ASME B18.12-2001
[Revision of ASA B18.12-1962 (R1991)]

GLOSSARY OF TERMS FOR MECHANICAL FASTENERS

AN AMERICAN NATIONAL STANDARD



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CONTENTS

Foreword iv
Committee Roster v
Correspondence With the B18 Committee viii

1 Introduction 1

2 Terminology 1
2.1 Basic Fastener Terminology 1
2.2 Fastener Characteristics (Excluding Head Styles) 3
2.3 Fastener Head Styles 7
2.4 Dimensional Terms and Size 12
2.5 Terms Relating to the Manufacture of Fasteners 17
2.6 Fastener Performance Terminology 19
2.7 Terms Relating to Material and Heat Treatment of Fasteners 20
2.8 Coatings and Finish Terminology 20
2.9 Quality Assurance Including Inspection Terminology 21
2.10 Packaging 22

3 Product Families 22
3.1 Externally Threaded Products 22
3.2 Internally Threaded Products 38
3.3 Nonthreaded Products 42
3.4 Miscellaneous Fasteners 51

Tables
1 Common Applications of Threaded Fastener Head Styles 8
2 Type Designations for Tapping Screws and Metallic Drive Screws 32
3 Screw and Washer Assembly Combinations 38

Index 53

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FOREWORD

Sectional Committee B18 on Dimensional Standardization of Bolts, Nuts, Rivets, Screws, and Similar Fasteners was organized in March 1922 under the procedure of the American Standards Association with the Society of Automotive Engineers and The American Society of Mechanical Engineers as joint sponsors.

Subcommittee 10 on the Glossary of Terms for Mechanical Fasteners was organized in February 1947. The purpose of the subcommittee was to promote and coordinate the standardization of fastener nomenclature for those products falling under the scope of the various other subcommittees of the B18 Sectional Committee, the definitions themselves being the responsibility of the cognizant subcommittee. It was later decided that terms not strictly in the above category but closely allied should be defined in the Glossary.

During the development period, several drafts of the Glossary were prepared and studied by Subcommittee 10 before a suitable format and content could be agreed upon.

To cover completely the field of mechanical fasteners, it has been necessary to include in this Standard illustrations of certain fastener features and types of fasteners that are of proprietary origin. Because it was impossible to include all variations of such proprietary designs, this Standard includes selected illustrations that exemplify the type of fastener or feature described. This selection was made on an impartial basis. The inclusion of any one proprietary design in this Standard does not constitute endorsement by the committee or the sponsors, nor is omission of certain styles to be construed as rejection of such styles by the committee and sponsors.

The previous edition of ASA B18.12 was approved by the B18 Sectional Committee, the sponsors, and the American Standards Association, and it was designated as an American Standard on June 22, 1962.

In May 1995 Subcommittee 12 of the B18 Standards Committee set forth the concept that a complete update and significant revision of the Glossary of Terms was necessary. The content was completely reorganized to reflect a logical approach to basic fastener characteristics and configurations. Many new sections and items, such as blind fasteners and retaining rings, were included. In total, 538 terms are included in this Edition of the Standard, which was approved by the committee in December 2000. This Standard was approved by the American National Standards Institute on August 15, 2001.

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

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

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Secretary, B18 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

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

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

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

Subject: Cite the applicable paragraph number(s) and the topic of the inquiry.

Edition: Cite the applicable edition of the Standard for which the interpretation is being requested.

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

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

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

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GLOSSARY OF TERMS FOR MECHANICAL FASTENERS

1 INTRODUCTION

1.1 Scope

This Standard is a summary of nomenclature and terminology currently used to define and/or describe mechanical fasteners, related characteristics, and the manufacturing processes that produce these products. Utilization of these terms by manufacturers and consumers is intended to reduce or eliminate confusion and serve as a sound basis for communication.

(a) Primary Operations. Mechanical fasteners are produced by forming or screw machine operations. Forming is generally scrapless and, depending upon size, may produce fasteners at rates exceeding 500 pieces per minute. Screw machining, although more tightly toleranced, is significantly slower and generates scrap because it involves the removal of material.

(b) Secondary Operations. Fasteners generally undergo several secondary operations or processes such as thread rolling, heat treating, or plating.

(c) Fastener. A fastener is a mechanical device designed specifically to hold, join, couple, assemble, or maintain equilibrium of single or multiple components. The resulting assembly may function dynamically or statically as a primary or secondary component of a mechanism or structure. Based on the intended application, a fastener is produced with varying degrees of built-in precision and engineering capability, ensuring adequate, sound service under planned, preestablished environmental conditions.

(d) Bolts, Studs, Screws, Nuts, Washers, Rivets, Pins, and Custom Formed Parts. These items are the general product families in which mechanical fasteners are best classified. Within each product family are numerous types that may have a name conforming to the technical language of a national standard or alternately may have a name that has its origins in commercial or marketing nomenclature often taken from its intended application. Such names, for example, include the "stove bolt" and "carriage bolt." Because mechanical fasteners are used in just about every mechanical assembly, they necessarily have been designed to meet a broad range of applications from watch and computer assembly to the space shuttle design. The names given to fasteners appear to be as limitless as the designer's imagination. While many fasteners may look alike, they generally have defined engineered capabilities based upon their intended application.

1.2 Referenced Documents

In the development of this Standard, a number of terms were written based upon language found in more than 230 standards and other publications of the following organizations:

(a) American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

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

(c) Industrial Fasteners Institute (IFI), 1717 East Ninth Street, Suite 1105, Cleveland, OH 44114-2879

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

2 TERMINOLOGY

2.1 Basic Fastener Terminology

2.1.1 *commercial fastener:* manufactured to published consensus standards and stocked by manufacturers or distributors.

2.1.2 *compression fastener:* a fastener whose primary function is to resist compressive forces.

2.1.3 *endurance limit or endurance strength:* the maximum alternating stress that a fastener can withstand for a specified number of stress cycles without failure.

2.1.4 *headed fastener:* a fastener having one end enlarged or formed.

2.1.5 *headless fastener:* a fastener, either threaded or unthreaded, that does not have either end enlarged.

2.1.6 *high strength fastener:* a fastener having high tensile and shear strengths attained through combinations of materials, work-hardening, and heat treatment.

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These fasteners usually have a tensile strength in excess of 120,000 psi.

2.1.7 *lockpins and collars:* a headed and externally grooved mechanical device designed for insertion through holes in assembled parts. A cylindrical collar is swaged into the external groove as the lock pin is hydraulically tensioned. Collars are either smooth bored or may contain a fit-tab. An optional flange provides a built-in washer.

2.1.8 *mechanical properties:* identify the reaction of a fastener to applied loads. Rarely are the mechanical properties of the fastener those of the raw material from which it was made. Properties such as tensile and yield strengths, hardness, and ductility will vary widely, depending upon choice of manufacturing methods and metallurgical treatments.

2.1.9 *modified standard:* a part that is standard with one or more of its features or characteristics slightly changed. Such a part is normally ordered to a customer's print is used by that customer in a particular application, but the part is such that any interested manufacturer can produce it.

2.1.10 *nonstandard fastener or special fastener:* a fastener that differs in size, length, configuration, material, or finish from established and published standards.

2.1.11 *physical properties:* inherent in the raw material and remain unchanged, or with only slight alteration in the fastener following manufacture. Such properties are density, thermal conductivity, and magnetic susceptibility.

2.1.12 *Part Identifying Number (PIN):* a 21-character code that identifies an ASME B18 manufactured product by specific characteristic fields such as fastener family identification, B18 standard identification, fastener style or type, thread series, nominal diameter, nominal length or dimensional/other characteristics, material and treatment, plating, coating, and passivation and special features relevant to the fastener product.

2.1.13 *precision fastener:* manufactured to close dimensional and geometric tolerances.

2.1.14 *proof load:* a tensile load that the fastener must support without evidence of permanent deformation. Proof load is an absolute value, not a maximum or minimum value. For most carbon or alloy steel fastener strength grades or property classes, proof loads are established at approximately 90 to 93% of the expected minimum yield strength. Proof loads are frequently used as design values in joint analysis and fastener selection.

2.1.15 *proof test:* a form of tensile test where the maximum load applied is the proof load value in the applicable specification.

2.1.16 *fastener quality:* the accuracy of manufacture of the fastener such that it conforms to its specified tolerances, limits, and requirements.

2.1.17 *aircraft/aerospace fastener:* intended for use in a flying vehicle.

2.1.18 *fit:* the amount of clearance or interference between mating parts.

2.1.19 *shear fastener:* a fastener whose primary function is to resist forces applied at a right angle to the fastener axis that tend to shear it.

2.1.20 *standard fastener:* can be described from nationally recognized consensus standards documents and may be produced by any interested manufacturing facility.

