AN AMERICAN NATIONAL STANDARD

Metric Small Solid Rivets

ANSI/ASME B18.1.3M - 1983

12 mm Nominal Diameter and Smaller

REAFFIRMED 1995

FOR CURRENT COMMITTEE PERSONNEL
PLEASE SEE ASME MANUAL AS-11

REAFFIRMED 2001

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Government Key Words:
Rivet, Solid, Small — Metric

SPONSORED AND PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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

Date of Issuance: March 31, 1984

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

ERRATA

to

ANSI/ASME B18.1.3M-1983
METRIC SMALL SOLID RIVETS

Page 4, Table 3 – *Under* Main dimension 12.0 *for* Ds Min, *correct* 12.80 *to read* 11.80

Page 5, Table 4 –

(1) *Under* Main dimension 12.0 *for* Ds Min, *correct* 12.80 *to read* 11.80

(2) *Under* Main dimension 4.0 *for* Head (DK) Basic (K) Min, *correct* 2.35 *to read* 2.25

M0131E

OCTOBER 1985

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

M0131E

FOREWORD

(This Foreword is not a part of ANSI/ASME B18.1.3M-1983, Metric Small Solid Rivets.)

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 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 1 was subsequently established and charged with the responsibility for technical content of standards covering solid rivets.

At its meeting on December 4, 1974, Committee B18 authorized preparation of a series of standards for metric fasteners. Subcommittee 1 was assigned responsibility for developing standards for metric solid rivets.

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 product be covered in separate standards, and Subcommittee 1 accepted this approach.

This Standard was approved by letter ballot of Committee B18 on February 4, 1983, and was subsequently approved by the sponsor and submitted to the American National Standards Institute for designation as an American National Standard. This was granted on September 8, 1983.

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CONTENTS

AN AMERICAN NATIONAL STANDARD

METRIC SMALL SOLID RIVETS
12 mm Nominal Diameter and Smaller

1 INTRODUCTORY NOTES

1.1 Scope

1.1.1 This Standard covers complete general and dimensional data for those types of metric small solid rivets recognized as American National Standard. Included is an appendix covering formulas on which dimensional data are based. It should be understood, however, that where questions arise concerning acceptance of a product, the dimensions in the tables shall govern over recalculation by formula.

1.1.2 The inclusion of dimensional data in this Standard is not intended to imply that all of the products described are stock production sizes. Consumers should consult with manufacturers concerning the availability of products. For recommended diameter–length combinations, refer to Table 7.

1.1.3 Metric small solid rivets purchased for Government use shall conform to this Standard and additionally to the requirements of Appendix II.

1.2 Comparison With ISO Standards

Except for the inclusion of the 9 mm and 11 mm diameters as nonpreferred sizes and the relegating of the 1 mm and 1.2 mm to the secondary series, the basic rivet diameters shown in this Standard are in conformance with the ISO Recommendation, Rivet Shank Diameters, ISO R1051-1969E for sizes up to and including 12 mm. At present, there are no ISO Standards for commercial small solid rivets nor are any contemplated at this time.

1.3 Rivet Diameters

The nominal sizes of metric small rivets from 1 mm through 12 mm are given in Table 1 and shall be considered American National Standard. This, however, does not preclude the manufacture or use of rivets having other diameters which shall be considered special.

1.4 Rivet Head Styles

This Standard covers specifications for flat head rivets as given in Table 3, round head rivets as given in Table 4, and flat 90° countersunk head rivets as shown in Table 5.

The proportions for heads of rivets indicated in the respective tables shall be standard; other proportions shall be considered special. Where nonstandard diameter rivets are required for special applications, the proportions of heads and points, if pointed, should preferably be based on the formulations given in Appendix I.

1.5 Dimensions

All dimensions in this Standard are given in millimeters (mm) unless otherwise stated. Symbols specifying geometric characteristics are in accordance with American National Standard, Dimensioning and Tolerancing, ANSI Y14.5.

1.6 Terminology

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

1.7 Related Standards

It should be noted that Standards for large rivets, tubular and split rivets, and other related fasteners are published under separate cover.

1.8 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 ANSI Standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, New York 10018, or from The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

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

1.9 Designation

Metric small solid rivets shall be designated by the following data in the sequence shown: nominal size; nominal length; product name, including head style; pointed (where other than plain point is desired); material; and protective finish, if required. See examples below:

(*a*) 6 × 50 Plated Metric Flat Head Rivet, Solid, Steel, Zinc

(*b*) 8 × 25 Pointed, Brass Metric Round Head Rivet, Solid

1.10 Part Numbering System

The Government Part Numbering System for metric small solid rivets is given in Appendix II. This system may be used by any user needing a definitive part numbering system.

TABLE 1 RIVET DIAMETERS, mm

Nominal Diameter	
Main Series	Secondary Series
	(1.0)
	(1.2)
	(1.4)
1.6	
2.0	
2.5	
3.0	
	(3.5)
4.0	
5.0	
6.0	
	(7.0)
8.0	
	(9.0)
10.0	
	(11.0)
12.0	

GENERAL NOTE:
Sizes in parentheses ( ) are nonpreferred.

2 GENERAL DATA

2.1 Head Information

2.1.1 Head Dimensions. The head dimensions tabulated in the respective dimensional tables are applicable to rivets produced by the normal cold heading process. Tolerances applicable to rivets made by the hot heading or forging process shall be as agreed upon between the manufacturer and purchaser. On countersunk heads, the junction of the conical bearing surface with the nominal rivet diameter may not be the same as the actual junction of head with shank, so the head height delineating the conical bearing surface is a reference dimension.

2.1.2 Head True Position. The axis of the head shall be located at true position relative to the axis of the rivet shank within a tolerance zone having a diameter equivalent to 6% of the specified maximum head diameter.

2.1.3 Bearing Surface. The bearing surface on round and flat head rivets shall be perpendicular to the axis of the rivet shank within 2°.

2.2 Underhead Fillets

Rivets shall be furnished with a definite fillet (R) under the head. Except for 1, 1.2, and 1.4 mm sizes, the radius of the fillet shall not exceed 10% of the maximum shank diameter or 0.80 mm, whichever is smaller. Fillet limits are shown on product dimensional tables.

2.3 Length

2.3.1 Measurement. The length of rivet shall be measured, parallel to the axis of the rivet, from the extreme end to the plane of the bearing surface for rivets having flat bearing surface type heads, and to

TABLE 2 TOLERANCE ON LENGTH, mm

Nominal Rivet Diameter	Nominal Rivet Diameter	Tolerance on Length Plus
1 to 3	to 25 incl.	0.50
	over 25	0.75
3.5 to 5	to 25 incl.	0.50
	from 25 to 50 incl.	0.75
	over 50	0.90
6 to 10	to 25 incl.	0.70
	from 25 to 75 incl.	0.80
	over 75	1.00
11 to 12	to 75 incl.	0.80
	from 75 to 150 incl.	1.00
	over 150	1.20

the top of the head for rivets having countersunk type heads.

2.3.2 Tolerance on Length. The tolerance on the length of rivets shall be as shown in Table 2.

2.3.3 Standard Lengths. The standard rivet diameter–length combinations shall be as depicted in Table 7.

2.4 Straightness

Straightness: the shank of the rivet shall be straight within a maximum camber of 0.006 mm/mm of rivet length.

2.5 Points

Unless otherwise specified, rivets shall have plain sheared ends. The end shall be perpendicular within 2° to the axis of the rivet and reasonably flat, sufficient for the purposes of driving that end satisfactorily. Where so specified by the user, rivets having standard header points as shown in Table 6 shall be furnished.

2.6 Materials and Mechanical Properties

2.6.1 Steel. Suitable material for solid steel rivets is covered by the American Society for Testing and Materials, ASTM Standard A 31, Grade A; or SAE Recommended Practice, Mechanical and Chemical Requirements for Nonthreaded Fasteners, SAE J430, Grade 0.

2.6.2 Other Materials. Where so specified, rivets may also be made from corrosion resistant steel, brass, aluminum, or other materials having properties as agreed upon between the manufacturer and purchaser.

2.6.3 Hardness Testing. When hardness tests are required for rivets larger than 4 mm nominal diameter, they shall be made at the midradius of a cross section of the rivet body, one diameter from the end of the rivet.

When hardness tests are required for rivets with nominal diameters of 4 mm or less, they shall be tested in the core at a distance of one diameter from the end of the rivet and using an appropriate hardness test method with hardness readings which will convert to the equivalent hardness scale or reading of the reference standard.

2.7 Finish

Unless otherwise specified, rivets shall be supplied with a natural (as annealed processed) finish, unplated or uncoated.

2.8 Workmanship

The finished rivets shall be free from defects affecting their serviceability. Bursts or shear bursts at the periphery of the head shall be acceptable, provided that if two or more bursts are present, then only one may have a width greater than 0.040D, and this one burst shall not have a width exceeding 0.080D, where D is the actual part diameter. A definition of bursts and shear bursts may be found in SAE Recommended Practice J-1061a (or latest issue).

2.9 Marking Practice

Unless specified on the inquiry or order, the heads of rivets produced to this Standard are not required to be identified as being metric series product. Manufacturer's identification symbol and location are at producer's option. Markings may be raised or depressed and shall not be considered part of the head height.

2.10 Hole Sizes

Due to the many variables in the application of rivets, such as materials, grip length, sandwich elements, etc., this Standard does not offer a table of recommended hole sizes and tolerances. However, as a guide, the hole size should be from 105% to 108% of the nominal rivet diameter, using the lower end of the range for short grip lengths and the upper end of the range for long grip lengths.

