tolerance of minus 15 percent.

7. Head Height. The head height is the distance, as measured parallel to the axis of the bolt, from the top of the head to the under head bearing surface.

8. Wrenching Height. The wrenching height is the distance, measured at a corner of the hex, from the plane of the bearing surface to the last plane of full formed hex, i.e., the plane closest to the top of head at which the width across corners of the hex is within its specified limits.

9. Corner Fill. The rounding due to lack of fill at the six corners of the head shall be reasonably uniform.

10. True Position of Head. The axis of the hex head shall be located at true position with respect to the axis of the bolt (determined over a distance under the head equal to one bolt diameter) within a tolerance zone of diameter equal to 6 percent of the specified maximum width across flats.

11. Bearing Surface. The bearing surface shall be reasonably flat. However, a die seam across the bearing face shall be permissible. Bearing surface shall be

perpendicular to the axis of the body within a tolerance of 3 deg for sizes M24 and smaller, and 2 deg for sizes larger than M24. Angularity measurement shall be taken at a location to avoid interference from a die seam.

12. Body Diameter

12.1 Bolts shall be furnished with full diameter body within the limits specified in Table 1, or shall be threaded to the head unless the purchaser specifies bolts with "reduced diameter body" (12.3).

12.2 There may be a reasonable swell, fin, or die seam on the body adjacent to the underside of head not to exceed the nominal bolt diameter by the following:

0.75 mm for M12 and M14
1.25 mm for M16
1.50 mm for M20 thru M30
2.30 mm for M36

12.3 Bolts may be obtained with "reduced diameter body" if so specified, however, bolts with nominal lengths shorter than 4D are not recommended. Where "reduced diameter body" is specified, the body diameter shall be within the limits specified in Table 2. A shoulder under the head may be supplied at option of the manufacturer. When a shoulder is supplied, its diameter and length shall be as specified in Table 2.

13. Fillet. The fillet at junction of head and shank shall be a smooth concave curve within an envelope of R minimum and a radius tangent to the shank and to the underside of the head at a point equal to one-half of Da maximum from the axis of the bolt.

14. Length. The length of the bolt shall be measured parallel to the axis of the bolt from the underside of head to the extreme end of the shank. Tolerances for bolt lengths are given in Table 3.

15. Point. Bolts need not be pointed.

16. Straightness. Shanks of bolts shall be straight within a maximum camber of 0.006 mm/mm of bolt length for bolts having nominal lengths of 300 mm or shorter; and within 0.008 mm/mm of bolt length for bolts having nominal lengths over 300 mm to 600 mm. The referee gage and gaging procedure for checking bolt straightness is given in Appendix I.

17. Thread Length

17.1 The length of thread on bolts shall be controlled by the grip gaging length Lg max as set forth in 17.2 thru 17.4.

17.2 Grip Gaging Length, Lg max, is the distance measured parallel to the axis of bolt, from the underside of the head to the face of a non-counterbored or non-countersunk standard GO thread ring gage assembled by hand as far as the thread will permit. The maximum grip gaging length, as calculated and rounded to one decimal place, for any bolt length shall be equal to the nominal bolt length, L, minus the basic thread length, B, as specified in Table 1, (Lg max = L - B). It represents the minimum design grip length of the bolt and shall be used as the criterion for inspection and for determining thread availability when selecting bolt lengths even though usable threads may extend beyond this point.

All bolts of nominal lengths equal to or shorter than the sum of the basic thread length, B, plus a length of 2½ thread pitches for sizes up to and including M24, and B plus 3½ thread pitches for sizes larger than M24 shall be threaded full length. For bolts which are threaded full length, the distance from the bearing surface of the head to the face of a non-counterbored or non-countersunk standard GO thread ring gage assembled by hand as far as the thread will permit, shall not exceed the equivalent of 2½ thread pitches for sizes up to and including M24, and 3½ thread pitches for sizes larger than M24.

17.3 Basic Thread Length B, as specified in Table 1, is a reference dimension, intended for calculation purposes only, and is the distance, measured parallel to the axis of the bolt, from the extreme end of the bolt to the last complete (full form) thread.

17.4 Incomplete Thread Diameter. The major diameter of incomplete thread shall not exceed the actual major diameter of the full form thread.

18. Thread Series. Threads shall be metric coarse thread series conforming to dimensions for general purpose external threads given in ANSI B1.13, unless otherwise specified by the purchaser. The class 6g tolerance shall apply to plain finish (unplated or uncoated) bolts, and to plated or coated bolts before plating or coating. For bolts with additive finish, the 6g diameters may be exceeded by the amount of the allowance, i.e., the basic diameters shall apply to bolts after plating or coating.