EXAMPLE: An order that specifies $\frac{1}{2}$–13 × 2 UNC-2A Hex Cap Screws, SAE J429 Grade 5, should result in the identical product being delivered by any fastener manufacturer accepting the order. Often it is said that a standard fastener could be ordered by phone and the identical product received from multiple sources.

All other fasteners would be classified as SPECIAL or NONSTANDARD and would properly fall into three groups:

(a) modified standard
(b) proprietary—patented
(c) engineered special parts

Generally these will require a written description and/or blueprint or drawing to communicate what exactly is required.

2.1.21 *stock fastener:* commercially available in a quantity from a manufacturer or distributor of fasteners.

2.1.22 *substandard fastener:* does not meet its specified requirements related to fit, form, or function.

2.1.23 *tensile strength:* the maximum tension-applied load a fastener can support prior to or coincident with its fracture. Tensile strength is normally expressed in terms of stress [i.e., pounds per square inch (psi) for inch module product and megapascals (MPa) for metric product].

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2.1.24 *tension fastener:* a fastener whose primary function is to resist forces that tend to elongate it.

2.1.25 *threaded fastener:* a fastener, a portion of which has some form of screw thread.

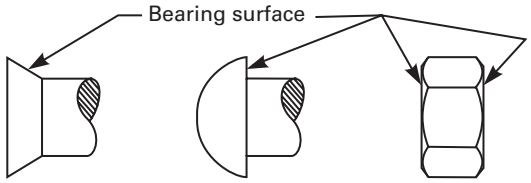
2.1.26 *wedge tensile test:* a wedge under the head of a bolt or screw or under a nut used when testing studs, induces a bending stress when subjected to a tension-applied load, which demonstrates ductility and the integrity of the head-to-shank junction.

2.1.27 *yield strength:* the tension-applied load at which the fastener experiences a specific amount of permanent deformation (i.e., the bolt has been stressed beyond its elastic limit and is in the plastic zone). It is very difficult to test full-size bolts for yield strength, because of different strain rates in the threaded section, thread runout, and unthreaded shank, which together comprise the stressed length. A proof load concept is the method for checking full-size bolts.

2.2 Fastener Characteristics (Excluding Head Styles)

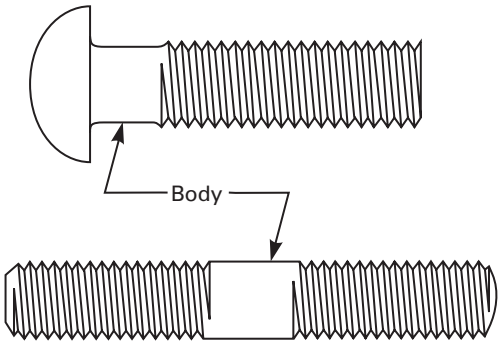
2.2.1 *bearing face:* the load-carrying surface.

EXAMPLES: underside of bolt head, washer-face on nut, and/or the surface of the fastener that is in contact with the joint surface.



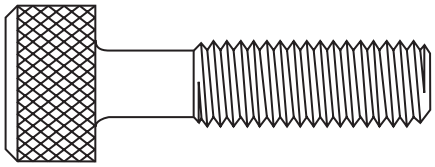
2.2.2 *blank:* a portion of material cut off before the first stage of forming.

2.2.3 *body, threaded fastener:* the unthreaded portion of the shank.



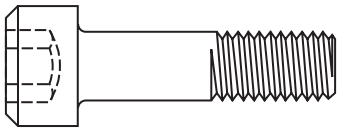
2.2.3.1 *bound body (body-bound or fitted):* has a definite interference or extremely small clearance with its mating hole.

2.2.3.2 *externally relieved body:* a body on which the diameter of the entire body or a portion thereof is reduced to less than the minimum pitch diameter of the thread.



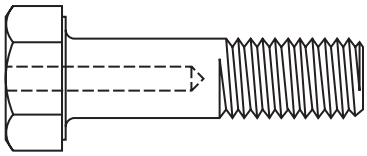
Externally Relieved Body

2.2.3.3 *full or nominal diameter body:* a body whose diameter is generally within the dimensional limits of the major diameter of the thread. Sometimes referred to as "full size body."



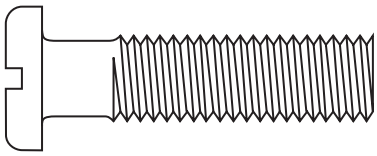
Full or Nominal Diameter Body

2.2.3.4 *internally relieved body:* has an axial hole drilled through a portion of the body.



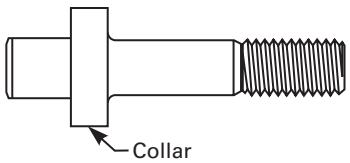
Internally Relieved Body

2.2.3.5 *reduced diameter body:* a body whose diameter may range from the minimum pitch diameter of the thread and does not exceed the minimum full size body diameter.



Reduced Diameter Body

2.2.4 *collar:* a raised ring or flange of material on the head or shank of a fastener.



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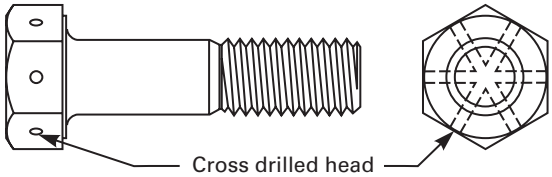
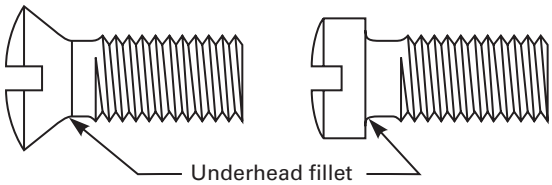
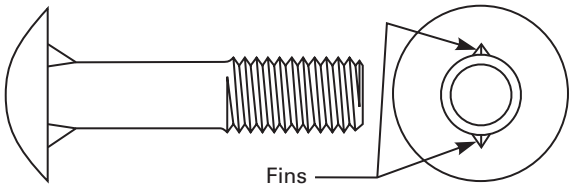
2.2.5 *cross drilled:* a fastener having one or more holes in the head or shank at right angles to, and normally intersecting, the axis of the fastener.



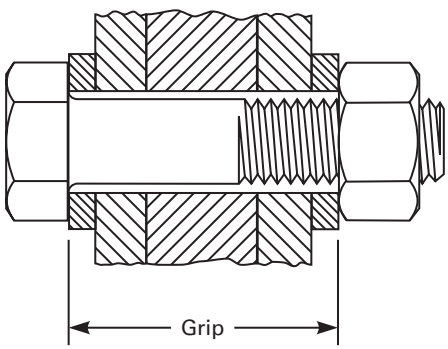
2.2.6 *underhead fillet or fillet radius:* the radiused section at the junction of the head and shank of a headed fastener.



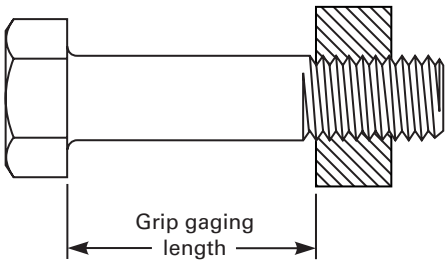
2.2.7 *fin:* a form of key under the head of a fastener that serves to keep the fastener from turning during assembly and use.



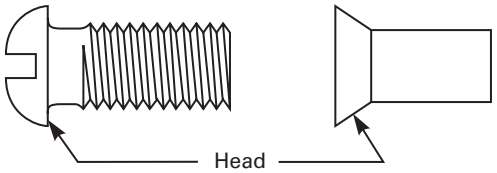
2.2.8 *grip:* a term normally associated with structural bolting, the grip is the thickness of material or parts that the fastener is designed to secure when assembled.



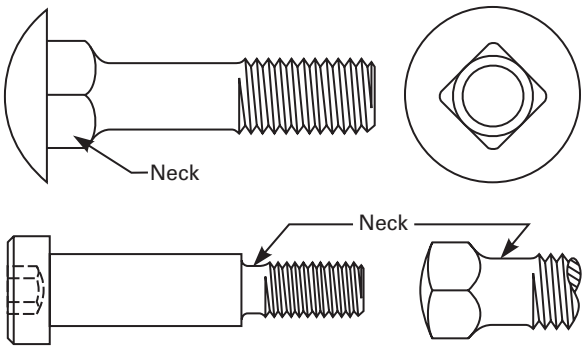
2.2.9 *grip gaging length:* the distance measured parallel to the axis of a bolt or screw from the underhead bearing surface to the face of the appropriate noncounterbored or noncountersunk GO thread ring gage assembled by hand as far as the thread will permit.



2.2.10 *head:* the head of a fastener is the enlarged shape on one end. The shape may be upset or trimmed and is always dimensionally larger than the nominal fastener diameter.



2.2.11 *neck:* used to define (1) a specialized form of a portion of the body of a fastener near the head to perform a definite function, such as preventing rotation, etc.; and (2) a reduced diameter of a portion of the shank of a fastener that is required for manufacturing or application reasons.