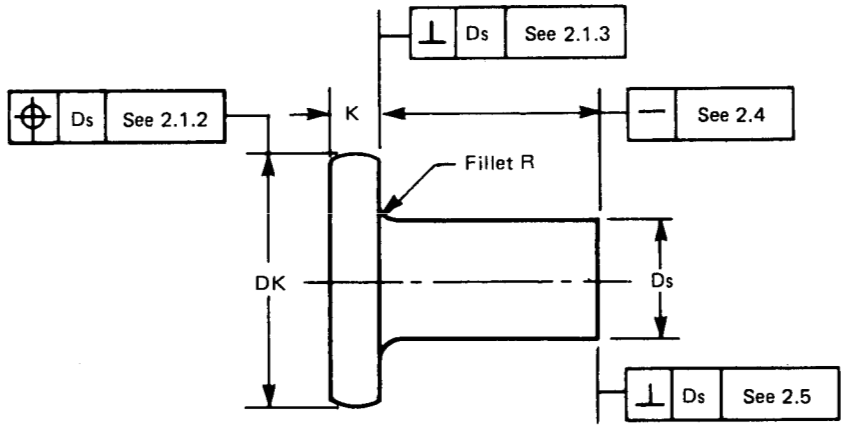


TABLE 3 DIMENSIONS OF FLAT HEAD RIVETS, mm

Main				1.6	2.0	2.5	3.0		4.0	5.0	6.0		8.0		10.0		12.0
Secondary	**(1.0)**	**(1.2)**	**(1.4)**					**(3.5)**				**(7.0)**		**(9.0)**		**(11.0)**	
Ds																	
Max	1.05	1.25	1.45	1.65	2.05	2.55	3.06	3.56	4.06	5.08	6.08	7.10	8.10	9.10	10.12	11.12	12.12
Min	0.95	1.15	1.35	1.52	1.92	2.42	2.90	3.40	3.90	4.88	5.88	6.85	7.85	8.85	9.80	10.80	12.80
Head (DK)																	
Basic	2.00	2.40	2.80	3.20	4.00	5.00	6.00	7.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00
Max	2.20	2.60	3.00	3.40	4.20	5.20	6.25	7.25	8.25	10.25	12.35	14.35	16.40	18.40	20.40	22.45	24.45
Min	1.80	2.20	2.60	3.00	3.80	4.80	5.75	6.75	7.75	9.75	11.65	13.65	15.60	17.60	19.60	21.55	23.55
Basic (K)	0.33	0.40	0.46	0.53	0.66	0.83	0.99	1.16	1.32	1.65	1.98	2.31	2.64	2.97	3.30	3.63	3.96
Max	0.45	0.52	0.48	0.68	0.81	0.98	1.14	1.31	1.50	1.83	2.18	2.51	2.89	3.22	3.55	3.88	4.24
Min	0.21	0.28	0.34	0.38	0.51	0.68	0.84	1.01	1.14	1.47	1.78	2.11	2.39	2.72	3.05	3.38	3.68
Fillet (R)																	
Max	0.15	0.15	0.15	0.15	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.70	0.80	0.80	0.80	0.80	0.80
Min	0.05	0.05	0.05	0.05	0.10	0.15	0.15	0.15	0.20	0.25	0.30	0.40	0.40	0.40	0.40	0.45	0.50

GENERAL NOTES:
(a) Sizes in parentheses ( ) are nonpreferred.
(b) For additional requirements refer to Section 2, General Data

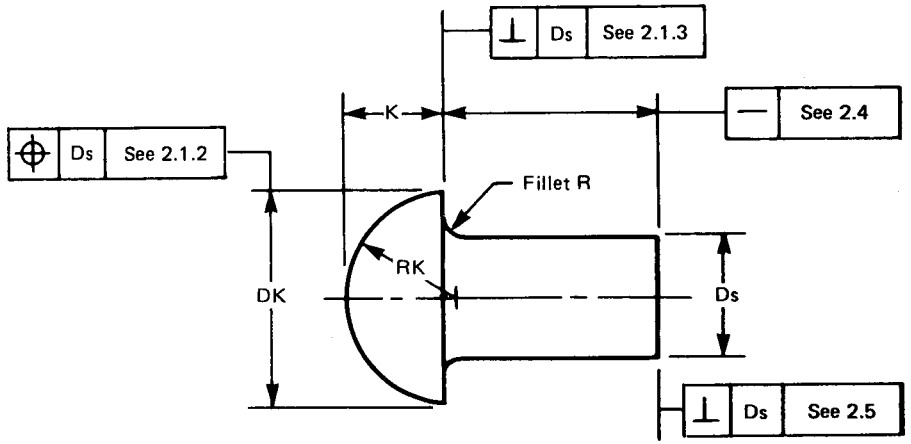


TABLE 4 DIMENSIONS OF ROUND HEAD RIVETS, mm

Main				1.6	2.0	2.5	3.0		4.0	5.0	6.0		8.0		10.0		12.0
Secondary	(1.0)	(1.2)	(1.4)					(3.5)				(7.0)		(9.0)		(11.0)	
Ds																	
Max	1.05	1.25	1.45	1.65	2.05	2.55	3.06	3.56	4.06	5.08	6.08	7.10	8.10	9.10	10.12	11.12	12.12
Min	0.95	1.15	1.35	1.55	1.92	2.42	2.90	3.40	3.90	4.88	5.88	6.85	7.85	8.85	9.80	10.80	12.80
Head (DK)																	
Basic	1.75	2.10	2.45	2.80	3.50	4.38	5.25	6.13	7.00	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00
Max	1.95	2.30	2.65	3.05	3.75	4.63	5.50	6.38	7.28	9.03	10.80	12.55	14.40	16.15	17.95	19.70	21.50
Min	1.55	1.90	2.25	2.55	3.25	4.13	5.00	5.88	6.72	8.47	10.20	11.95	13.60	15.35	17.05	18.80	20.50
Basic (K)	0.60	0.72	0.84	0.96	1.20	1.50	1.80	2.10	2.40	3.00	3.60	4.20	4.80	5.40	6.00	6.60	7.20
Max	0.72	0.84	0.96	1.08	1.32	1.62	1.92	2.25	2.55	3.15	3.75	4.38	4.98	5.58	6.20	6.80	7.40
Min	0.48	0.60	0.72	0.84	1.08	1.38	1.68	1.95	2.35	2.85	3.45	4.02	4.62	5.22	5.80	6.40	7.00
RK Approx.	0.94	1.13	1.31	1.50	1.88	2.35	2.81	3.29	3.75	4.69	5.63	6.57	7.50	8.44	9.38	10.32	11.26
Fillet (R)																	
Max	0.15	0.15	0.15	0.20	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.70	0.80	0.80	0.80	0.80	0.80
Min	0.05	0.05	0.05	0.10	0.10	0.15	0.15	0.15	0.20	0.25	0.30	0.40	0.40	0.40	0.40	0.45	0.50

GENERAL NOTES:
(a) Sizes in parentheses ( ) are nonpreferred.
(b) For additional requirements refer to Section 2, General Data

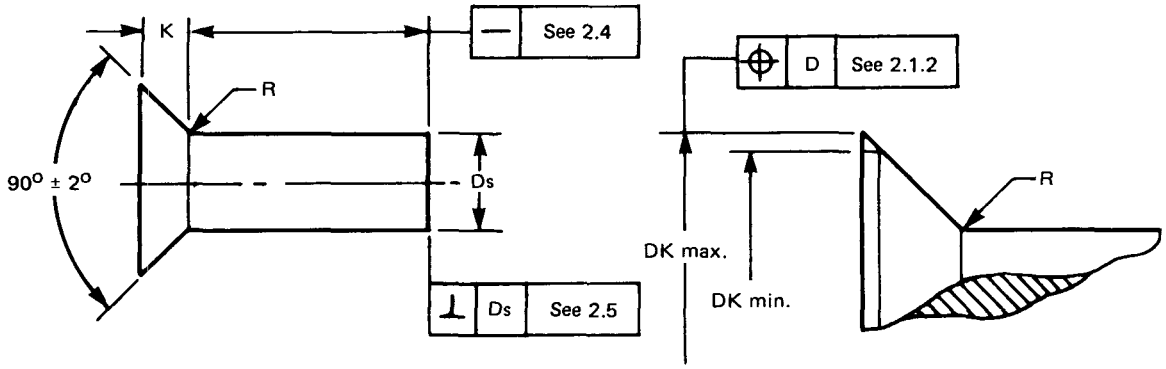


TABLE 5 DIMENSIONS OF FLAT COUNTERSUNK HEAD RIVETS, mm

D		Ds		DK		K	R	
Body Diameter		Shank Diameter		Head Diameter		Head Height	Underhead Fillet Radius	
Main Series	Secondary Series	Max	Min	Max (2)	Min (3)	Ref (1)	Max	Min
	(1.0)	1.05	0.95	1.93	1.68	0.43	0.15	0.05
	(1.2)	1.25	1.15	2.31	2.03	0.51	0.15	0.05
	(1.4)	1.45	1.35	2.68	2.38	0.60	0.15	0.05
1.6		1.65	1.52	3.06	2.72	0.68	0.15	0.05
2.0		2.05	1.92	3.81	3.38	0.85	0.20	0.10
2.5		2.55	2.42	4.75	4.25	1.06	0.25	0.15
3.0		3.06	2.90	5.70	5.09	1.28	0.30	0.15
	(3.5)	3.56	3.40	6.64	5.96	1.49	0.35	0.15
4.0		4.06	3.90	7.58	6.82	1.70	0.40	0.20
5.0		5.08	4.88	9.48	8.53	2.13	0.50	0.25
6.0		6.08	5.88	11.36	10.27	2.55	0.60	0.30
	(7.0)	7.10	6.85	13.26	11.97	2.98	0.70	0.40
8.0		8.10	7.85	15.14	13.70	3.40	0.80	0.50
	(9.0)	9.10	8.85	17.02	15.43	3.83	0.80	0.50
10.0		10.12	9.80	18.92	17.11	4.25	0.80	0.50
	(11.0)	11.12	10.80	20.80	18.84	4.68	0.80	0.50
12.0		12.12	11.80	22.68	20.57	5.10	0.80	0.50

GENERAL NOTES:
(a) Sizes in parentheses ( ) are nonpreferred.
(b) For additional requirements refer to Section 2, General Data

NOTES:
(1) Head height (K) is given for reference purposes only. Variations in this dimension are controlled by the head and shank diameters and the included angle of the head.
(2) Sharp edged head. Tabulated maximum values calculated on nominal head height, maximum shank diameter, and 92° included angle extended to a sharp edge.
(3) Rounded or flat edged irregularly shaped head. Tabulated values calculated from nominal head height, minimum shank diameter, and 88° included angle.