19. Material and Mechanical Properties. Unless otherwise specified, steel bolts shall conform to the requirements specified in SAE J1199 or ASTM F568. Bolts of other materials such as stainless steel, brass, bronze and aluminum alloys shall have properties as agreed upon by the manufacturer and the purchaser.

20. Finish. Unless otherwise specified, screws and bolts shall be supplied with a natural (as processed) finish, unplated or uncoated.

21. Identification Symbols. Steel bolts shall be marked with the property class symbol and with the manufacturer's identification symbol. Minimum height of property class symbols shall be 3.2 mm for M12 and M14 bolts, and 4.0 mm for M16 and larger bolts. Markings shall be located on the top of the head and may be raised or recessed unless otherwise ordered by the purchaser. When raised, markings shall project not less than 0.1 mm for M12 and M14 bolts, and 0.3 mm for M16 and larger bolts above the surface of the head, and total head height (head plus markings) shall not exceed the specified maximum head height plus 0.3 mm for M12 and M14 bolts, and 0.4 mm for M16 and larger bolts.

22. Options. Options, where specified, shall be at the discretion of the manufacturer unless otherwise agreed upon by the manufacturer and the purchaser.

23. Terminology. For definitions of terms relating to fastener or component features thereof used in this standard, refer to American National Standard, Glossary of Terms for Mechanical Fasteners, ANSI B18.12.

24. Workmanship. Bolts shall not contain an excess of surface imperfections which might affect their serviceability, such as burrs, seams, laps, loose scale and other irregularities.

25. Clearance Holes. The recommended sizes of clearance holes in material to be assembled using heavy hex bolts are the normal series given in Appendix II.

26. Designation

26.1 Heavy hex bolts shall be designated by the following data, preferably in the sequence shown: product name, nominal diameter and thread pitch, nominal length, steel property class or material identification, and protective coating, if required.

Note

It is common practice in ISO standards to omit thread pitch from the product size designation when screw threads are the metric coarse thread series, e.g., M20 is M20 x 2.5.

Examples:

Heavy hex bolt, M20 x 2.5 x 160, class 4.6, zinc plated.

Heavy hex bolt, M36 x 4 x 80, silicon bronze

26.2 The Government part numbering system for metric heavy hex bolts is given in Appendix III.

27. Referenced Standards

Copies of referenced ASTM standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

Copies of referenced SAE standards may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

Copies of referenced ISO standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