2.2.11.1 *fin neck:* a style of neck consisting of two or more fins (see para. 2.2.7) under and integral with the head.

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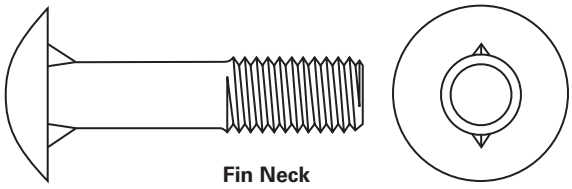
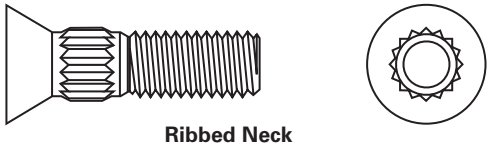


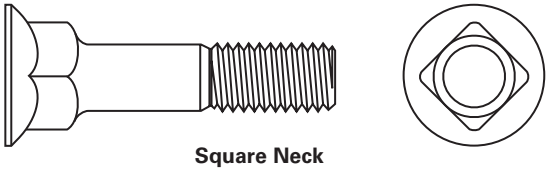
Fin Neck

2.2.11.2 *ribbed neck:* a style of neck consisting of longitudinal ribs around the shank adjacent to the underside of the head.



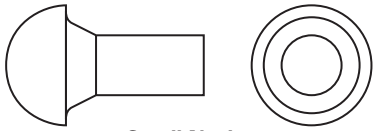
Ribbed Neck

2.2.11.3 *square neck:* a style of neck consisting of a square shoulder formed integral with the underside of the head.



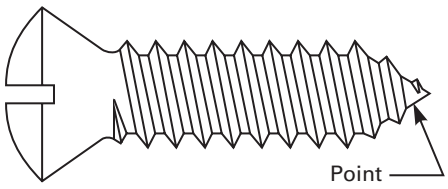
Square Neck

2.2.11.4 *swell neck:* a tapered or variable neck.

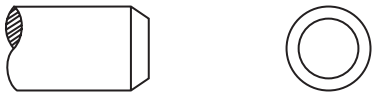


Swell Neck

2.2.12 *point:* on a fastener is a conical or cylindrical configuration of the end of the shank of a headed fastener or of each end of a headless fastener. Depending on point style and manufacturing equipment, the point may be formed (header point), extruded (dog point), or machined (cup screw point). Points applicable to set screws and tapping screws are described and illustrated under the respective screw types in para. 3.1.2.

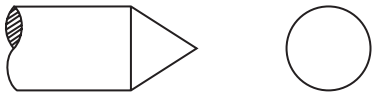


2.2.12.1 *chamfer point:* a truncated cone point, the end of which is approximately flat and perpendicular to the fastener axis. These points on threaded fasteners generally have point included angles of 45 to 90 deg and a point diameter equal to or slightly less than the minor diameter of the thread. This point is intended to facilitate entry of fasteners into holes at assembly and protects the lead thread from damage during handling.



Chamfer Point

2.2.12.2 *cone point:* a sharp conical point designed to perform perforating or aligning functions at assembly.



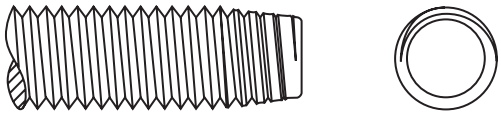
Cone Point

2.2.12.3 *gimlet point:* a threaded cone point usually having a point angle of 45 to 50 deg. It is used on thread forming screws such as Type AB tapping screws, wood screws, lag bolts, etc.



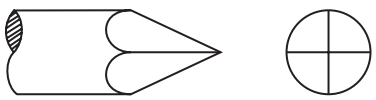
Gimlet Point

2.2.12.4 *header point:* a chamfered point normally produced during the heading operation. The screw blank is chamfered before threads are rolled.



Header Point

2.2.12.5 *nail point:* a sharp pyramidal point generally having a point angle of 30 to 45 deg, and is produced by a pinching operation. It is designed for piercing wood or other resilient materials.



Nail Point

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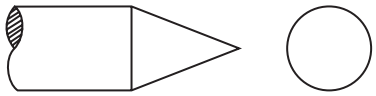
2.2.12.6 *needle point:* a cone point of long length intended to perform a piercing function.



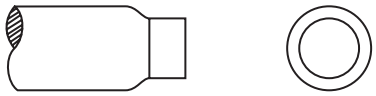
Needle Point

2.2.12.7 *oval point:* a radiused point, sometimes referred to as a "crowned end" or "round point."



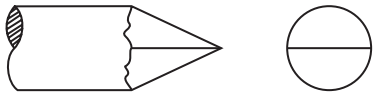
Oval Point

2.2.12.8 *pilot point:* a cylindrical point having a diameter somewhat smaller than the shank diameter. It is designed to facilitate the alignment and starting of such fasteners as drive screws and groove pins into holes at assembly. (See also para. 3.1.2.18.3, *full dog point.*)



Pilot Point

2.2.12.9 *pinch point:* a short sharp cone point, usually having a point angle of 45 deg, formed by a pinching operation. This point is normally limited to diameters of $\frac{1}{4}$ in. or smaller and is applied to metal drive screws and Type BP tapping screws.



Pinch Point

2.2.12.10 *plain point:* a term applied to the unpointed end of a fastener cut approximately flat and perpendicular to the fastener axis. These points on threaded fasteners may be slightly concave especially when threads are rolled.



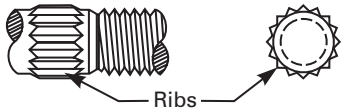
Plain Point

2.2.12.11 *spherical point:* an oval point in which the point radius is equal to half the shank diameter.

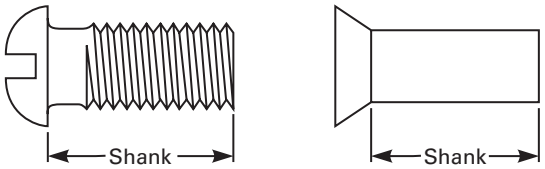


Spherical Point

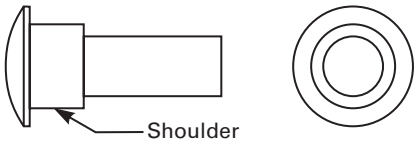
2.2.13 *ribs:* small ridges of material usually formed longitudinally around the shank (sometimes referred to as serrations or knurls).



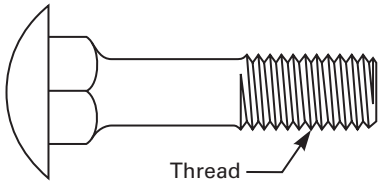
2.2.14 *shank:* that portion of a headed fastener that lies between the head and the extreme point end.



2.2.15 *shoulder:* an enlarged portion of the body of a threaded fastener or shank of an unthreaded fastener.



2.2.16 *thread:* a ridge of uniform section in the form of a helix on the external or internal surface of a cylinder. This is known as a straight or parallel thread to distinguish it from a taper thread that is formed on a cone or frustum of a cone.



2.2.16.1 *right-hand thread:* a thread is a right-hand thread if, when viewed axially, it winds in a clockwise and receding direction. All threads are right-hand threads unless otherwise designated.

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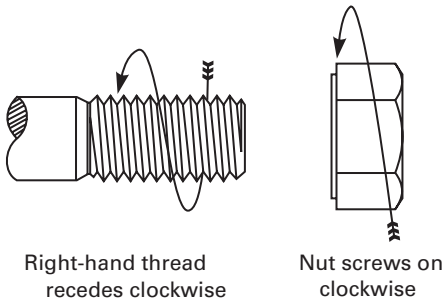
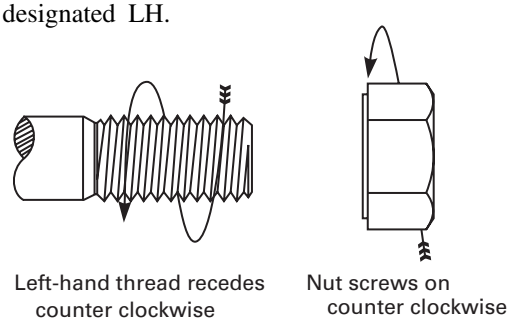


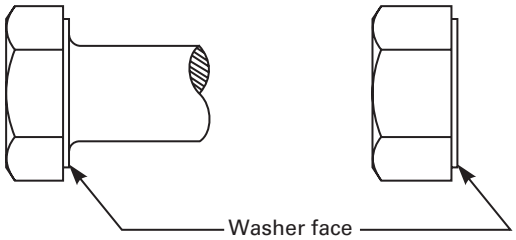
Right-Hand Thread

2.2.16.2 *left-hand thread:* a thread is a left-hand thread if, when viewed axially, it winds in a counter clockwise and receding direction. All left-hand threads are designated LH.



