

D-17-19  
ANSI B18.2.3.6M-79  
26 APRIL 1979

### 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  
United Engineering Center, 345 E. 47th Street  
New York, NY 10017 or

The American National Standards Institute  
1430 Broadway, New York, NY 10018

|                                 |  |
|---------------------------------|--|
| Title of Document:              | Bolt, Heavy Hex -- Metric                    |
| ANSI Document No.:              | ANSI B18.2.3.6M-1979                         |
| Date of Specific Issue Adopted: | 26 April 1979                                |
| Releasing Industry Group:       | The American Society of Mechanical Engineers |
| Custodians:                     | Military Coordinating Activity               |
| Army -- AR                      | Army -- AR                                   |
| Navy -- AS                      |  |
| Air Force -- 99                 | (Project 5306-0621)                          |
| Review Activities:              | User Activities:                             |
| Army -- AV, MI, ER              | Army -- ME, AT                               |
| Navy -- MC                      | Navy -- SH                                   |
| DLA -- IS                       |  |
| NSA -- NS                       |  |
|                                 | Civil Agencies:                              |
|                                 | GSA-FSS                                      |

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.

FSC 5305

No part of this document may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Date of Issuance: August 31, 1979

Copyright © 1979 by  
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS  
All Rights Reserved  
Printed in U.S.A.

THIS DOCUMENT CONTAINS 1 PAGES.

**ERRATA**

to

**ANSI B18.2.3.6M-1979  
METRIC HEAVY HEX BOLTS**

Page 2, Note 18, *change B1.13 to read B1.13M*

Page 9, *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



D-17-19

AMERICAN NATIONAL STANDARD

# Metric Heavy Hex Bolts

---

ANSI B18.2.3.6M - 1979

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  
United Engineering Center, 345 E. 47th Street  
New York, NY 10017 or

The American National Standards Institute  
1430 Broadway, New York, NY 10018

|                                 |  |
|---------------------------------|--|
| Title of Document:              | Bolt, Heavy Hex – Metric                     |
| ANSI Document No.:              | ANSI B18.2.3.6M-1979                         |
| Date of Specific Issue Adopted: | 26 April 1979                                |
| Releasing Industry Group:       | The American Society of Mechanical Engineers |
| Custodians:                     | Military Coordinating Activity               |
| Army – AR                       | Army – AR                                    |
| Navy – AS                       |  |
| Air Force – 99                  | (Project 5306-0621)                          |
| Review Activities:              | User Activities:                             |
| Army – AV, MI, ER               | Army – ME, AT                                |
| Navy – MC                       | Navy – SH                                    |
| DLA – IS                        |  |
| NSA – NS                        |  |
|                                 | Civil Agencies:                              |
|                                 | GSA-FSS                                      |

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.

|          |
|----------|
| FSC 5305 |
|----------|

---

No part of this document may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Date of Issuance: August 31, 1979

Copyright © 1979 by  
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS  
All Rights Reserved  
Printed in U.S.A.

## 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.

**AMERICAN NATIONAL STANDARDS COMMITTEE B18  
STANDARDIZATION OF BOLTS, NUTS, RIVETS, SCREWS,  
WASHERS AND SIMILAR FASTENERS**

**OFFICERS**

**R. P. Trowbridge, Chairman**  
**J. B. Levy, Vice-Chairman**  
**H. G. Muenchinger, Vice-Chairman**  
**Richard McGinnis, Secretary**

**COMMITTEE PERSONNEL**

**AMERICAN CHAIN ASSOCIATION**

*L. E. Hampel, Moline Malleable Iron Company, St. Charles, Illinois*

**AMERICAN HARDWARE MANUFACTURERS ASSOCIATION**

*Donald Wanek, Wrought Washer Manufacturing Company, Milwaukee, Wisconsin*

**AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS**

*R. T. Kelly, Hitchcock Publishing Company, Wheaton, Illinois*

**AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS**

*E. R. Friesth, Deere & Company, Moline, Illinois*

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS, THE**

*A. R. Machell, Jr., Xerox Corporation, Rochester, New York*  
*F. P. Tisch, Desert Hot Springs, California*  
*R. P. Trowbridge, GM Technical Center, Warren, Michigan*  
*C. R. Adams, Alternate, Newport News Shipbuilding & Dry Dock Company, Newport News, Virginia*  
*K. E. McCullough, Alternate, SPS Technologies, Jenkintown, Pennsylvania*

**ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION**

*W. J. Derner, FMC Corporation, Indianapolis, Indiana*

**ENGINE MANUFACTURERS ASSOCIATION**

*K. F. Naylor, Cummins Engine Company, Columbus, Indiana*

**FARM & INDUSTRIAL EQUIPMENT INSTITUTE**

*E. R. Friesth, Deere & Company, Moline, Illinois*

**HAND TOOLS INSTITUTE**

*C. B. Ingersoll, J. H. Williams Company, Buffalo, New York*

**INDUSTRIAL FASTENERS INSTITUTE**

*R. B. Belford, Industrial Fasteners Institute, Cleveland, Ohio*  
*A. R. Breed, The Lamson & Sessions Company, Cleveland, Ohio*  
*D. A. Garrison, Russell, Burdsall & Ward, Inc. Rock Falls, Illinois*  
*R. W. Groover, Bethlehem Steel Company, Lebanon, Pennsylvania*  
*E. J. Heldman, Holo-Krome Company, West Hartford, Connecticut*  
*Jack Shugart, Rockford Products Corporation, Rockford, Illinois*  
*D. P. Wagner, Illinois Tool Works, Inc., Elgin, Illinois*  
*D. D. Wheeler, Armco Steel Corporation, Kansas City, Missouri*  
*N. W. Bellas, Alternate, Illinois Tool Works, Inc., Elgin, Illinois*  
*R. M. Harris, Alternate, Bethlehem Steel Corporation, Lebanon, Pennsylvania*  
*F. R. Ling, Alternate, Russell, Burdsall & Ward, Inc., Mentor, Ohio*

**METAL CUTTING TOOL INSTITUTE**

*D. J. Emanuelli, Greenfield Tap & Die, Greenfield, Massachusetts*

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

- J. B. Levy*, General Electric Company, Schenectady, New York  
*F. F. Weingruber*, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania  
*F. K. Kitzantides*, Alternate, National Electrical Manufacturers Association, Washington, D.C.

## NATIONAL ELEVATOR INDUSTRY, INC.

- R. J. Cummings*, Otis Elevator Company, Mahwah, New Jersey

## SOCIETY OF AUTOMOTIVE ENGINEERS

- H. W. Ellison*, GM Corporation, Warren, Michigan  
*S. E. Mallen*, Ford Motor Company, Dearborn, Michigan  
*R. S. Piotrowski*, Mack Trucks, Inc., Allentown, Pennsylvania  
*C. F. Schaening*, GM Engineering Standards Section, Warren, Michigan  
*R. R. Sjoberg*, International Harvester Company, Hinsdale, Illinois  
*D. W. Vial*, Chrysler Corporation, Detroit, Michigan

## SOCKET SCREW PRODUCTS BUREAU

- E. R. Carter, Jr.*, The Allen Manufacturing Company, Hartford, Connecticut  
*Jack Trilling*, Great Lakes Screw, Chicago, Illinois

## TELEPHONE GROUP

- R. A. Agnew*, Western Electric Company, Chicago, Illinois  
*R. Morse*, Bell Laboratories, Columbus, Ohio  
*H. Haefeli*, Alternate, Bell Laboratories, Columbus, Ohio

## TUBULAR RIVET &amp; MACHINE INSTITUTE

- J. G. Zeratsky*, National Rivet & Manufacturing Company, Waupun, Wisconsin

## U.S. DEPARTMENT OF THE AIR FORCE

To be appointed

## U.S. DEPARTMENT OF THE ARMY

- M. E. Taylor*, U.S. Army Armament R & D Command, Dover, New Jersey  
*Allen Herskovitz*, Alternate, U.S. Army Armament R & D Command, Dover, New Jersey