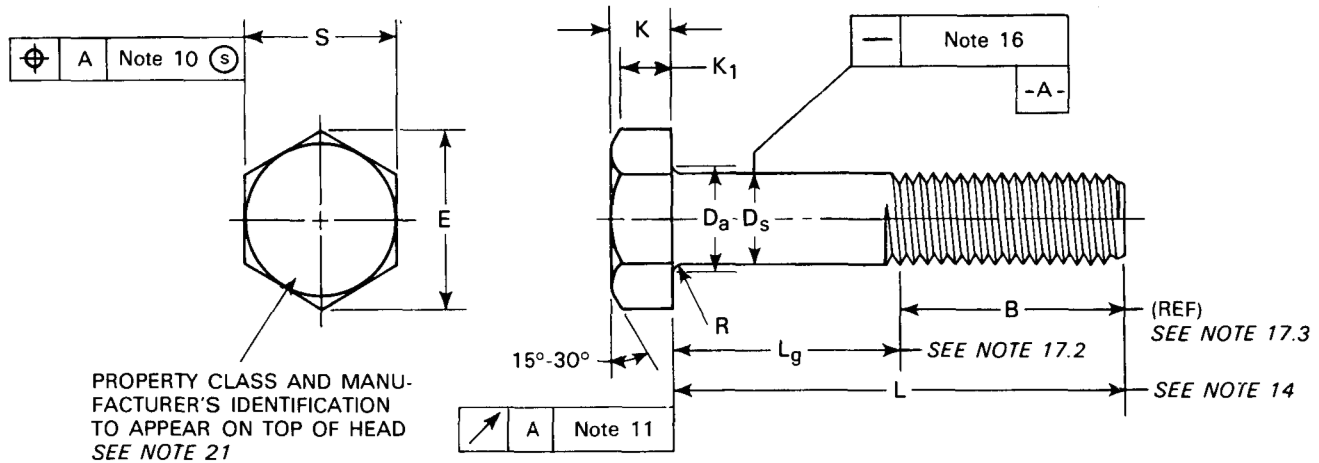


Table 1 Dimensions of Heavy Hex Bolts

D	Ds		S		E		K		K_1	Da	R	B (Ref)		
Nominal Bolt Size & Thread Pitch	Body Diameter		Width Across Flats		Width Across Corners		Head Height		Wrench-ing Height	Fillet Transi-tion Dia	Radius of Fillet	Thread Length (Basic)		
	Max	Min	Max	Min	Max	Min	Max	Min	Min	Max	Min	Bolt Lengths ⩽ 125	Bolt Lengths > 125 and ⩽ 200	Bolt Lengths > 200
M12 x 1.75	12.70	11.30	21.00	20.16	24.25	22.78	7.95	7.24	5.2	13.7	0.6	30	36	49
M14 x 2	14.70	13.30	24.00	23.16	27.71	26.17	9.25	8.51	6.2	15.7	0.6	34	40	53
M16 x 2	16.70	15.30	27.00	26.16	31.18	29.56	10.75	9.68	7.0	17.7	0.6	38	44	57
M20 x 2.5	20.84	19.16	34.00	33.00	39.26	37.29	13.40	12.12	8.8	22.4	0.8	46	52	65
M24 x 3	24.84	23.16	41.00	40.00	47.34	45.20	15.90	14.56	10.5	26.4	0.8	54	60	73
M30 x 3.5	30.84	29.16	50.00	49.00	57.74	55.37	19.75	17.92	13.1	33.4	1.0	66	72	85
M36 x 4	37.00	35.00	60.00	58.80	69.28	66.44	23.55	21.72	15.8	39.4	1.0	78	84	97
See Notes	12				8.9		7		8	13		17.3		

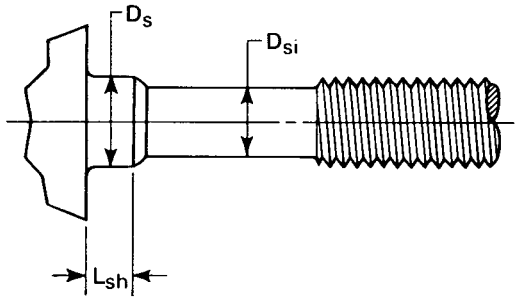


Table 2 Dimensions of Reduced Body Diameter

Nominal Bolt Dia and Thread Pitch	Ds		Dsi		Ls_h	
	Shoulder Diameter		Body Diameter		Shoulder Length	
	Max	Min	Max	Min	Max	Min
M12 x 1.75	12.70	11.30	10.95	10.68	7.0	6.0
M14 x 2	14.70	13.30	12.77	12.50	8.0	7.0
M16 x 2	16.70	15.30	14.77	14.50	9.0	8.0
M20 x 2.5	20.84	19.16	18.49	18.16	11.0	10.0
M24 x 3	24.84	23.16	22.13	21.80	13.0	12.0

Note: Shoulder is optional.

Table 3 Length Tolerances

Nominal Length	Nominal Bolt Diameter		
	M12 thru M16	M20 and M24	M30 and M36
to 50 mm	1.3	2.0	3.0
over 50 to 80 mm	1.5	2.5	3.5
over 80 to 120 mm	1.8	3.0	4.0
over 120 to 180 mm	2.0	3.5	4.5
over 180 to 240 mm	4.0	4.0	6.0
over 240 mm	5.0	5.0	6.0