Left-Hand Thread

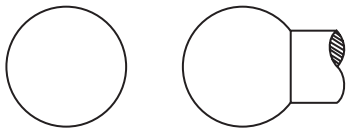
2.2.17 *washer face:* a circular boss on the bearing surface of a screw or nut. The only bolt that has a washer face is the heavy hex structural bolt.



2.3 Fastener Head Styles

2.3.1 Threaded Fasteners. Refer to Table 1 for a listing of common applications of threaded fastener head styles.

2.3.1.1 *ball head:* a head approximately spherical in shape.



Ball Head

2.3.1.2 *binding head:* has a rounded top surface, slightly tapered side surface, and a flat bearing surface, a portion of which is sometimes undercut adjacent to the shank.



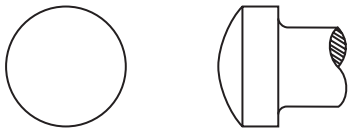
Binding Head

2.3.1.3 *button head:* as applied to threaded fasteners has a low rounded top surface with a large flat bearing surface. (See also para. 2.3.1.28, *truss head.*)



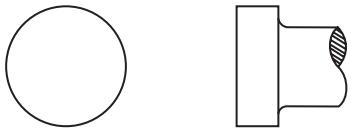
Button Head

2.3.1.4 *fillister head:* has a rounded top surface, cylindrical side surface, and a flat bearing surface.



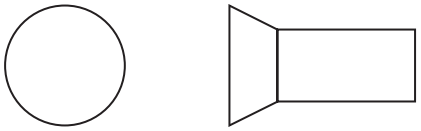
Fillister Head

2.3.1.5 *flat fillister head:* has a flat top surface, cylindrical side surface, and a flat bearing surface.



Flat Fillister Head

2.3.1.6 *countersunk head:* designed to be flush with the surface when installed.



Countersunk Head

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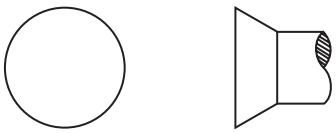
TABLE 1 COMMON APPLICATIONS OF THREADED FASTENER HEAD STYLES

Head Style	Bolts	Machine Screws	Tapping Screws	Wood Screws	Cap Screws	Set Screws	Drive Screws	
							Metal	Wood
Ball head	...	X	...	A	...	...	...	...
Binding head	...	AB	...	...	...	...	...	...
Button head	X	...	...	...	D	...	...	...
Fillister head	...	ABC	ABC	...	A	...	...	...
Flat fillister head	...	A	...	...	...	...	...	...
Flat head: 82 deg	...	ABC	ABC	ABC	AD	...	X	AX
Flat head: 90 deg	...	ABS	ABS	...	...	...	...	...
Flat head: 100 deg	...	AB	...	...	...	...	...	...
Flat trim head	...	B	B	...	...	...	...	...
Flat undercut head	...	AB	AB	...	...	...	...	...
Headless	...	...	...	...	...	ADE	...	...
Hexagon head	AX	AX	AX	...	X	...	...	...
Hexagon washer head	AX	AX	AX	...	...	...	...	...
Oval head	...	ABC	ABC	ABC	A	...	...	AX
Oval trim head	...	B	B	...	...	...	...	...
Oval undercut head	...	AB	AB	...	...	...	...	...
Pan head	...	ABC	ABC	...	...	...	X	...
Round countersunk head	X	...	...	...	...	...	...	...
Round head	...	AB	AB	AB	A	...	X	AX
Round washer head	...	AB	AB	...	...	...	...	...
Socket head	...	...	...	...	DE	...	...	...
Square countersunk head	X	...	...	...	...	...	...	...
Square head	X	...	...	...	...	X	...	...
T-head	X	...	...	...	...	...	...	...
Truss head	...	ABC	ABC	...	...	...	...	...
12-point head	...	X	...	...	X	...	...	...
12-spline head	...	...	...	...	X	...	...	...

A = Slotted
B = Cross recessed
C = Clutch recessed
D = Hexagon socket
E = Spline socket
X = Plain, no slot or recess
S = Square recess

2.3.1.7 *flat head:* has a flat top surface and a conical bearing surface with various nominal head angles (82 deg, 90 deg, and 100 deg). (See also para. 2.3.1.20, *round countersunk head.*)



Flat Head

2.3.1.8 *flat trim head:* has a smaller head diameter and lower head height than the standard flat head.



Flat Trim Head

2.3.1.9 *flat undercut head:* basically the same as the standard flat head, except it is undercut to 70% of the basic head height.



Flat Undercut Head

2.3.1.10 *headless:* normally has a slot, recess, or socket in one end.



Headless

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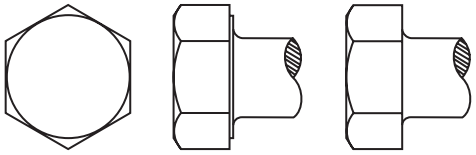
2.3.1.11 *hexagon head:* has a flat or indented top surface, six flat sides, and a flat bearing surface or washer face.



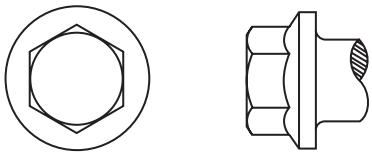
Hexagon Head

2.3.1.12 *hexagon washer head:* a hexagonally shaped head with an integral, formed washer at the base of the hexagon. The washer diameter may be equal to or greater than the width across corners of the hexagon.



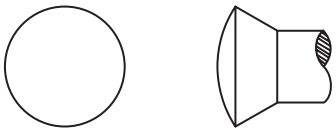
Hexagon Washer Head

2.3.1.13 *hexagon flange head:* a hexagonally shaped head with an integral circular collar connected to the base of the hexagon by a conic section. The flanged diameter is normally larger than the width across corners of the hexagon.



Hexagon Flange Head

2.3.1.14 *oval head:* has a rounded top surface and a conical bearing surface with head angle of nominally 82 deg (90 deg for metric).



Oval Head

2.3.1.15 *oval trim head:* has a smaller head diameter and lower head height than the standard oval head with a controlled radius at the junction of the top and the conical bearing surface.



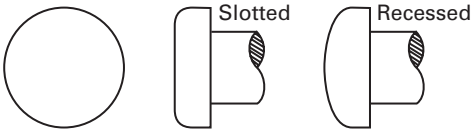
Oval Trim Head

2.3.1.16 *oval undercut head:* the same basic head as the standard oval head except it is shorter. The screw head is undercut to 70% of the basic head side height to afford a greater length of thread.



Oval Undercut Head

2.3.1.17 *pan head:* has a flat bearing surface and a flat top surface rounding into a cylindrical side surface. On recessed pan heads, the top surface is a semi-elliptical, rounding into a cylindrical side surface.

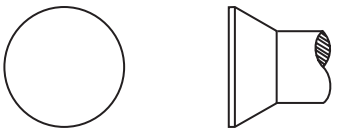


Pan Head

2.3.1.18 *recessed head:* head having a designed indentation or recess centered in its top surface to facilitate installation/driving.

2.3.1.19 *reduced or shear head:* a fastener head designed primarily for shear application loading that has a head height less than the standard head height for a fastener designed for full axial tension.

2.3.1.20 *round countersunk head:* a circular head having a flat top surface and conical bearing surface. (See also paras. 2.3.1.7 and 2.3.2.8, *flat head.*)



Round Countersunk Head

2.3.1.21 *round head:* has a semi-elliptical top surface and a flat bearing surface. This term also is applied to a fastener head designed without a driving surface or recess.

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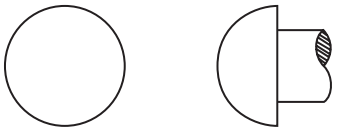


Round Head

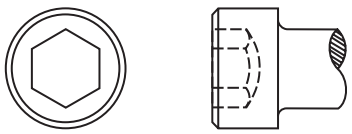
2.3.1.22 *round washer head:* a washer head upon which a round head is formed. (See also para. 2.3.1.31, *washer head*.)



Round Washer Head

2.3.1.23 *slotted head:* a head having a slot centered across its top surface to facilitate driving.

2.3.1.24 *socket head:* has a flat chamfered top surface with a smooth or knurled cylindrical side surface and a flat bearing surface. A hexagon or spline (formerly known as "fluted") socket is formed in the center of the top surface.



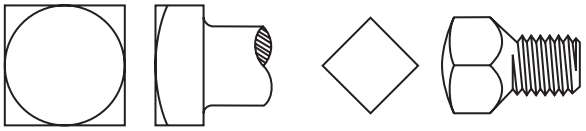
Socket Head

2.3.1.25 *square countersunk head:* a square head having a flat top surface and pyramidal bearing surface.