## U.S. DEPARTMENT OF DEFENSE

- Eli Schwartz*, Defense Industrial Supply Center, Philadelphia, Pennsylvania  
*Lewis Pieninck*, Alternate, Defense Industrial Supply Center, Philadelphia, Pennsylvania

## U.S. DEPARTMENT OF THE NAVY

- J. R. Ruff*, Department of the Navy, Washington, D.C.  
*M. S. Orysh*, Alternate, Department of the Navy, Philadelphia, Pennsylvania

## U.S. MACHINE CAP WOOD &amp; TAPPING SCREW BUREAUS

- S. C. Adamek*, Pheoll Manufacturing Company, Chicago, Illinois  
*R. M. Byrne*, U.S. Screw Service Bureau, New York, New York  
*T. J. Ferry*, E.W. Ferry Screw Products Company, Inc., Cleveland, Ohio  
*Casey Gordon*, Parker-Kalon, Campbellsville, Kentucky  
*H. G. Muenchinger*, Continental Screw Company, New Bedford, Massachusetts  
*K. D. Ringland*, Parker-Kalon, USM Corporation, Campbellsville, Kentucky  
*R. H. Seymour*, Reed & Prince Manufacturing Company, Worcester, Massachusetts  
*Louis Zanin*, Elco Industries, Inc., Rockford, Illinois  
*Paul Foytho*, Alternate, Harvey Hubbel, Inc., Bridgeport, Connecticut

## INDIVIDUAL COMPANIES

- D. N. Badgley*, Clark Equipment Company, Battle Creek, Michigan  
*R. W. Bertola*, The Ohio Nut & Washer Company, Mingo Junction, Ohio  
*E. D. Cowlin*, Canton, Ohio  
*J. E. Eaton, Jr.*, IBM Corporation, Boulder, Colorado  
*J. F. Tornow*, Microdot Inc., Troy, Michigan

## INDIVIDUAL MEMBERS

- C. O. Franklin*, Valley Bolt Company, Marion, Iowa  
*F. E. Graves*, Fairfield, Connecticut

**PERSONNEL OF SUBCOMMITTEE NO. 2 —  
SQUARE AND HEX BOLTS AND NUTS**

*R. R. Sjoberg, Chairman*, International Harvester Company, Hinsdale, Illinois  
*R. B. Belford, Secretary*, Industrial Fasteners Institute, Cleveland, Ohio  
*S. C. Adamek*, Pheoil Manufacturing Company, Chicago, Illinois  
*D. N. Badgley*, Clark Equipment Company, Battle Creek, Michigan  
*A. G. Baustert*, Federal Screw Works, Detroit, Michigan  
*A. R. Breed*, The Lamson & Sessions Company, Cleveland, Ohio  
*R. M. Byrne*, U.S. Screw Service Bureau, New York, New York  
*Art Clever*, Deere & Company, Moline, Illinois  
*W. J. Derner*, FMC Corporation, Indianapolis, Indiana  
*D. A. Garrison*, Russell, Burdsall & Ward, Inc., Rock Falls, Illinois  
*F. E. Graves*, Fairfield, Connecticut  
*R. M. Harris*, Bethlehem Steel Corporation, Lebanon, Pennsylvania  
*J. B. Levy*, General Electric Company, Schenectady, New York  
*D. T. Lipari*, Bell Telephone Laboratories, Inc., Columbus, Ohio  
*A. R. Machell, Jr.*, Xerox Corporation, Rochester, New York  
*K. E. McCullough*, SPS Technologies, Jenkintown, Pennsylvania  
*J. C. McMurray*, Russell, Burdsall & Ward Inc., Mentor, Ohio  
*H. G. Muenchinger*, Continental Screw Company, New Bedford, Massachusetts  
*J. F. Nagy*, Ford Motor Company, Dearborn, Michigan  
*I. M. Park*, The Steel Company of Canada, Ltd., Hamilton, Ontario, Canada  
*C. F. Schaening*, General Motors Corporation, Warren, Michigan  
*Lou Strang*, Caterpillar Tractor Company, East Peoria, Illinois  
*M. E. Taylor*, U.S. Army Armament R & D Command, Dover, New Jersey  
*R. P. Trowbridge*, General Motors Corporation, Warren, Michigan  
*P. A. Vacca*, Defense Industrial Supply Center, Philadelphia, Pennsylvania  
*F. F. Weingruber*, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania  
*D. D. Wheeler*, Armco Steel Corporation, Kansas City, Missouri  
*Tony Nebesney, Alternate*, FMC Corporation, Indianapolis, Indiana  
*L. Pieninck, Alternate*, Defense Industrial Supply Center, Philadelphia, Pennsylvania