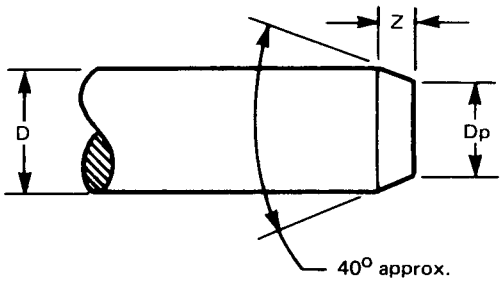


TABLE 6 DIMENSIONS OF STANDARD HEADER POINTS FOR METRIC SMALL SOLID RIVETS, mm

D Nominal	Pt. Length Z Approx.	Pt. Dia Dp Approx.	Nom. Rivet Length (1)
(1.0)	0.25	0.80	6
(1.2)	0.30	1.00	7
(1.4)	0.35	1.15	9
1.6	0.40	1.30	10
2.0	0.50	1.65	10
2.5	0.65	2.05	15
3.0	0.75	2.45	20
(3.5)	0.90	2.85	20
4.0	1.0	3.25	25
5.0	1.25	4.10	30
6.0	1.50	4.90	40
(7.0)	1.75	5.70	40
8.0	2.00	6.55	40
(9.0)	2.25	7.35	50
10.0	2.50	8.20	50
(11.0)	2.75	9.00	60
12.0	3.00	9.80	75

GENERAL NOTES:
(a) Sizes in parentheses ( ) are nonpreferred.
(b) No standard tolerances for point dimensions are contemplated.

NOTE:
(1) Header points normally apply to these nominal shank lengths or shorter. The pointing of longer shank lengths may require machining to the dimensions specified.

TABLE 7 RECOMMENDED RIVET LENGTHS, mm

Nominal Rivet Length	Nominal Rivet Size																
	(1.0)	(1.2)	(1.4)	1.6	2.0	2.5	3.0	(3.5)	4.0	5.0	6.0	(7.0)	8.0	(9.0)	10.0	(11.0)	12.0
2	FR	FR															
3	A	A	FR	FR	FR												
4	A	A	A	A	A	FR	FR										
5	A	A	A	A	A	A	A	FR	FR								
6	A	A	A	A	A	A	A	A	A	FR							
8	A	A	A	A	A	A	A	A	A	A	A	FR	FR				
10		A	A	A	A	A	A	A	A	A	A	A	A	FR	FR		
12			A	A	A	A	A	A	A	A	A	A	A	A	A	FR	FR
15				A	A	A	A	A	A	A	A	A	A	A	A	A	A
18					A	A	A	A	A	A	A	A	A	A	A	A	A
20					A	A	A	A	A	A	A	A	A	A	A	A	A
22						A	A	A	A	A	A	A	A	A	A	A	A
25						A	A	A	A	A	A	A	A	A	A	A	A
28							A	A	A	A	A	A	A	A	A	A	A
30							A	A	A	A	A	A	A	A	A	A	A
32								A	A	A	A	A	A	A	A	A	A
35								A	A	A	A	A	A	A	A	A	A
38									A	A	A	A	A	A	A	A	A
40									A	A	A	A	A	A	A	A	A
45										A	A	A	A	A	A	A	A
50										A	A	A	A	A	A	A	A
55											A	A	A	A	A	A	A
60											A	A	A	A	A	A	A
65												A	A	A	A	A	A
70												A	A	A	A	A	A
75													A	A	A	A	A
80													A	A	A	A	A
85														A	A	A	A
90														A	A	A	A
95															A	A	A
100															A	A	A
110																A	A
120																	A

GENERAL NOTE:
Lengths between heavy lines are recommended for the applicable rivet size and head style where A denotes all head styles, F denotes flat head style, and R denotes round head style.

APPENDIX I
TABLES AND FORMULAS FOR RIVET DIMENSIONS

SHANK DIAMETER, mm
D = nominal diameter of rivet shank

Nominal Diameter (D)		Shank Diameter (Ds)			
		Tolerances		Diameter	
Main Series	Secondary Series	Plus	Minus	Max.	Min.
	(1.0)	0.05	0.05	1.05	0.95
	(1.2)	0.05	0.05	1.25	1.15
	(1.4)	0.05	0.05	1.45	1.35
1.6		0.05	0.08	1.65	1.52
2.0		0.05	0.08	2.05	1.92
2.5		0.05	0.08	2.55	2.42
3.0		0.06	0.10	3.06	2.90
	(3.5)	0.06	0.10	3.56	3.40
4.0		0.06	0.10	4.06	3.90
5.0		0.08	0.12	5.08	4.88
6.0		0.08	0.12	6.08	5.88
	(7.0)	0.10	0.15	7.10	6.85
8.0		0.10	0.15	8.10	7.85
	(9.0)	0.10	0.15	9.10	8.85
10.0		0.12	0.20	10.12	9.80
	(11.0)	0.12	0.20	11.12	10.80
12.0		0.12	0.20	12.12	11.80

GENERAL NOTE:
Sizes in parentheses ( ) are nonpreferred.

FLAT HEAD RIVET, mm
D = nominal diameter of rivet shank

Nominal Rivet Size	Head Diameter (DK)			Head Height (K)		
		Tolerance			Tolerance	
	Basic	Plus	Minus		Plus	Minus
(1.0)	DK = 2.00D	0.20	0.20	K = 0.33D	0.12	0.12
(1.2)		0.20	0.20		0.12	0.12
(1.4)		0.20	0.20		0.12	0.12
1.6		0.20	0.20		0.15	0.15
2.0		0.20	0.20		0.15	0.15
2.5		0.20	0.20		0.15	0.15
3.0		0.25	0.25		0.15	0.15
(3.5)		0.25	0.25		0.15	0.15
4.0		0.25	0.25		0.18	0.18
5.0		0.25	0.25		0.18	0.18
6.0		0.35	0.35		0.20	0.20
(7.0)		0.35	0.35		0.20	0.20
8.0		0.40	0.40		0.25	0.25
(9.0)		0.40	0.40		0.25	0.25
10.0		0.40	0.40		0.25	0.25
(11.0)		0.45	0.45		0.25	0.25
12.0		0.45	0.45		0.28	0.28

GENERAL NOTE:
Sizes in parentheses ( ) are nonpreferred.

ROUND HEAD RIVET, mm
D = nominal diameter of rivet shank

Nominal Rivet Size	Head Diameter (DK)			Head Height (K)			Head Radius (Rk) Basic Approx.
		Tolerance			Tolerance		
	Basic	Plus	Minus		Plus	Minus	
(1.0)	DK = 1.75D	0.20	0.20	K = 0.60 D	0.12	0.12	RK = 0.938 D
(1.2)		0.20	0.20		0.12	0.12	
(1.4)		0.20	0.20		0.12	0.12	
1.6		0.25	0.25		0.12	0.12	
2.0		0.25	0.25		0.12	0.12	
2.5		0.25	0.25		0.12	0.12	
3.0		0.25	0.25		0.12	0.12	
(3.5)		0.25	0.25		0.15	0.15	
4.0		0.28	0.28		0.15	0.15	
5.0		0.28	0.28		0.15	0.15	
6.0		0.30	0.30		0.15	0.15	
(7.0)		0.30	0.30		0.18	0.18	
8.0		0.40	0.40		0.18	0.18	
(9.0)		0.40	0.40		0.18	0.18	
10.0		0.45	0.45		0.20	0.20	
(11.0)		0.45	0.45		0.20	0.20	
12.0		0.50	0.50		0.20	0.20	

GENERAL NOTE:
Sizes in parentheses ( ) are nonpreferred.

FLAT COUNTERSUNK HEAD RIVET, mm
D = nominal diameter of rivet shank

Nominal Rivet Size	Head Diameter (DK)			Head Height (K)
		Tolerance		
	Basic	Plus	Minus	Basic (Ref)
(1.0)	DK = 1.85D	0.08	0.17	K = 0.425D
(1.2)	↓	0.09	0.19	↓
(1.4)		0.09	0.21	
1.6		0.10	0.24	
2.0		0.11	0.32	
2.5		0.12	0.38	
3.0		0.15	0.46	
(3.5)		0.16	0.52	
4.0		0.18	0.58	
5.0		0.23	0.72	
6.0		0.26	0.83	
(7.0)		0.31	0.98	
8.0		0.34	1.10	
(9.0)		0.37	1.22	
10.0		0.48	1.51	
(11.0)		0.58	1.63	
12.0	↓			↓

GENERAL NOTE:
Sizes in parentheses ( ) are nonpreferred.