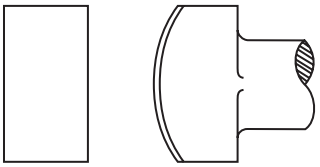
Square Countersunk Head

2.3.1.26 *square head:* has a flat top surface, four flat sides, and a flat bearing surface. Square heads on set screws have a rounded top surface and may have an underhead construction tapered or radiused directly into the threads.



Square Head

2.3.1.27 *T-head:* a rectangular shaped head, having a rounded top surface, flat sides, and a flat bearing surface.



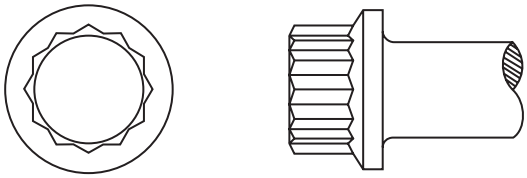
T-Head

2.3.1.28 *truss head:* has a low rounded top surface with a flat bearing surface. For a given screw size, the diameter of the truss head is larger than the diameter of the corresponding round head. (It is sometimes called "oven head" or "stove head.")



Truss Head

2.3.1.29 *12-point flange head:* has a flat or indented top surface, 24 flats (double hex), with an integral formed circular collar connected to the base of the double hex by a conic section. It is sometimes called "double hexagon head."



12-Point Flange Head

2.3.1.30 *12-spline head:* has 12 splines centered at 30 deg increments around the outer circumference of the head and are parallel to the axis of the screw or bolt.

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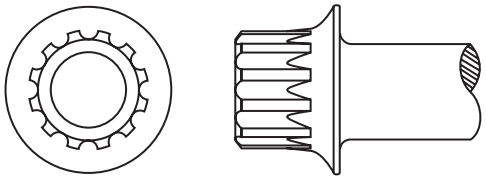
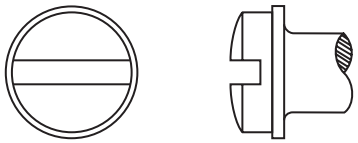


12-Spline Head

2.3.1.31 *washer head:* a head having a circular collar with a large flat bearing surface upon which various other head styles are integrally superimposed.

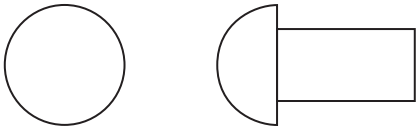


Washer Head

2.3.1.32 *wrenching:* a provision that allows for internal or external driving of a head or external driving of a nut.

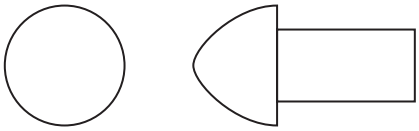
2.3.2 Nonthreaded Fasteners

2.3.2.1 *button head:* a circular head having a hemispherical top surface and a flat bearing surface. It is sometimes called "round head."



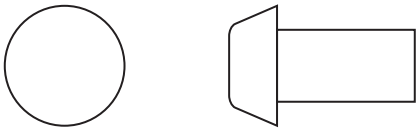
Button Head

2.3.2.2 *high button head:* a circular head having a high semi-elliptical (acorn shaped) top surface and a flat bearing surface. It is sometimes called "acorn head."



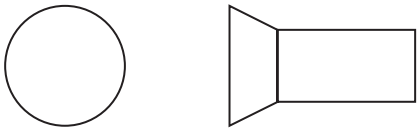
High Button Head

2.3.2.3 *cone head:* a high conical head with a small, flat, truncated top and a flat bearing surface.



Cone Head

2.3.2.4 *countersunk head:* a circular head having a flat top surface and a conical bearing surface with head angles that vary with the rivet type.



Countersunk Head

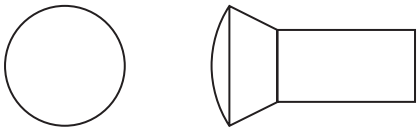
2.3.2.5 *flat top countersunk head:* the head designation used for large rivets. (See also para. 2.3.1.6, *countersunk head*.)

2.3.2.6 *flat top countersunk head (with chamfered top):* similar to a flat top countersunk head but has a chamfered top as shown in the following figure.



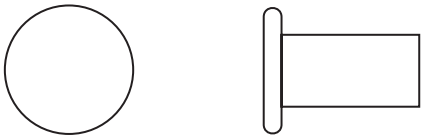
Flat Top Countersunk Head (With Chamfered Top)

2.3.2.7 *round top countersunk head:* head designation used for large rivets. Round top countersunk head is a circular head having a rounded top surface and a conical bearing surface with a head angle of 78 deg.



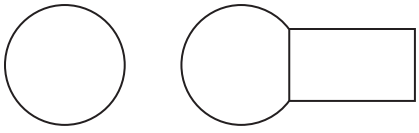
Round Top Countersunk Head

2.3.2.8 *flat head:* a low cylindrical head having a flat top, rounded side surface, and a flat bearing surface.



Flat Head

2.3.2.9 *globe head:* a head approximately spherical in shape.



Globe Head

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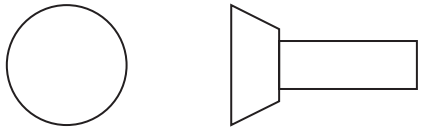
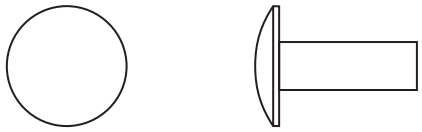
2.3.2.10 *machine head:* a high inverted conical head with a large flat top, tapered side surface, and a small flat bearing surface.



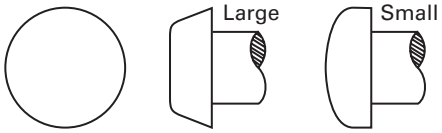
Machine Head

2.3.2.11 *oval head:* a circular head having a low rounded top surface and a flat bearing surface. For a given size, the oval head is thinner than the button head but thicker than the truss head.



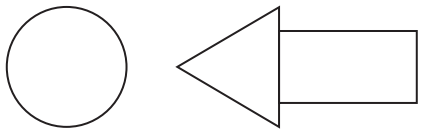
Oval Head

2.3.2.12 *pan head:* on large rivets is a low conical head with a flat top and flat bearing surface. The pan head on small rivets has a semi-elliptical top surface and flat bearing surface.



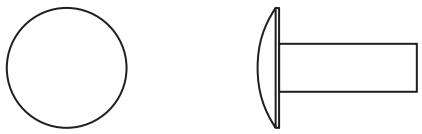
Pan Head

2.3.2.13 *steeple head:* a sharp conical head having a flat bearing surface.



Steeple Head

2.3.2.14 *truss (wagon box) head:* a large circular head having a low rounded top surface and flat bearing surface.



Truss (Wagon Box) Head

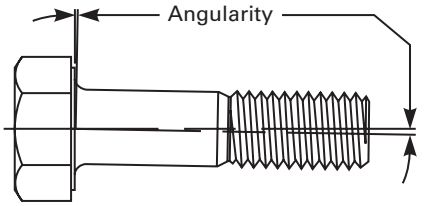
2.4 Dimensional Terms and Size

The following terms are commonly used in designating the size and dimensioning of fasteners and their various components.

2.4.1 *actual size:* the measured size of a given fastener characteristic.

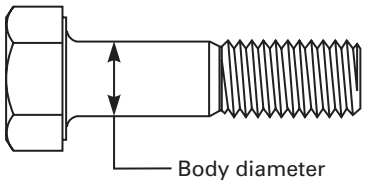
2.4.2 *allowance:* an intentional difference between the maximum material limits of mating parts. It is the minimum clearance (positive allowance) or maximum interference (negative allowance) between such parts. (See also para. 2.4.12, *fit*.)

2.4.3 *angularity:* the angle between the axes of two surfaces of a fastener.

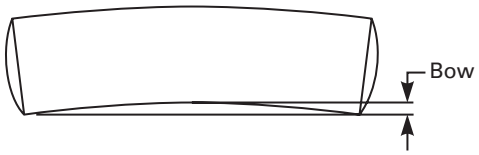


2.4.4 *basic size:* size from which the limits of size are derived by the application of allowances and tolerances.

2.4.5 *body diameter:* the diameter of the body of a threaded fastener.



2.4.6 *bow or camber:* the amount that a side of a surface of a fastener deviates from being straight.



2.4.7 *chamfer angle:* the angle of the chamfer measured from the normal to the axis of the fastener and is generally specified in conjunction with either a length or a diameter.

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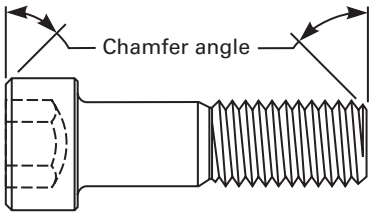
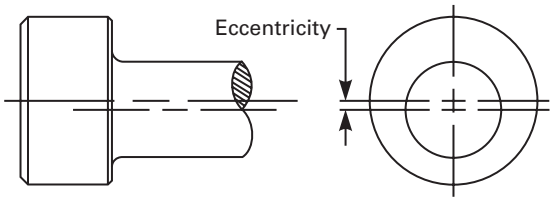


2.4.8 *concentric, concentricity:* two surfaces of a fastener are concentric when they have a common center or axis. *Concentricity* is the term used to describe this condition.