## CONTENTS

|  | Page |
|--|------|
| General Data .....   | 1    |
| <b>Tables</b>  |      |
| 1. Dimensions of Heavy Hex Bolts .....                               | 4    |
| 2. Dimensions of Reduced Body Diameter .....                         | 5    |
| 3. Length Tolerances .....   | 5    |
| 4. Metric Heavy Hex Bolts – Standard Sizes For Government Use .....  | 10   |
| <b>Appendixes</b>  |      |
| Appendix I Bolt Straightness Referee Gage and Gaging Procedure ..... | 6    |
| II Recommended Clearance Holes For Bolts .....                       | 7    |
| III Government Standard Items and Part Numbering System .....        | 8    |

## 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  $D_a$  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  $L_g$  max as set forth in 17.2 thru 17.4.

**17.2** Grip Gaging Length,  $L_g$  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, ( $L_g$  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  $2\frac{1}{2}$  thread pitches for sizes up to and including M24, and  $B$  plus  $3\frac{1}{2}$  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  $2\frac{1}{2}$  thread pitches for sizes up to and including M24, and  $3\frac{1}{2}$  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.

AMERICAN NATIONAL STANDARD  
METRIC HEAVY HEX BOLTS

ANSI B18.2.3.6M-1979

**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.

AMERICAN NATIONAL STANDARD  
METRIC HEAVY HEX BOLTS

ANSI B18.2.3.6M-1979

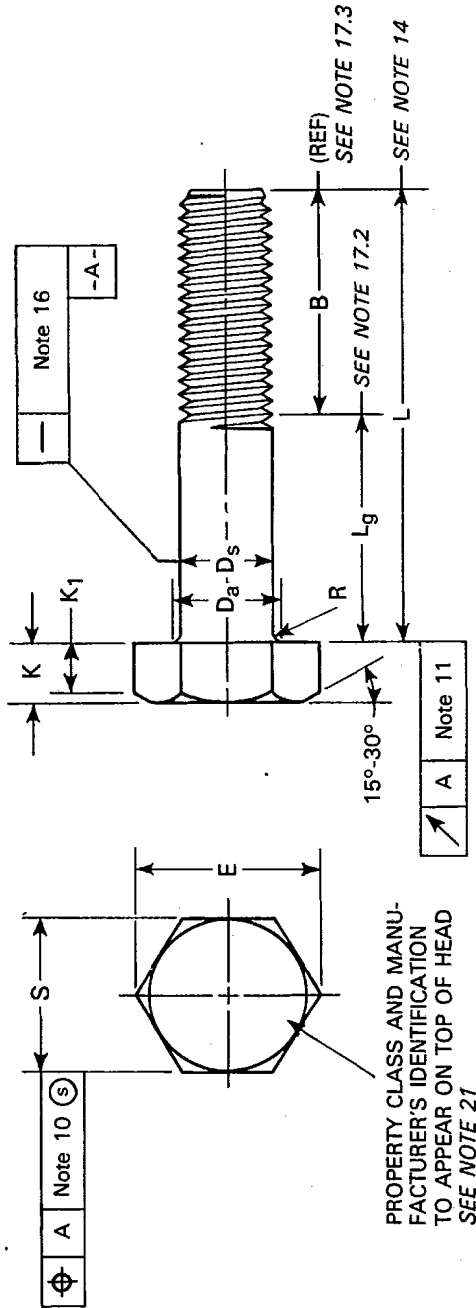
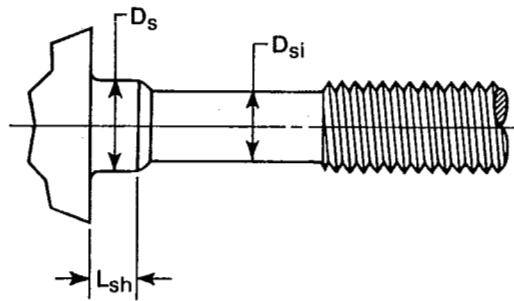