STANDARD HEADER POINTS
D = nominal diameter of rivet

Nominal Rivet Size	Point Diameter	Point Length
	Basic (Approx.)	Basic (Approx.)
All Sizes	Dp = 0.818D	Z = 0.250D

APPENDIX II

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*) Nominal Size and Length Combinations—as specified on the last page of this Appendix.

(*b*) Head Type — as coded in Part Numbering System.

(*c*) Material — Carbon Steel — as coded in Part Numbering System.

(*d*) Finish — Plain Finish or Tin Coated — as coded in Part Numbering System.

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*) Head type

(*d*) Nominal size

(*e*) Nominal length

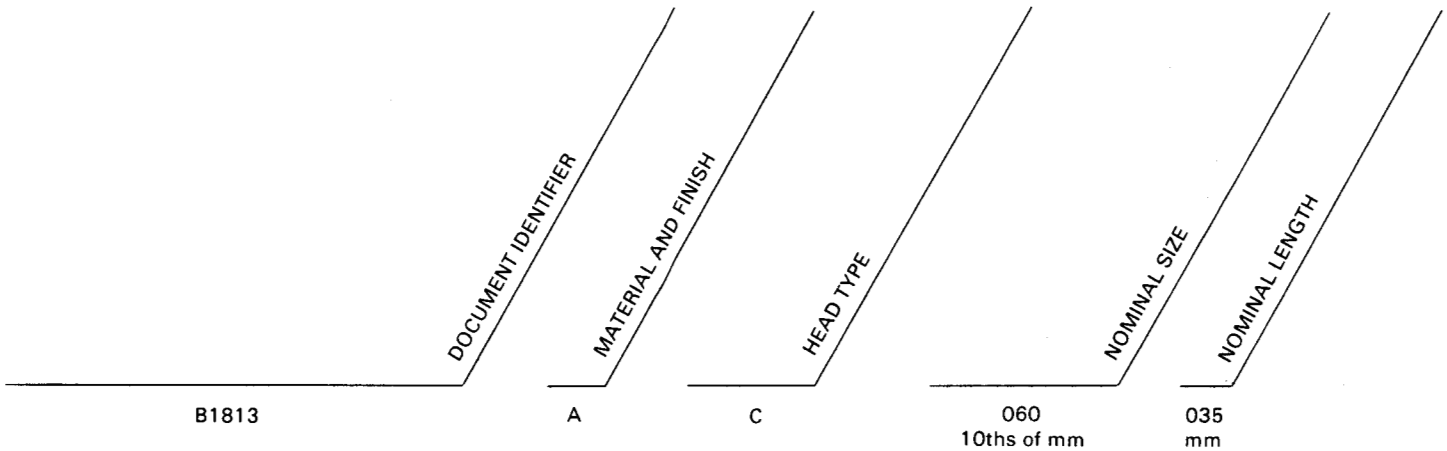
NOTE: The Part Numbering System may also be used for nonstandard size and length combinations.

Quality Assurance Provisions: Quality assurance provisions shall be in accordance with FF-R-556, Rivet, Solid, Small; Rivet, Tubular, Small; Flat Washer (Burr); Cap, Rivet; General Purpose.

Packaging: Packaging shall be in accordance with PPP-H-1581, Hardware (Fasteners and Related Items), Packaging 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, Composition C1006 thru C1012 (UNS G10060 thru G10120)

B — Steel, Composition C1006 thru C1012 (UNS G10060 thru G10120) and tin plated per ASTM B545, Tin, Electro-deposited Coatings of, SC3, 15 μm minimum average thickness

HEAD TYPE CODE

F — Flat Head
R — Round Head
C — Flat, Countersunk Head

EXAMPLE: B1813AC060035 indicates a Rivet, Solid, Small — Metric made of steel, Composition C1006 through C1012, flat, countersunk head, 6 mm nominal size and 35 mm in length.

METRIC SMALL SOLID RIVETS — STANDARD SIZES FOR GOVERNMENT USE

Table 7 in this Standard is to be used for selection of standard sizes for Government use. *Nominal rivet sizes in parentheses are not to be considered as standard sizes for Government use.*

AMERICAN NATIONAL STANDARDS FOR BOLTS, NUTS, RIVETS, SCREWS, WASHERS, AND SIMILAR FASTENERS

Small Solid Rivets	B18.1.1—1972 (R1983)
Large Rivets	B18.1.2—1972 (R1983)
Metric Small Solid Rivets	B18.1.3M—1983
Square And Hex Bolts and Screws	B18.2.1—1981
Square And Hex Nuts	B18.2.2—1983
Metric Hex Cap Screws	B18.2.3.1M—1979
Metric Formed Hex Screws	B18.2.3.2M—1979
Metric Heavy Hex Screws	B18.2.3.3M—1979
Metric Hex Flange Screws	B18.2.3.4M—1979
Metric Hex Bolts	B18.2.3.5M—1979
Metric Heavy Hex Bolts	B18.2.3.6M—1979
Metric Heavy Hex Structural Bolts	B18.2.3.7M—1979
Metric Hex Lag Screws	B18.2.3.8M—1981
Metric Hex Nuts, Style 1	B18.2.4.1M—1979
Metric Hex Nuts, Style 2	B18.2.4.2M—1979
Metric Slotted Hex Nuts	B18.2.4.3M—1979
Metric Hex Flange Nuts	B18.2.4.4M—1982
Metric Hex Jam Nuts	B18.2.4.5M—1979
Metric Heavy Hex Nuts	B18.2.4.6M—1979
Socket Cap, Shoulder And Set Screws—Inch Series	B18.3—1982
Socket Head Cap Screws (Metric Series)	B18.3.1M—1982
Metric Series Hexagon Keys And Bits	B18.3.2M—1979
Hexagon Socket Head Shoulder Screws: Metric Series	B18.3.3M—1979
Hexagon Socket Button Head Cap Screws: Metric Series	B18.3.4M—1979
Hexagon Socket Flat Countersunk Head Cap Screws (Metric Series)	B18.3.5M—1983
Metric Series Hexagon Socket Set Screws	B18.3.6M—1979
Round Head Bolts (Inch Series)	B18.5—1978
Metric Round Head Short Square Neck Bolts	B18.5.2.1M—1981
Metric Round Head Square Neck Bolts	B18.5.2.2M—1982
Wood Screws	B18.6.1—1981
Slotted Head Cap Screws, Square Head Set Screws And Slotted Headless Set Screws	B18.6.2—1972 (R1983)
Machine Screws And Machine Screw Nuts (M-4)	B18.6.3—1972 (R1983)
Thread Forming And Thread Cutting Tapping Screws And Metallic Drive Screws (Inch Series)	B18.6.4—1981
General Purpose Semi-Tubular Rivets, Full Tubular Rivets, Split Rivets And Rivet Caps	B18.7—1972 (R1980)
Clevis Pins And Cotter Pins	B18.8.1—1972 (R1983)
Taper Pins, Dowel Pins, Straight Pins, Grooved Pins And Spring Pins (Inch Series)	B18.8.2—1978
Plow Bolts	B18.9—1958 (R1977)
Track Bolts And Nuts	B18.10—1982
Miniature Screws	B18.11—1961 (R1983)
Glossary Of Terms For Mechanical Fasteners	B18.12—1961 (R1981)
Screw And Washer Assemblies—Sems	B18.13—1961 (R1983)
Forged Eyebolts	B18.15—1969
Mechanical And Performance Requirements For Prevailing-Torque Type Steel Metric Hex Nuts And Hex Flange Nuts	B18.16.1M—1979
Torque-Tension Test Requirements For Prevailing-Torque Type Steel Metric Hex Nuts And Hex Flange Nuts	B18.16.2M—1979
Dimensional Requirements For Prevailing-Torque Type Steel Metric Hex Nuts And Hex Flange Nuts	B18.16.3M—1982
Wing Nuts, Thumb Screws And Wing Screws	B18.17—1968 (R1983)
Lock Washers	B18.21.1—1983
Plain Washers	B18.22.1—1965 (R1981)
Metric Plain Washers	B18.22M—1981
Beveled Washers	B18.23.1—1967 (R1975)
Inspection and Quality Assurance for General Purpose Metric Fasteners	B18.18.1M—1982
Inspection and Quality Assurance for High-Volume Machine Assembly Metric Fasteners	B18.18.2M—1982
Inspection and Quality Assurance for Special Purpose Metric Fasteners	B18.18.3M—1982
Inspection and Quality Assurance for Highly Specialized Engineered Applications — Metric Fasteners	B18.18.4M—1982

M00131

M00131

AN AMERICAN NATIONAL STANDARD

Metric Heavy Hex Flange Screws

ANSI/ASME B18.2.3.9M - 1984

REAFFIRMED 1995

FOR CURRENT COMMITTEE PERSONNEL
PLEASE SEE ASME MANUAL AS-11

Government Key Words:
Screw, Heavy Hex Flange Head — Metric

SPONSORED AND PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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

Date of Issuance: December 31, 1984

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

FOREWORD

(This Foreword is not part of ANSI/ASME B18.2.3.9M-1984.)

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 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 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.