2.4.9 *countersink:* an internal chamfer.

2.4.10 *design size:* size from which the limits of size are derived by the application of tolerances. When there is no allowance, the design size is the same as the basic size.

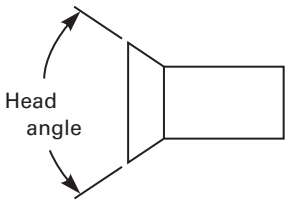
2.4.11 *eccentric, eccentricity:* two surfaces of a fastener are eccentric when they do not have the same center or axis. The amount by which the centers or axes are displaced from each other is called *eccentricity*. This is not to be confused with Full Indicator Movement (FIM). (See also para. 2.4.36, *runout.*)



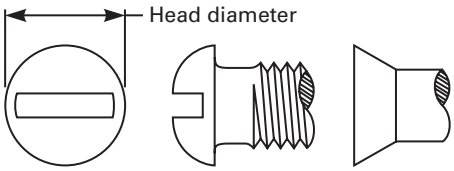
2.4.12 *fit:* the general term used to signify the range of tightness that may result from the application of a specific combination of allowances and tolerances in the design of mating parts.

2.4.12.1 *actual fit:* the relation existing between two mating parts with respect to the amount of clearance or interference that is present when they are assembled.

2.4.13 *head angle:* the included angle of the bearing surface of the head.

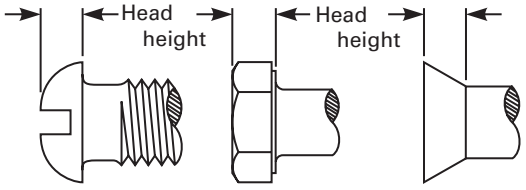


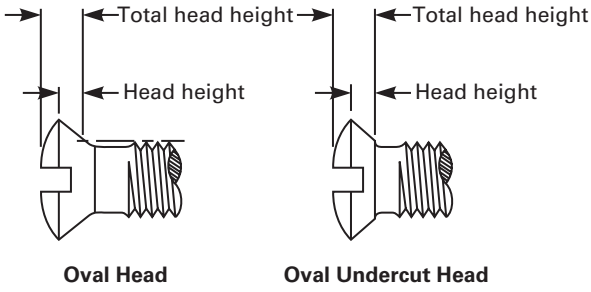
2.4.14 *head diameter:* the diameter at the largest periphery of the head.



2.4.15 *head eccentricity:* the amount that the head of a fastener is eccentric with the fastener body or shank.

2.4.16 *head height:* for a flat bearing surface head, the head height is the overall distance, measured parallel to the fastener axis, from the extreme top to the bearing surface. For a conical bearing surface head, the head height is the overall distance, measured in a line parallel to the fastener axis, from the extreme top to the intersection of the bearing surface with the extended thread major diameter cylinder on a threaded fastener or with the shank on an unthreaded fastener. For flat and oval undercut heads, it is this distance measured to the intersection of the bearing surface with the undercut. For oval heads and undercut oval heads, the overall distance is referred to as total head height.





2.4.17 *head length:* for rectangular or irregular shaped heads, the head length is the distance along the longest axis of the head, measured in a plane perpendicular to the axis of the fastener.

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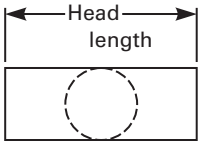
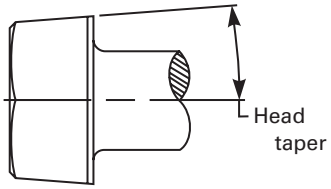
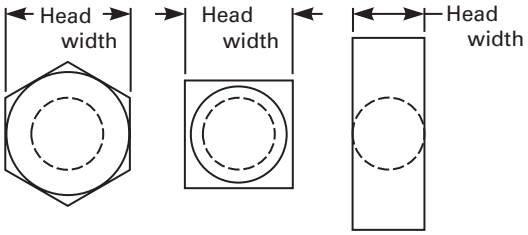


2.4.18 *head taper:* the angle formed by the side or sides of the head and the axis of the fastener. This is not applicable to conventional countersunk heads and should not be confused with head angle.

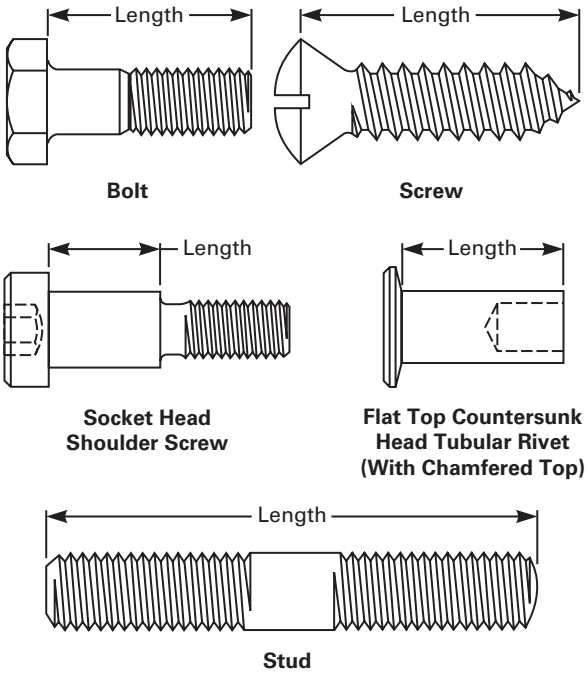


2.4.19 *head width:* the distance across opposite flats of hexagon, square, or 12-point heads measured in a plane perpendicular to the fastener axis. For rectangular or irregular shaped heads, the head width is the distance along the narrowest axis of the head measured in a like manner.



2.4.20 *length:* the length of a headed fastener is the distance from the intersection of the largest diameter of the head with the bearing surface to the extreme point, measured in a line parallel to the axis of the fastener. Exceptions: The length of a shoulder screw and a socket head shoulder screw is the length of the shoulder.

The length of a flat top countersunk head tubular rivet (with chamfered top) is measured from the intersection of the bearing surface with the shank diameter to the extreme point. The length of a headless fastener is the distance from one extreme point to the other, measured in a line parallel to the axis of the fastener.



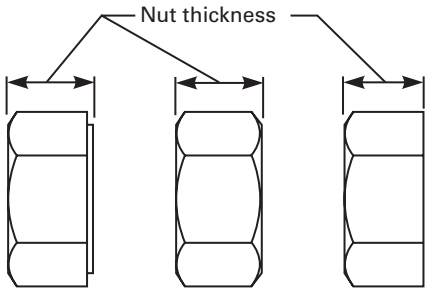
2.4.21 *length of thread engagement:* for two mating threads, the distance between the extreme points of contact on the pitch cylinders or cones, measured parallel to the axis.

2.4.22 *limits of size:* the applicable maximum and minimum sizes (commonly referred to as "limits").

2.4.23 *maximum material condition (MMC):* for a feature of a fastener, the maximum amount of material permitted by the tolerance shown for that feature.

2.4.24 *nominal size:* is the designation used for the purpose of general identification.

2.4.25 *nut thickness:* the overall distance from the top of the nut to the bearing surface, measured parallel to the axis of the nut.



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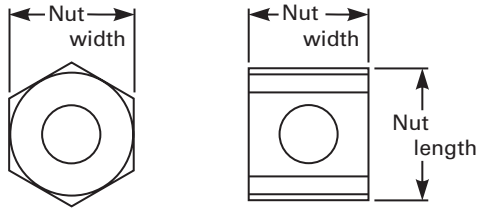
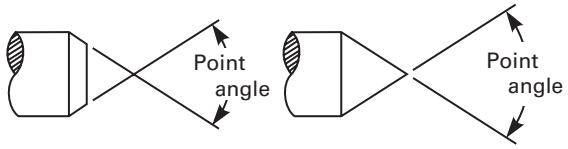
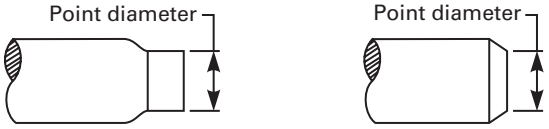
2.4.26 *nut width and length:* the nut width is the distance across opposite flats of hexagon, square, or 12-point nuts. See the following illustration for width and length of rectangular nuts.



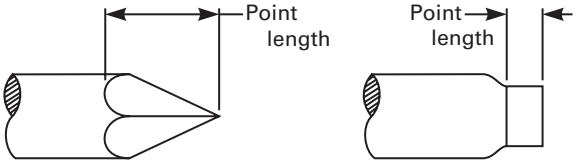
2.4.27 *point angle:* the included angle of the point.