Table 1 Dimensions of Heavy Hex Bolts

| D          | Ds    |       | S     |       | E     |       | K     |       | K <sub>1</sub> | Da   | R    | B (Ref) |     |     |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|----------------|------|------|---------|-----|-----|
|            | Max   | Min   | Max   | Min   | Max   | Min   | Max   | Min   |                |      |      | Max     | Min | Max |
| 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      | 35  | 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 | D <sub>s</sub>    |       | D <sub>si</sub> |       | L <sub>sh</sub> |      |
|-----------------------------------|-------------------|-------|-----------------|-------|-----------------|------|
|                                   | 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

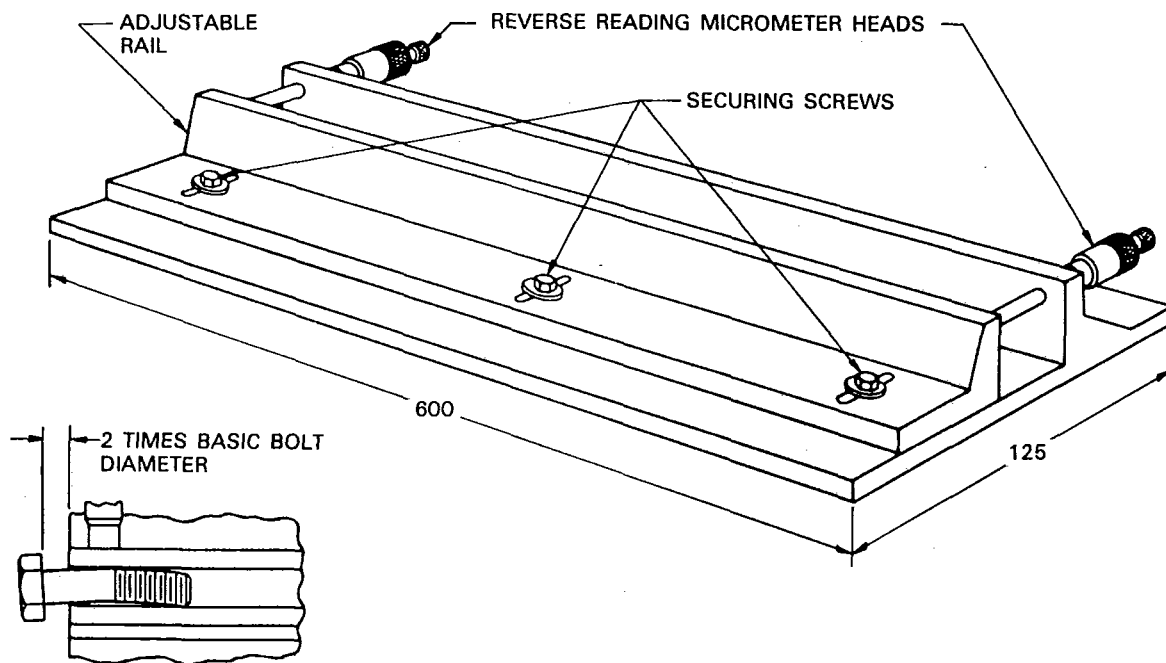
The conformance of bolts to shank straightness or camber limitations set forth in the respective product standards shall be checked by using the gage illustrated below in accordance with the following procedure:

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

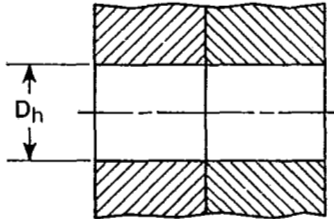
the rails equal to this distance by obtaining common readings on both micrometer heads. The adjustable rail shall then be locked in place by tightening securing screws.