Following issuance of ANSI B18.2.3.4M-1979, interest developed in the farm equipment, heavy truck, and off-road vehicles industries for a second series of metric hex flange screws having a head widths across flats series equal to those of metric hex cap screws. During the analytical research study to optimize head proportions of hex flange screws (refer to Foreword of ANSI/ASME B18.2.3.4M-1984), this larger head series was also investigated, and appropriate values for the various head characteristics were established for screw sizes M10 through M20.

This new design of metric heavy hex flange screws was submitted by the United States of America/Canada to ISO/TC2 at its May 1982 meetings. TC2 accepted the proposal and authorized development of ISO standards.

Following these ISO decisions, Subcommittee 2 drafted this Standard.

This Standard was approved by letter ballot of the ASME Standards Committee B18 on April 18, 1983, and was subsequently approved by the American Society of Mechanical Engineers and submitted to the American National Standards Institute for designation as an American National Standard. This was granted on March 23, 1984.

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Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners

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CONTENTS

AN AMERICAN NATIONAL STANDARD

METRIC HEAVY HEX FLANGE SCREWS

GENERAL DATA

1 Scope

1.1 This Standard covers the complete general and dimensional data for metric heavy hex flange screws 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 items. Consumers are requested to consult with manufacturers concerning lists of stock production heavy hex flange screws.

1.3 Heavy hex flange screws purchased for government use shall conform to this Standard and, additionally, to the requirements of Appendix III.

2 Comparison With ISO Standards

2.1 Heavy hex flange screws as presented in this Standard have been coordinated, to the extent possible, with a draft ISO proposed standard.

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 ANSI Y14.5M, Dimensioning and Tolerancing.

4 Top of Head. The top of head shall be either full form or indented, at manufacturer's option. The top of head shall be 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 -15%.

5 Head Height. The head height is the distance, as measured parallel to the axis of the screw, from the top of the head to the plane of the bearing circle diameter.

6 Hex Height. The hex height is the distance, measured at a corner of the hex, from the junction of hex head with the flange to the top of the head.

7 Wrenching Height. The wrenching height is the distance at a corner of the hex from the junction of hex head with the flange 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.

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

9 Gaging of Heavy Hex Flange Head. (See Table 2.) The head shall be gaged using two ring gages, A and B, to demonstrate the coincidental acceptability of hex height, wrenching height, corner fill, and width across corners. Gage A shall be placed over the head and shall seat on the flange. The gage shall not contact a flat surface when seated. Gage B shall be placed on the top of the head normal to the bolt axis. The two gages shall not be in contact.

NOTE: W_a min. equals theoretical width across corners. W_b max. equals minimum width across corners minus 0.001 mm. T_a max. is equal to minimum wrenching height K_1.

10 True Position of Head. The axis of the hex head shall be located at true position with respect to the axis of the screw (determined over a distance under the head equal to one screw diameter) within a tolerance zone of diameter specified in Table 5.

11 Flange. The top surface of the flange shall be conical or slightly rounded (convex) and the periphery shall be round within the specified maximum flange diameter and a tolerance of -5%. The contour of edge at flange periphery shall be optional provided the minimum flange thickness is maintained at the minimum bearing circle diameter.

12 Bearing Surface. The bearing surface shall be flat to concave to a maximum of 1.5 deg. from the plane formed by the bearing circle diameter. The plane formed by the bearing circle diameter shall be perpendicular to the axis of the body within 1 deg. and is expressed in terms of circular runout as specified in Table 1. The measurement of bearing face runout shall be made as close to the specified bearing circle diameter as possible while the screw is held in a collet or other gripping device at a distance equal to one nominal screw diameter from the plane formed by the bearing circle diameter.

13 Fillet. The fillet configuration at the junction of the head and shank shall conform to either Style A, as shown in Figs. 3 and 4 with limits as specified in Table 6, or Style B, as shown in Fig. 5 and with limits as specified in Table 7, at the option of the manufacturer, unless the fillet style is specified by the purchaser. The fillet shall be a smooth and continuous curve fairing smoothly into the underhead bearing surface and the shank within the limits specified. For Style A, no radius in the fillet contour shall be less than R min. as specified in Table 6.

14 Body Diameter. The diameter of the body on screws which are not threaded full length shall be within the limits specified in Table 1, unless the purchaser specifies screws with reduced diameter body. For screws threaded full length, the diameter of the unthreaded shank under the head shall neither exceed the specified maximum body diameter nor be less than the minimum body diameter given in Table 5.

Screws may be obtained with reduced diameter body if so specified; however, screws with nominal lengths shorter than four times their nominal size are not recommended. Where reduced diameter body is specified, the body diameter shall be within the limits specified in Table 10. The screw shall have a shoulder under the head. The diameter and length of the shoulder shall be as specified in Table 10.

15 Length. The length of the screw shall be measured parallel to the axis of the screw from the plane formed by the underhead bearing circle diameter to the extreme end of the shank. Tolerances for screw lengths are given in Table 8.

16 Points. The end of the screw shall be chamfered from a diameter equal to or slightly less than the thread root diameter to produce a length of chamfer or incomplete thread within the limits for Z specified in Table 9. The end of the screw shall be reasonably square with the axis of the screw, and where pointed blanks are used, the slight rim or cup resulting from roll threading shall be permissible. At the manufacturer's option, the end of the screw may have a rounded point of radius V as specified in Table 9.

17 Straightness. Shanks of screws shall be straight within a maximum camber of 0.006 mm/mm of screw length. The referee gage and gaging procedure for checking screw straightness is given in Appendix I.

18 Thread Length

18.1 The length of thread on screws shall be controlled by the maximum grip gaging length L_g and the minimum body length L_s as set forth in paras. 18.2 through 18.5.

18.2 Grip gaging length L_g max. is the distance, measured parallel to the axis of the screw, from the plane formed by the bearing circle diameter to the face of a noncounterbored or noncountersunk standard GO thread ring gage assembled by hand as far as the thread will permit. For standard diameter-length combinations of screws, the values for L_g max. are specified in Table 3. For diameter-length combinations not listed in Table 3, the maximum grip gaging length, as calculated and rounded to one decimal place, shall be equal to the nominal screw length L minus the basic thread length B as specified in Table 4 (L_g max. = $L - B$). L_g max. shall be used as a criterion for inspection.

18.3 Body length L_s min. is the distance, measured parallel to the axis of the screw, from the plane formed by the bearing circle diameter to the last scratch of thread or the top of the extrusion angle, whichever is closest to the head. For standard diameter-length combinations of screws, the values of L_s min. are specified in Table 3. For diameter-length combinations not listed in Table 3, the minimum body length, as calculated and rounded to one decimal place, shall be equal to the maximum grip gaging length (as computed) minus the maximum transition length as given in Table 4 (L_s min. = L_g max. - X max.). L_s min. shall be used as a criterion for inspection. Screws of nominal lengths which have a calculated L_s min. value equal to or less than the length L_u as specified in Table 4 shall be threaded full length. For screws which are threaded full length, the distance from the plane formed by the bearing circle diameter to the face of a noncounterbored or noncountersunk standard GO thread ring gage assembled by hand as far as the thread will permit shall not exceed the length L_u as specified in Table 4.

18.4 Basic thread length B as specified in Table 4 is a reference dimension intended for calculation purposes only, and is the distance, measured parallel to the axis of the screw, from the extreme end of the screw to the last complete (full form) thread.

18.5 Transition thread length X max. as specified in Table 4 is a reference dimension intended for calculation purposes only. It includes the length of incomplete threads and tolerances on grip gaging length and body length. The transition from full thread to incomplete thread shall be smooth and uniform. The major diameter of the incomplete threads shall not exceed the actual major diameter of the complete (full form) threads. For screws of property class 10.9 and higher strength materials (tensile strength 1040 MPa and higher), the transition threads shall have a rounded root contour no radius of which shall be less than the specified minimum radius at the root of the full form thread.

19 Thread Runout. The runout of the thread with respect to the axis of the screw shank shall be within the limits specified in Table 5 when measured at a distance of one screw diameter from the last complete thread. The referee gage and gaging procedure for checking thread runout are given in Appendix I.

20 Threads

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

20.2 Acceptability. Unless otherwise specified, screw thread acceptability shall be determined based on System 21 of ANSI B1.3M, Screw Thread Gaging Systems for Dimensional Acceptability (Metric Screw Threads M and MJ).

21 Material and Mechanical Properties. Unless otherwise specified, steel screws shall conform to the requirements for property class 9.8 or property class 10.9 as specified in SAE J 1199, Mechanical Properties, Externally Threaded Steel Fasteners, or ASTM F 568, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners. Screws of other materials such as stainless steel, brass, bronze, and aluminum alloys shall have properties as agreed upon by the manufacturer and the purchaser. Properties of screws of several grades of nonferrous materials are covered in ASTM F 468M, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use, and several stainless steel materials in ASTM F 738, Specification for Stainless Steel Metric Bolts, Screws, and Studs.

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

23 Identification Symbols. Steel screws shall be marked with the property class symbol and with the manufacturer's identification symbol. Minimum height of property class symbols shall be 2.3 mm for M10 and M12 screws, 3.2 mm for M14 and M16 screws, and 4.0 mm for M20 screws. 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 M14 and smaller screws, and 0.3 mm for M16 and M20 screws above the surface of the head; and total head height (head plus markings) shall not exceed the specified maximum head height plus 0.2 mm for M10 screws, 0.3 mm for M12 and M14 screws, and 0.4 mm for M16 and M20 screws.

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

25 Terminology. For definitions of terms relating to fasteners or component features thereof used in this Standard, refer to ASA B18.12, Glossary of Terms for Mechanical Fasteners.