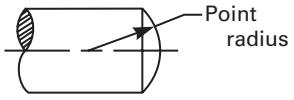
2.4.28 *point diameter:* the diameter of the point measured at the extreme end of the fastener. It may sometimes be designated as "chamfer diameter" or "pilot diameter" on respective point types.



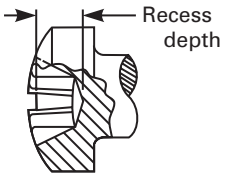
2.4.29 *point length:* the length of the pointed portion of the fastener, measured parallel to the axis of the fastener from the extreme end. It may sometimes be designated as "chamfer length" or "pilot length" on respective point types.



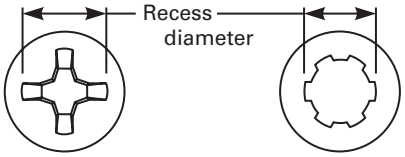
2.4.30 *point radius:* the spherical radius on an oval or spherical point.



2.4.31 *recess depth:* the distance measured parallel to the fastener axis from the intersection of the head surface with the maximum diameter of the recess to the bottom of the recess.

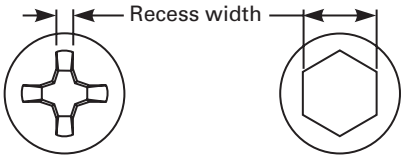


2.4.32 *recess diameter:* the recess diameter is the diameter measured in a plane perpendicular to the axis of the fastener over the intersection of the outermost extremities of the recess with the head surface.



2.4.33 *recess eccentricity:* the amount that a recess in a recessed head is eccentric with the shank of the fastener.

2.4.34 *recess width:* the distance measured in a plane perpendicular to the axis of the fastener across the intersection of the sides or wings of the recess with the head surface.



2.4.35 *reference dimension:* on a fastener is a dimension without tolerance used for informational purposes only.

2.4.36 *runout:* a term frequently used interchangeably with eccentricity but that normally refers to the amount that the outside surface of one component of a fastener runs out with respect to the outside surface of another component. As such, it includes eccentricity, angularity, and bow. The amount of runout is usually expressed in terms of Full Indicator Movement (FIM).

2.4.37 *shank diameter:* the diameter of the shank of an unthreaded fastener. The diameter of the unthreaded portion of a threaded shank is termed the "body diameter." (See also para. 2.4.5, *body diameter.*)

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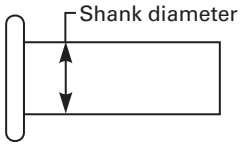
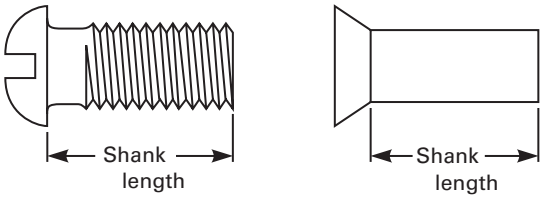
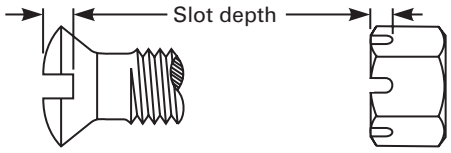


2.4.38 *shank length:* the length of shank, measured parallel to the axis of the fastener.

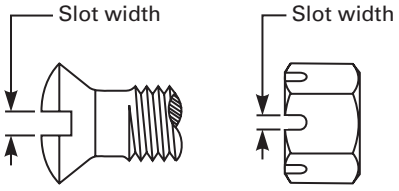


2.4.39 *slot depth:* the slot depth on a headed fastener is the distance measured parallel to the axis of the fastener from the highest part of the head to the intersection of the bottom of the slot with the head or bearing surface. The slot depth on a nut or headless fastener is the distance measured parallel to the fastener axis from the top surface to the extreme bottom of the slot.

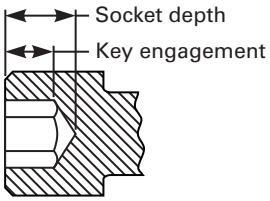


2.4.40 *slot eccentricity:* the amount that a slot in a slotted head is eccentric with the body of the fastener.

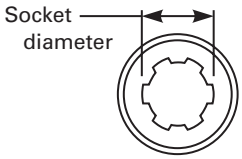
2.4.41 *slot width:* the distance measured in a plane perpendicular to the axis of the fastener over the intersection of the sides of the slot with the head surface of a headed fastener or top surface of a nut.



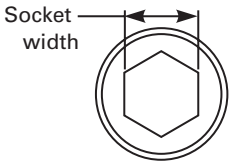
2.4.42 *socket depth:* the distance measured parallel to the fastener axis from the intersection of the socket with the head surface to the extreme end of the socket. In socket head screws, the effective socket depth is most often specified as "key engagement," which is the distance from the intersection of the socket with the head surface to that depth to which the key or wrench will penetrate, measured in a like manner.



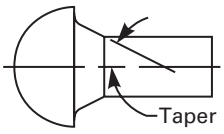
2.4.43 *socket diameter:* the diameter measured in a plane perpendicular to the axis of the fastener over the intersection of the outermost extremities of the socket with the head surface.



2.4.44 *socket width:* the distance measured in a plane perpendicular to the axis of the fastener over the intersection of opposite sides of the socket with the head surface.



2.4.45 *taper:* as used for fasteners, is the angle between one side and the axis of the fastener. Taper may refer to head, shank, or some other feature of a fastener.



2.4.46 Thread Lengths

2.4.46.1 *complete thread:* the length of complete thread is the length of that cross section of a threaded length having full form at both crest and root. Where there is a chamfer at the start of the thread not exceeding two pitches in length, it is included within the length of the complete thread. The thread length on the drawing shall be the gaging length or the length of threads having full form (i.e., the partial threads shall be outside or beyond the length specified).

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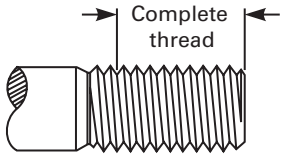
When designing threaded products, it is necessary to take cognizance of: (1) such permissible length of chamfer and (2) the first two threads that by virtue of HI-LO gaging practice may be included within the length of complete thread. However, where the application is such as to require a minimum or maximum number or length of complete threads, the specification shall so state. Similar specification is required for definite length of engagement.



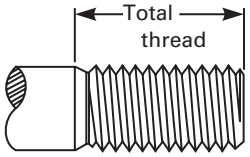
2.4.46.2 *effective thread:* includes the complete thread and that portion of the incomplete thread having fully formed roots but having crests not fully formed; also called a "useful thread."

2.4.46.3 *incomplete thread:* also known as the vanish or washout thread. On straight threads, the incomplete thread is that portion at the end having roots not fully formed by the lead or chamfer on threading tools.

On taper threads, the crest at the end may also be not fully formed due to the intersection of the major cone of an external thread or the minor cone of an internal thread with the cylindrical surface of the work.

2.4.46.4 *thread runout:* see para. 2.4.36, *runout.*

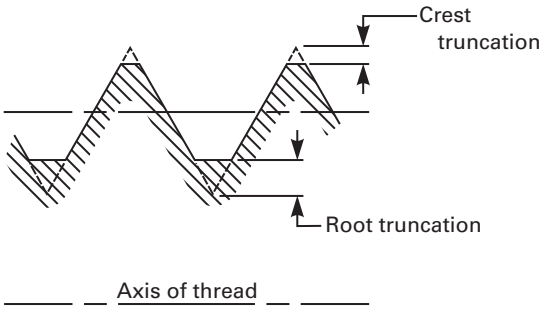
2.4.46.5 *total thread:* includes the complete or effective thread and the incomplete thread.



2.4.47 *tolerance:* the total permissible variation of a size. The tolerance is the difference between the limits of size.

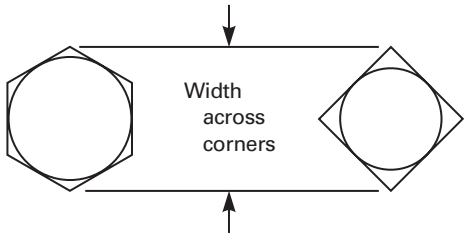
2.4.48 *truncate, truncation:* to truncate is to cut off the apex. Truncation is the axial or centerline length by which the apex is cut off.

2.4.48.1 *crest truncation:* the distance, measured perpendicular to the axis, between the sharp crest (or crest apex) and the cylinder or cone that bounds the crest.

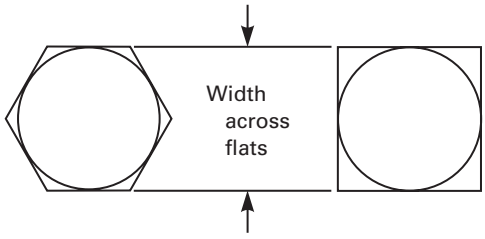


2.4.48.2 *root truncation:* the distance, measured perpendicular to the axis, between the sharp root (or root apex) and the cylinder or cone that bounds the root.