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<br>Dia and<br>Thread Pitch | Dh—Clearance Hole Diameter, Basic |                                    |                    |
|-------------------------------------|-----------------------------------|------------------------------------|--------------------|
|                                     | Close<br>Clearance                | Normal<br>Clearance<br>(Preferred) | Loose<br>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

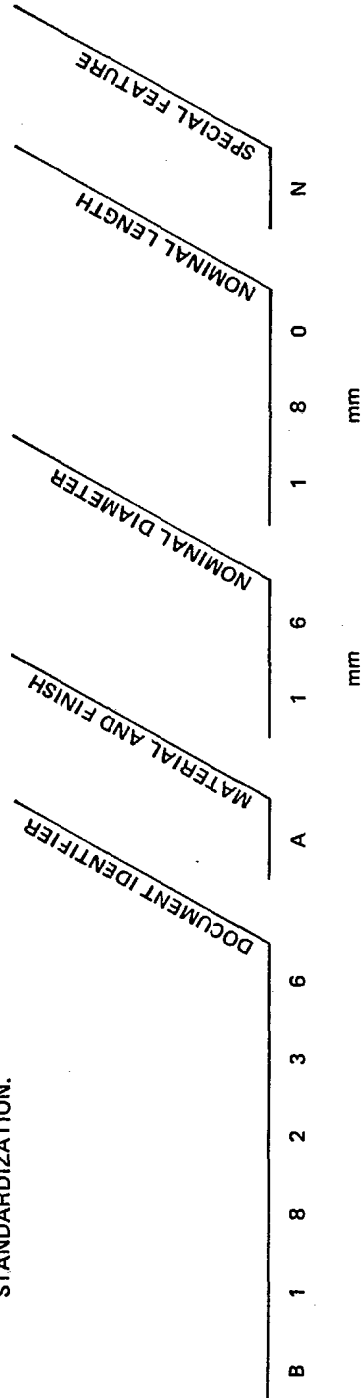
The Part Numbering System may also be used for non-standard diameter and length combinations.

**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             |                                   |         |         |           |         |           |         |
| 50             |                                   |         |         |           |         |           |         |
| 55             |                                   |         |         |           |         |           |         |
| 60             |                                   |         |         |           |         |           |         |
| 65             |                                   |         |         |           |         |           |         |
| 70             |                                   |         |         |           |         | 30070     |         |
| 75             |                                   |         |         |           |         |           |         |
| 80             |                                   |         |         |           |         |           |         |
| 90             |                                   |         |         |           |         |           |         |
| 100            |                                   |         |         |           |         |           |         |
| 110            |                                   |         |         |           |         |           |         |
| 120            |                                   |         |         |           |         |           |         |
| 130            | 12130                             |         |         |           |         |           |         |
| 140            |                                   |         |         |           |         |           |         |
| 150            |                                   | 14150   |         |           |         |           |         |
| 160            |                                   |         | 16160   | 20160     | 24160   |           |         |
| 180            |                                   |         |         |           |         |           |         |
| 200            |                                   |         |         |           |         |           |         |
| 220            |                                   |         |         |           |         |           |         |
| 240            |                                   |         |         |           |         |           |         |
| 260            |                                   |         |         |           |         |           |         |
| 300            | 12300                             | 14300   | 16300   | 20300     | 24300   | 30300     | 36300   |

FOR SELECTION WITHIN THIS AREA, USE ANSI B18.2.3.3M, METRIC HEAVY HEX HEAD SCREW SELECTION CRITERIA, APPENDIX III, TABLE 8.

STANDARD DIAMETER AND LENGTH COMBINATION