All tolerances are plus and minus

APPENDIX I

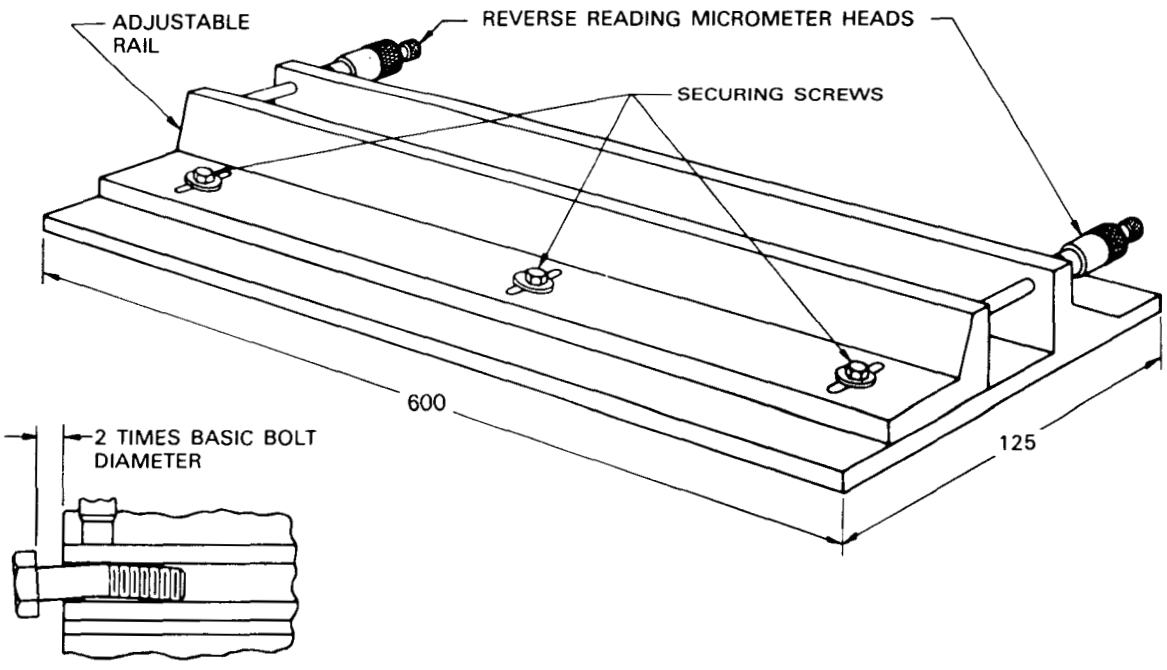
BOLT STRAIGHTNESS
REFEREE GAGE AND GAGING PROCEDURE

The conformance of bolts to shank straightness or camber limitations set forth in the respective product standards shall be checked by using the gage illustrated below in accordance with the following procedure:

Allowable total camber on the product to be inspected shall be calculated by multiplying the specified permissible camber per mm of length by the product length expressed as a one place decimal. The total camber thus derived shall be added to the specified maximum body diameter exclusive of allowance for swell or fin under head and the adjustable rail of gage shall be adjusted to provide a parallel space between the rails equal to this distance by obtaining common readings on both micrometer heads. The adjustable rail shall then be locked in place by tightening securing screws.

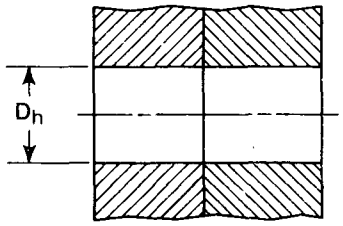
The product shall then be inserted between rails, excluding from the gage any permissible length of swell or fillet under the head. The products shall be rotated by hand through full 360 deg. Any interference occurring between the product and the gage which is sufficient to prevent rotation shall indicate excessive camber.

TYPICAL STRAIGHTNESS GAGE



APPENDIX II

RECOMMENDED CLEARANCE HOLES FOR BOLTS



Clearance Holes for Bolts

Nom Bolt Dia and Thread Pitch	Dh—Clearance Hole Diameter, Basic		
	Close Clearance	Normal Clearance (Preferred)	Loose Clearance
M12 x 1.75	13.0	13.5	14.5
M14 x 2	15.0	15.5	16.5
M16 x 2	17.0	17.5	18.5
M20 x 2.5	21.0	22.0	24.0
M24 x 3	25.0	26.0	28.0
M30 x 3.5	31.0	33.0	35.0
M36 x 4	37.0	39.0	42.0

Notes:

1. **Normal Clearance.** Normal clearance hole sizes are preferred for general purpose applications, and should be specified unless special design considerations dictate the need for either a close or loose clearance hole.

2. **Close Clearance.** Close clearance hole sizes should be specified only where conditions such as critical alignment of assembled parts, wall thickness or other limitations necessitate use of a minimal hole. When close clearance holes are specified, special provision (e.g., countersinking) must be provided at the bolt entry side to permit proper seating of the bolt head.

3. **Loose Clearance.** Loose clearance hole sizes should be specified only for applications where maximum adjustment capability between components being assembled is necessary.

4. **Recommended Tolerances.** The clearance hole diameters given in the table are minimum sizes. Recommended tolerances are plus 0.3 mm for bolt diameters M12 thru M16; and plus 0.4 mm for bolt diameters M20 thru M36.

APPENDIX III

Government Standard Items and Part Numbering System

Note

The Government encourages the general use of this appendix to achieve maximum parts standardization.

This appendix establishes the standard items for Government application selected from the possible variations of items within the scope of the standard and provides a part numbering system for identification and application in engineering documents.