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

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

28 Designation

28.1 Heavy hex flange screws 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., M10 is M10 × 1.5.

Examples:

Heavy hex flange screw, M10 × 1.5 × 50, class 9.8, zinc plated

Heavy hex flange screw, M16 × 2 × 100, class 10.9

28.2 The government part numbering system for metric heavy hex flange screws is given in Appendix III.

29 Inspection and Quality Assurance. Unless otherwise specified, acceptability shall be based on conformance with the requirements specified in ANSI B18.18.1M, Inspection and Quality Assurance for General Purpose Metric Fasteners, with inspection level B for acceptability.

30 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, New York 10018.

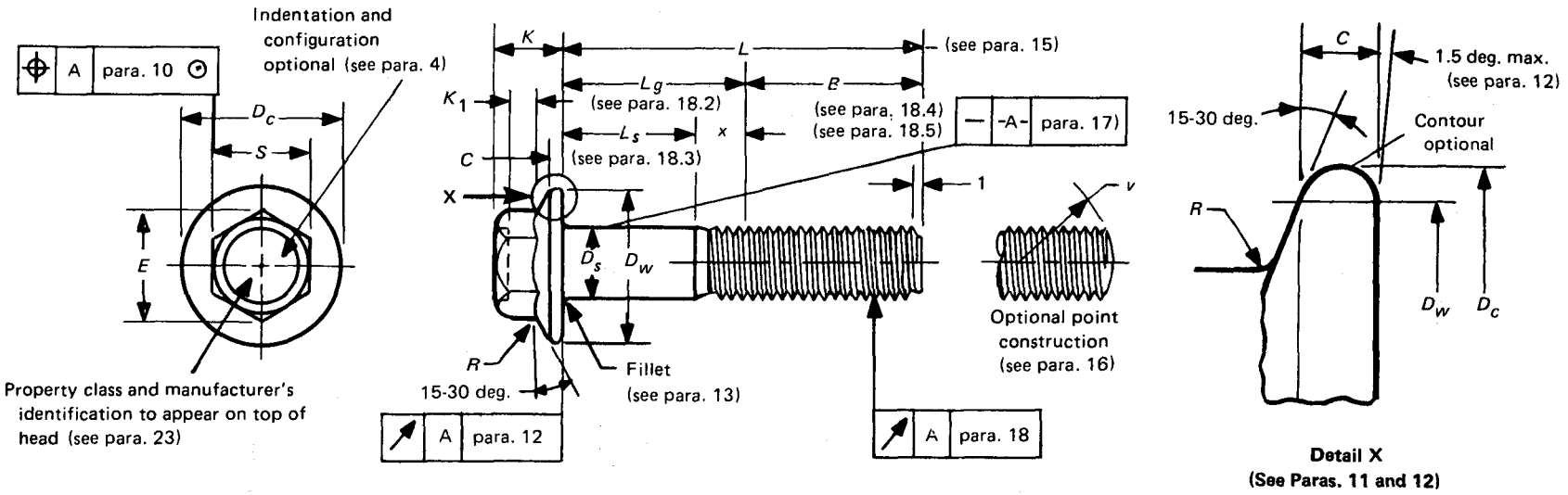


FIG. 1

TABLE 1 DIMENSIONS OF HEAVY HEX FLANGE SCREWS

Nom. Screw Diam. and Thread Pitch	D_s Body Diameter		S Width Across Flats		E Width Across Corners		D_c Flange Diam.	D_w Bearing Circle Diam.	Circular Runout of Bearing Circle FIM	C Flange Edge Thickness	K Head Height	K_1 Wrenching Height	R Flange Top Fillet Radius
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
M10 X 1.5	10.00	9.78	15.00	14.57	17.32	16.32	22.3	19.6	0.43	1.5	8.6	3.70	0.6
M12 X 1.75	12.00	11.73	18.00	17.57	20.78	19.68	26.6	23.8	0.50	1.8	10.4	4.60	0.7
M14 X 2	14.00	13.73	21.00	20.48	24.25	22.94	30.5	27.6	0.55	2.1	12.4	5.50	0.9
M16 X 2	16.00	15.73	24.00	23.16	27.71	25.94	35.0	31.9	0.61	2.4	14.1	6.20	1.0
M20 X 2.5	20.00	19.67	30.00	29.16	34.64	32.66	43.0	39.9	0.76	3.0	17.7	7.90	1.2
See para.	14				7, 8, 9		11, 12	12	12	11	5	7, 9	11

TABLE 2 GAGING OF HEAVY HEX FLANGE HEADS

Nom. Screw Diam. and Thread Pitch	W_a		T_a		W_b		T_b
	Gage A				Gage B		
	Inside Diam.		Thickness		Inside Diam.		Thickness
	Max.	Min.	Max.	Min.	Max.	Min.	Min.
M10 X 1.5	17.33	17.32	3.70	3.69	16.31	16.30	5.0
M12 X 1.75	20.79	20.78	4.60	4.59	19.67	19.66	5.0
M14 X 2	24.26	24.25	5.50	5.49	22.93	22.92	6.0
M16 X 2	27.72	27.71	6.20	6.19	25.93	25.92	6.0
M20 X 2.5	34.65	34.64	7.90	7.89	32.65	32.64	6.0

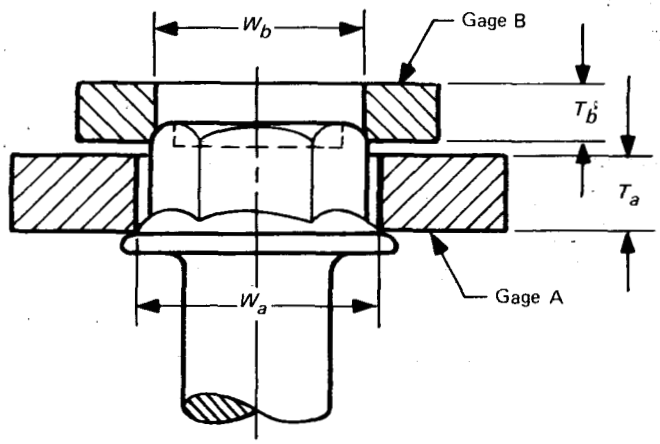


FIG. 2 GAGING OF HEX FLANGE SCREWS
(See Para. 9)

TABLE 3 MAXIMUM GRIP GAGING LENGTHS AND MINIMUM BODY LENGTHS

Nom. Diam. and Thread Pitch	M10 × 1.5		M12 × 1.75		M14 × 2		M16 × 2		M20 × 2.5	
L Nominal Length	L_g Max.	L_s Min.	L_g Max.	L_s Min.	L_g Max.	L_s Min.	L_g Max.	L_s Min.	L_g Max.	L_s Min.
14										
16										
20										
25										
30										
35										
40	14.0	6.5								
45	19.0	11.5	15.0	6.2						
50	24.0	16.5	20.0	11.2	16.0	6.0				
(55)	29.0	21.5	25.0	16.2	21.0	11.0	17.0	7.0		
60	34.0	26.5	30.0	21.2	26.0	16.0	22.0	12.0		
(65)	39.0	31.5	35.0	26.2	31.0	21.0	27.0	17.0	19.0	6.5
70	44.0	36.5	40.0	31.2	36.0	26.0	32.0	22.0	24.0	11.5
(75)	49.0	41.5	45.0	36.2	41.0	31.0	37.0	27.0	29.0	16.5
80	54.0	46.5	50.0	41.2	46.0	36.0	42.0	32.0	34.0	21.5
(85)	59.0	51.5	55.0	46.2	51.0	41.0	47.0	37.0	39.0	26.5
90	64.0	56.5	60.0	51.2	56.0	46.0	52.0	42.0	44.0	31.5
100	74.0	66.5	70.0	61.2	66.0	56.0	62.0	52.0	54.0	41.5
110			80.0	71.2	76.0	66.0	72.0	62.0	64.0	51.5
120			90.0	81.2	86.0	76.0	82.0	72.0	74.0	61.5
130					90.0	80.0	86.0	76.0	78.0	65.5
140					100.0	90.0	96.0	86.0	88.0	75.5
150							106.0	96.0	98.0	85.5

GENERAL NOTES:

(a) L_g is grip gaging length; L_s is body length

(b) Diameter-length combinations between the dashed lines are recommended. Lengths in parentheses are not recommended.

(c) Screws with lengths above the solid line are threaded full length.

(d) For screws with lengths longer than the lower dashed lines, L_g and L_s values shall be computed from formulas as given in para. 18 of General Data.