The following variations are standard:

a. Diameter/Thread Pitch and Length Combinations—as specified in Table 4.

b. Material—Steel, Property Class 10.9.

c. Finish—Cadmium plating or zinc plating as coded in Part Numbering System.

d. Special Features—drilled head or self-locking, as specified.

The part number shall consist of the following element codes in the order shown:

a. Document Identifier – ANSI Standard Number less decimal points

b. Material and Finish

c. Nominal Diameter

d. Nominal Length

e. Special Features

Note

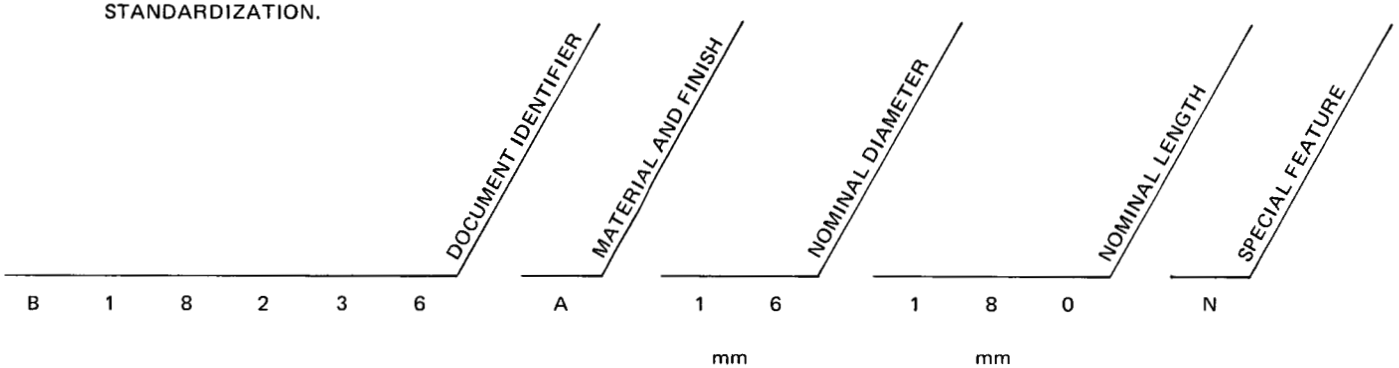
The Part Numbering System may also be used for non-standard diameter and length combinations.

Quality Assurance Provisions: Quality assurance provisions shall be in accordance with FF-S-85 Screw, Cap, Slotted and Hexagon Head.

Packaging: Packaging shall be in accordance with PPP-H-1581, Hardware (Fasteners and Related Items), Packaging and Packing for Shipment and Storage of.

PART NUMBERING SYSTEM COVERING STANDARD ITEMS FOR GOVERNMENT USE

NOTE: THE GOVERNMENT ENCOURAGES THE GENERAL USE OF THIS SYSTEM TO ACHIEVE MAXIMUM PARTS STANDARDIZATION.



MATERIAL AND FINISH CODE

A – Steel w/Cadmium Plating per QQ-P-416, Type II, Class 3 (0.005 mm Plating Thickness), Property Class 10.9.

B – Steel w/Zinc Plating per QQ-Z-325, Type II, Class 3 (0.005 mm Plating Thickness), Property Class 10.9.

SPECIAL FEATURE CODE

N – NONE

D – Drilled Head*

L – Self-Locking*

C – Drilled Head and Self-Locking*

EXAMPLE: B18236A16180N indicates a bolt, heavy hex-metric, made of cadmium plated steel, property class 10.9, 16 mm in diameter, 180 mm in length, with no special feature.

*Details will be provided when available.

Table 4 Metric Heavy Hex Bolts—Standard Sizes For Government Use

Nominal Length	Nominal Diameter and Thread Pitch						
	M12 x 1.75	M14 x 2	M16 x 2	M20 x 2.5	M24 x 3	M30 x 3.5	M36 x 4
20							
25							
30							
35							
40							
45	FOR SELECTION WITHIN THIS AREA, USE ANSI B18.2.3.3M, METRIC HEAVY HEX HEAD SCREW SELECTION CRITERIA, APPENDIX III, TABLE 8.						
50							
55							
60							
65							
70						30070	
75							
80							36080
90							
100							
110							
120							
130	12130						
140							
150		14150					
160			16160	20160	24160		
180							
200			STANDARD DIAMETER AND LENGTH COMBINATION				
220							
240							
260							
300	12300	14300	16300	20300	24300	30300	36300