TABLE 4 THREAD LENGTHS

Nominal Screw Diam. and Thread Pitch	*B* (Ref.) Thread Length Basic			*X* (Ref.)	L_u				
				Transition Thread Length	Unthreaded Length Underhead				
	Screw Lengths ≤125	Screw Lengths >125 and ≤200	Screw Lengths >200	Max.	Screw Lengths To and Incl.	Max.	Screw Lengths Over	Screw Lengths To and Incl.	Max.
M10 X 1.5	26	32	45	7.5	20	2.2	20	35	3.8
M12 X 1.75	30	36	49	8.8	24	2.6	24	40	4.4
M14 X 2	34	40	53	10.0	28	3.0	28	45	5.0
M16 X 2	38	44	57	10.0	32	3.0	32	50	5.0
M20 X 2.5	46	52	65	12.5	40	3.8	40	60	6.2

TABLE 5 TOLERANCE ZONE

Nominal Screw Diam. and Thread Pitch	Head True Position Tolerance Zone Diameter	D_{si} Minimum Body Diam. for Product Threaded to Head	Circular Runout of Shank to Thread
M10 X 1.5	0.70	8.86	0.58
M12 X 1.75	0.84	10.68	0.70
M14 X 2	0.98	12.50	0.70
M16 X 2	1.12	14.50	0.70
M20 X 2.5	1.40	18.16	0.84

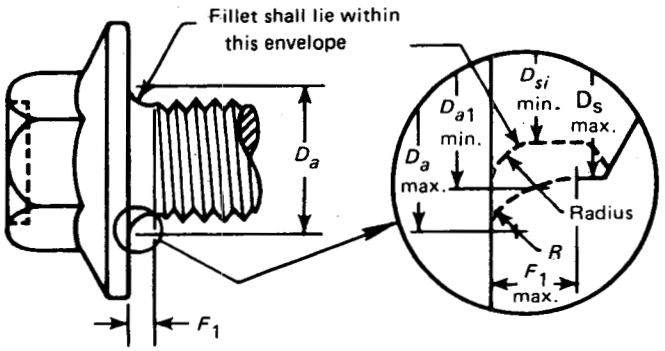


FIG. 3 STYLE A FILLET DETAIL FOR SHORT SCREWS

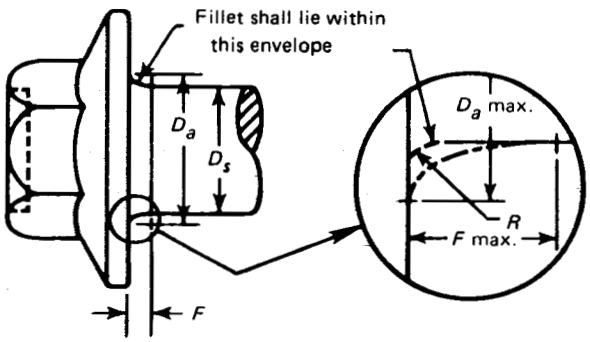


FIG. 4 STYLE A FILLET DETAIL FOR LONG SCREWS

TABLE 6 DIMENSIONS OF STYLE A UNDERHEAD FILLETS

Nominal Screw Diam. and Thread Pitch	D_{a1}	D_a	F	F_1	R
	Fillet Transition Diameter		Fillet Length		Fillet Radius
	For Short Screws	For Short and Long Screws	For Long Screws	For Short Screws	For Short and Long Screws
	Min.	Max.	Max.	Max.	Min.
M10 X 1.5	10.2	11.2	2.0	1.2	0.4
M12 X 1.75	12.2	13.7	3.0	1.3	0.6
M14 X 2	14.1	15.7	3.0	1.4	0.6
M16 X 2	16.5	17.7	3.0	1.6	0.6
M20 X 2.5	20.7	22.4	4.0	2.1	0.8

GENERAL NOTES:
(a) Short screws are screws which are threaded full length.
(b) Values of D_{si} are given in Table 5.

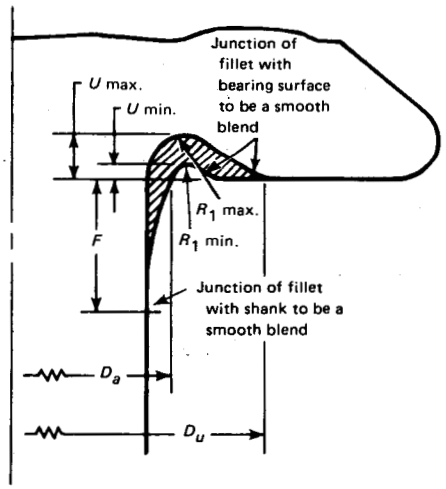


FIG. 5 STYLE B FILLET DETAIL

TABLE 7 DIMENSIONS OF STYLE B UNDERHEAD FILLETS

Nominal Screw Diam. and Thread Pitch	Style B						
	D_u	D_a	U		F	R_1	
	Max.	Max.	Max.	Min.	Max.	Max.	Min.
M10 x 1.5	12.5	10.8	0.31	0.13	2.1	0.45	0.20
M12 x 1.75	15.7	12.8	0.37	0.16	2.1	0.54	0.24
M14 x 2	18.1	14.8	0.43	0.19	2.1	0.63	0.28
M16 x 2	20.5	17.2	0.51	0.23	3.2	0.72	0.32
M20 x 2.5	26.1	21.6	0.65	0.29	4.2	0.90	0.40

TABLE 8 LENGTH TOLERANCES

Nominal Length	Nominal Screw Diameter	
	M10 Through M16	M20
To 10 mm	0.3	...
Over 10 to 18 mm	0.4	...
Over 18 to 30 mm	0.4	0.7
Over 30 to 50 mm	0.8	1.3
Over 50 to 80 mm	1.0	1.5
Over 80 to 120 mm	1.1	1.8
Over 120 to 180 mm	1.3	2.0
Over 180 to 240 mm	2.3	2.3
Over 240 mm	3.0	3.0

GENERAL NOTE: All tolerances are plus and minus.

TABLE 9 DIMENSIONS OF POINTS

Nominal Screw Diam. and Thread Pitch	*V*	*Z*	
	Point Radius	Point Length	
	Approx.	Max.	Min.
M10 X 1.5	14.0	2.25	0.75
M12 X 1.75	16.8	2.62	0.88
M14 X 2	19.6	3.00	1.00
M16 X 2	22.4	3.00	1.00
M20 X 2.5	28.0	3.75	1.25

GENERAL NOTES:
(a) *V* equals 1.4 times thread major diameter.
(b) *Z* max. equals 1.5 times thread pitch.
(c) *Z* min. equals 0.5 times thread pitch.

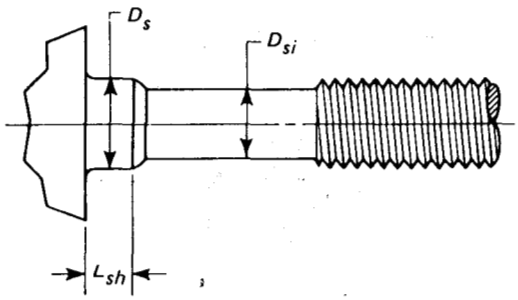


FIG. 6

TABLE 10 DIMENSIONS OF REDUCED BODY DIAMETER

Nominal Screw Diam. and Thread Pitch	D_s		D_{si}		L_{sh}	
	Shoulder Diameter		Body Diameter		Shoulder Length	
	Max.	Min.	Max.	Min.	Max.	Min.
M10 x 1.5	10.00	9.78	9.08	8.86	6.0	5.0
M12 x 1.75	12.00	11.73	10.95	10.68	7.0	6.0
M14 x 2	14.00	13.73	12.77	12.50	8.0	7.0
M16 x 2	16.00	15.73	14.77	14.50	9.0	8.0
M20 x 2.5	20.00	19.67	18.49	18.16	11.0	10.0

GENERAL NOTE: Shoulder is mandatory.

APPENDIX I

THREAD RUNOUT AND SCREW STRAIGHTNESS REFEREE GAGES AND GAGING PROCEDURE

(This Appendix is not an integral part of ANSI/ASME B18.2.3.9M-1984 and is included for information purposes only.)

Referee gages for simultaneously checking thread runout and screw straightness are illustrated below.

Both constructions can accommodate different lengths of screws through the combination of various lengths of sleeves to build up the required length L. When two or more sections are combined, care must be exercised to assure accurate alignment of the internal hole.

In the lower construction, GO thread ring gage A is centered on the sleeve B by means of positioning plug E and is secured in position by attachment screws C. The ring gage is set to class 6H maximum pitch diameter by use of the positioning plug E.

Diameter D_h of counterbore or hole in sleeve(s) equals the normal clearance hole diameter specified for the screw diameter in Appendix II. The sleeve length L (either single sleeve or combination of sleeve sections) shall be equal to the nominal screw length minus one nominal screw diameter.

To ensure adequate service life, gages and sleeve sections should be suitably hardened.

Failure of the product to enter the threads of the gage by hand for a minimum of two complete threads indicates excessive thread runout and/or out-of-straightness.

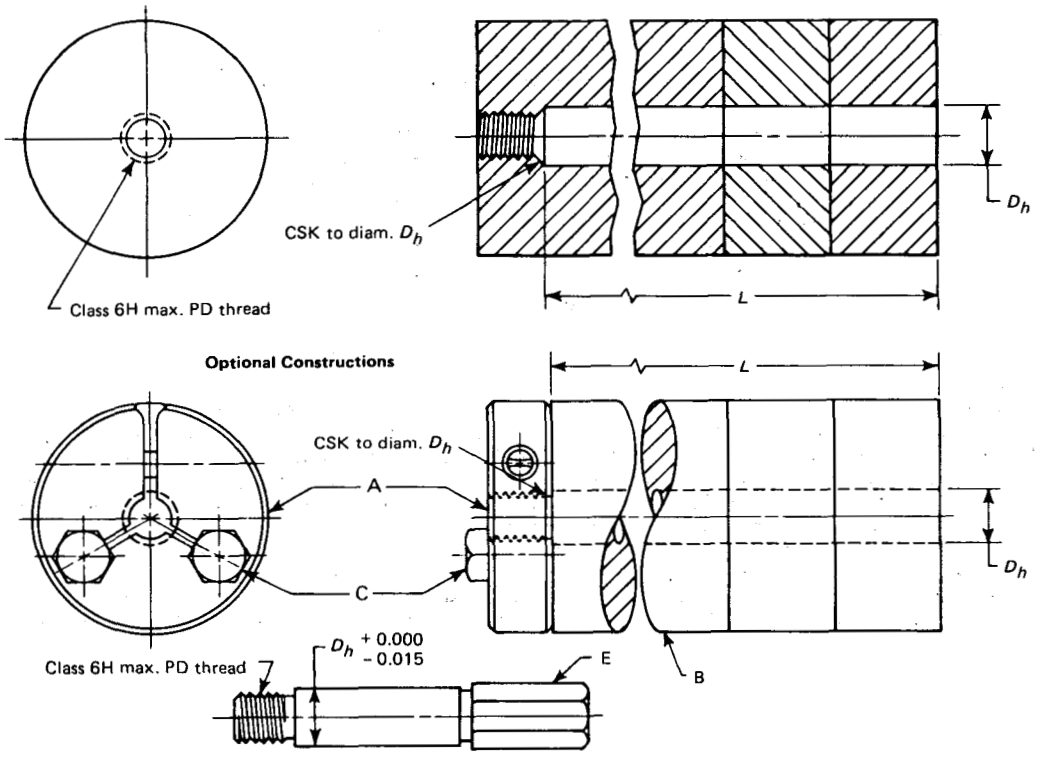


FIG. I

APPENDIX II
RECOMMENDED CLEARANCE HOLES FOR SCREWS

(This Appendix is not an integral part of ANSI/ASME B18.2.3.9M-1984 and is included for information purposes only.)

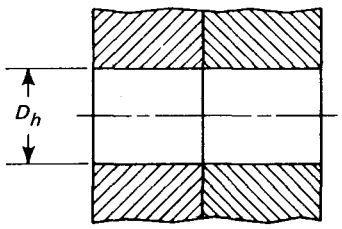


FIG. II

TABLE II CLEARANCE HOLES FOR SCREWS

Nominal Screw Diam. and Thread Pitch	Clearance Hole Diameter, Basic, D_h		
	Close Clearance	Normal Clearance (Preferred)	Loose Clearance
M10 X 1.5	10.5	11.0	12.0
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

GENERAL NOTES:

(a) *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

(b) *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 screw entry side to permit proper seating of the screw head.

(c) *loose clearance* — loose clearance hole sizes should be specified only for applications where maximum adjustment capability between components being assembled is necessary

(d) *recommended tolerances* — the clearance hole diameters given in the table are minimum sizes. Recommended tolerances are plus 0.3 mm for screw diameters M10 through M16; and plus 0.4 mm for screw diameter M20.

APPENDIX III
GOVERNMENT STANDARD ITEMS AND PART NUMBERING SYSTEM

(This Appendix is not an integral part of ANSI/ASME B18.2.3.9M-1984 and is included for information purposes only.)

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 III

(*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

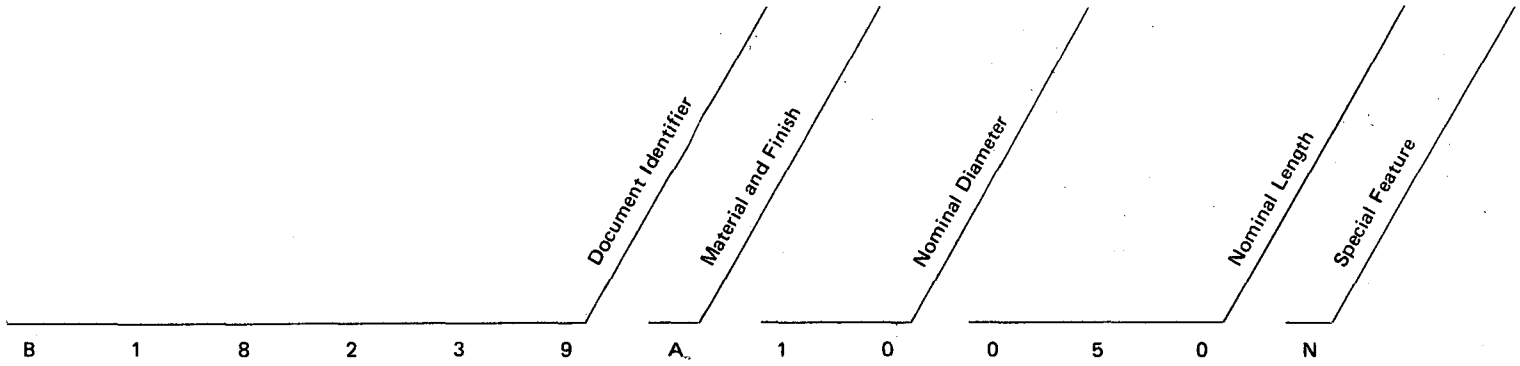
Note

The Part Numbering System may also be used for nonstandard diameter and length combinations.

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 STANDARIZATION.



Material and Finish Code
A = Steel with cadmium plating per QQ-P-416, Type II, Class 3 (5.1 μm thick), property class 10.9
B = Steel with zinc plating per ASTM B633, Fe/Zn 5 (5 μm thick) Type II, property class 10.9

Special Feature Code
N = None
D = Drilled Head (Note 1)
L = Self-Locking (Note 1)
C = Drilled Head and Self-Locking (Note 1)

EXAMPLE: B18239A10050N indicates a screw, heavy hex flange head – metric, made of cadmium plated steel, property class 10.9, 10 mm diam., 50 mm length, with no special feature.

NOTE:

(1) Details will be provided when available.

TABLE III METRIC HEAVY HEX FLANGE HEAD SCREWS – STANDARD SIZES FOR GOVERNMENT USE

Nominal Length	Nominal Diameter and Thread Pitch				
	M10 × 1.5	M12 × 1.75	M14 × 2	M16 × 2	M20 × 2.5
16	10016				
20		12020	14020		
25				16025	
30					20030
35					
40					
45					
50					
60	Standard				
70					
80		Diameter and			
90					
100	10100		Length		
110					
120		12120		Combination	
130					
140			14140		
150				16150	20150

AMERICAN NATIONAL STANDARDS FOR BOLTS, NUTS, RIVETS, SCREWS, WASHERS, AND SIMILAR FASTENERS

Small Solid Rivets B18.1.1-1972 (R1983)
Large Rivets B18.1.2-1972 (R1983)
Metric Small Solid Rivets B18.1.3M-1983
Square and Hex Bolts and Screws B18.2.1-1981
Square and Hex Nuts B18.2.2-1972 (R1983)
Metric Hex Cap Screws B18.2.3.1M-1979
Metric Formed Hex Screws B18.2.3.2M-1979
Metric Heavy Hex Screws B18.2.3.3M-1979
Metric Hex Flange Screws B18.2.3.4M-1984
Metric Hex Bolts B18.2.3.5M-1979
Metric Heavy Hex Bolts B18.2.3.6M-1979
Metric Heavy Hex Structural Bolts B18.2.3.7M-1979
Metric Hex Lag Screws B18.2.3.8M-1981
Metric Heavy Hex Flange Screws B18.2.3.9M-1984
Metric Hex Nuts, Style 1 ..... B18.2.4.1M-1979
Metric Hex Nuts, Style 2 ..... B18.2.4.2M-1979
Metric Slotted Hex Nuts B18.2.4.3M-1979
Metric Hex Flange Nuts B18.2.4.4M-1982
Metric Hex Jam Nuts B18.2.4.5M-1979
Metric Heavy Hex Nuts B18.2.4.6M-1979
Socket Cap, Shoulder and Set Screws — Inch Series B18.3-1982
Socket Head Cap Screws (Metric Series) B18.3.1M-1982
Metric Series Hexagon Keys and Bits B18.3.2M-1979
Hexagon Socket Head Shoulder Screws: Metric Series B18.3.3M-1979
Hexagon Socket Button Head Cap Screws: Metric Series B18.3.4M-1979
Hexagon Socket Flat Countersunk Head Cap Screws (Metric Series) B18.3.5M-1983
Metric Series Hexagon Socket Set Screws B18.3.6M-1979
Round Head Bolts (Inch Series) B18.5-1978
Metric Round Head Short Square Neck Bolts B18.5.2.1M-1981
Metric Round Head Square Neck Bolts B18.5.2.2M-1982
Wood Screws B18.6.1-1981
Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws B18.6.2-1972 (R1983)
Machine Screws and Machine Screw Nuts (M-4) B18.6.3-1972 (R1983)
Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series) B18.6.4-1981
General Purpose Semi-Tubular Rivets, Full Tubular Rivets, Split Rivets and Rivet Caps B18.7-1972 (R1980)
Metric General Purpose Semi-Tubular Rivets B18.7.1M-1984
Clevis Pins and Cotter Pins B18.8.1-1972 (R1983)
Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series) B18.8.2-1978
Plow Bolts B18.9-1958 (R1977)
Track Bolts and Nuts B18.10-1982
Miniature Screws B18.11-1961 (R1983)
Glossary of Terms for Mechanical Fasteners B18.12-1962 (R1981)
Screw and Washer Assemblies — Sems B18.13-1965 (R1983)
Forged Eyebolts B18.15-1969
Mechanical and Performance Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts B18.16.1M-1979
Torque-Tension Test Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts B18.16.2M-1979
Dimensional Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts B18.16.3M-1982
Wing Nuts, Thumb Screws, and Wing Screws B18.17-1968 (R1983)
Inspection and Quality Assurance for General Purpose Metric Fasteners B18.18.1M-1982
Inspection and Quality Assurance for High-Volume Machine Assembly Metric Fasteners B18.18.2M-1982
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Lock Washers B18.21.1-1972 (R1983)
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