2.4.49 *width across corners:* of hexagon, square, or rectangular shaped fasteners is the distance measured perpendicular to the axis of the fastener from the intersection of two sides to the intersection of the two opposite sides.



2.4.50 *width across flats:* of hexagon or square heads of fasteners is the distance measured perpendicular to the fastener axis across opposite sides of the fastener. (See also para. 2.4.19, *head width,* and para. 2.4.26, *nut width and length.*)



2.5 Terms Relating to the Manufacture of Fasteners

2.5.1 *blank:* the length of wire or rod sheared off as it enters a header to which machine pressures will be subsequently applied to form a part. (See also para. 2.2.2, *blank.*)

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2.5.2 *boltmaker:* a specialized type of transfer header that forms the head on a blank, may trim the head to a required shape, may point the end and roll a thread. (See also para. 2.5.37, *transfer header,* and para. 2.5.9, *cold forming.*)

2.5.3 *broaching:* the process of removing metal by pushing or pulling a cutting tool along the surface.

2.5.4 *burnishing:* the process of producing a smooth surface by rubbing or rolling a tool against the surface.

2.5.5 *burr:* a small amount of material extending out from the edge of a hole, shoulder, etc. as the result of a machining or forming operation.

2.5.6 *chip:* a small fragment of metal removed from a surface by cutting with a tool.

2.5.7 *coining:* a process of forming metal by forcing it to flow while confined within closed dies.

2.5.8 *cold header:* a horizontal machine that is supplied with wire or rod at room temperature and in a continuous manner produces parts by applying machine pressure to cause the metal to flow and form a given configuration. Machines that are used in this process are classified by the number of blows they deliver to each workpiece and the types of dies used to hold and shape the blank.

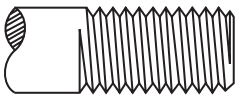
2.5.9 *cold forming (cold heading):* a process at room temperature that includes heading, upsetting, extrusion, and forging in a cold header, bolt maker, or parts former.

2.5.10 *cold working fillets:* application of machine pressures that produces compression of the outer metal fibers in the fillet. This process will improve the fatigue strength.

2.5.11 *counterboring:* the process of enlarging for part of its depth a hole previously formed and to provide a shoulder at the bottom of the enlarged hole. Special tools called counterbores are generally used for this operation.

2.5.12 *countersinking:* the process of beveling or flaring the end of a hole. Holes in which countersunk head type fasteners are to be used must be countersunk to provide a mating bearing surface.

2.5.13 *cut thread:* a thread produced by removing material from the surface with a form cutting tool.



Cut Thread

2.5.14 *drilling:* the process of forming holes by means of specialized cutting tools called drills.

2.5.15 *embossing:* the process of raising a boss or protuberance on the surface.

2.5.16 *extruding:* the process of reducing the size of some feature or diameter by forcing it through a die.

2.5.17 *facing:* the machining operation on the end, flat face, or shoulder of a fastener.

2.5.18 *flash:* the thin fin of metal along the sides or around the edges of a forged or upset section. It is caused when metal flows out between the edges of the forging dies.

2.5.19 *forging:* the process of forming a product by hammering or pressing. When the material is forged below the recrystallization temperature it is said to be cold forged. When worked above the recrystallization temperature it is said to be hot forged.

2.5.20 *grinding:* the process of removing material from the surface by the cutting action of a bonded abrasive wheel.

2.5.21 *ground thread:* a thread finished on the flanks by a grinding operation.

2.5.22 *header:* a specialized form of horizontal press.

2.5.23 *heading:* a manufacturing process involving the use of a header. This process may or may not involve upsetting or extruding. A part made from wire below the recrystallization temperature is said to be cold headed whereas parts made from wire above the recrystallization temperature are said to be hot headed.

2.5.24 *knurling:* the process of producing a roughened surface by means of a specialized forming tool called a knurl.

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2.5.25 *machining:* the process of forming the surface by cutting away material.

2.5.26 *milled from the bar:* fasteners machined from bar stock on a lathe, screw machine, etc.

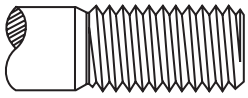
2.5.27 *nut former:* a transfer-type header that in successive steps makes a square or hexagon nut with a hole ready for threading.

2.5.28 *pointing:* a secondary machining operation consisting of cutting points on fastener blanks that were not pointed during the heading operation.

2.5.29 *polishing:* the process of producing a smooth surface by rubbing with fine abrasive wheels, belts, or compounds.

2.5.30 *punching:* the process of trimming or removing material with dies in a press.

2.5.31 *rolled thread:* a thread produced by the action of a form tool that when pressed into the surface of a blank displaces material radially.



Rolled Thread

2.5.32 *scale:* an oxide of iron sometimes formed on the surfaces of hot headed or forged fasteners.

2.5.33 *shaving:* a cutting operation in which thin layers of material are removed from the outer surfaces of the product.

2.5.34 *shot peening:* a cold working process in which the surface of a part is bombarded with small spherical media called shot.

2.5.35 *sliver:* an irregular shaped piece of metal clinging loosely to the finished fastener.

2.5.36 *slotting:* the process of forming or cutting the slot on the head of a fastener during either the primary or secondary operation.

2.5.37 *transfer header:* a multiple-solid die (usually three or four dies) cold header with a separate heading hammer for each die. The blank is transferred automatically between blows.

2.5.38 *trimming:* the term applied to the process of shaping or sizing by forcing a part through a die of desired size and shape.

2.5.39 *tumbling:* the process of cleaning or abrading parts in a rotating container, either with or without cleaning or abrasive materials.

2.5.40 *upsetting:* the process of increasing the cross sectional area by displacement of material longitudinally and radially.

2.5.41 *warm forming:* carried out below the critical temperature and does not alter the metal's properties. Typically the range of temperature is from 200°F to 1,000°F and is used for metals that work harden severely.

2.6 Fastener Performance Terminology

2.6.1 *cone proof load:* the axially applied load using a conical washer (defined in ASTM F 606 and ASTM F 606M) and threaded mandrel that a nut must withstand, without evidence of thread stripping or wall rupture.

2.6.2 *ductility:* the ability of a fastener to deform prior to fracture.

2.6.3 *fatigue strength:* the maximum load a fastener can withstand for a specified number of repeated applications before its failure.

2.6.4 *hardness:* a measure of the fastener material's ability to resist abrasion, indentation, and a tension applied load.

2.6.5 *proof load:* the tension-applied load that the fastener must support without evidence of permanent deformation.

2.6.6 *shear strength:* the maximum load applied normal to a fastener's axis, that can be supported prior to fracture.

2.6.7 *tensile strength:* the maximum tension applied load a fastener can support prior to or coincident with its fracture.

2.6.8 *torsional strength:* a load usually expressed in terms of applied torque at which a fastener fails by being twisted apart about its axis.

2.6.9 *toughness:* the fastener's ability to sustain impact and shock loading usually stated as impact strength.

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2.6.10 *yield strength:* the tension-applied load at which the fastener experiences a specific amount of permanent deformation.

2.7 Terms Relating to Material and Heat Treatment of Fasteners

2.7.1 *alloy steel:* a steel containing elements other than carbon that have been added to obtain definite mechanical or physical properties, such as higher strength at elevated temperatures, toughness, etc.

2.7.2 *annealed:* a fastener is considered in the annealed state when it has been heated at a given temperature for a given time and cooled at a given rate to make it soft; that is, free of hardness caused by working or previous heat treatment.

2.7.3 *carbon steel:* a steel that does not contain any substantial amounts of alloying materials other than carbon.

2.7.4 *case hardened:* a fastener of ferrous material having a surface that has been made harder than the core. (See also para. 2.8.21, *surface treatment,* and para. 2.8.20, *surface heat treatment.*)

2.7.5 *cold heading stock:* material produced under closely controlled manufacturing and inspection methods so as to be suitable for heading and to be free from those defects causing fractures during heading.

2.7.6 *decarburized:* a fastener has a decarburized surface when the carbon content of the surface is lower than the carbon content of the core.

2.7.7 *grains:* the individual crystals of the material.

2.7.8 *inclusions:* particles of nonmetallic impurities contained in material.

2.7.9 *laps:* longitudinal surface defects caused by folding over fins or sharp corners into the surface of the material.

2.7.10 *pits:* sharp depressions on the surface of a raw material or fastener.

2.7.11 *screw stock:* metal in the form of wire or rod that is used for making screw machine parts. Usually it is of a free machining type of material.

2.7.12 *soft:* describes the condition of a fastener that, though made from a material that can be, and normally is, hardened by heat treatment, has been left in the as-fabricated temper.

2.7.13 *stainless steel:* a corrosion-resistant type of alloy steel that contains a minimum of 12% chromium.

2.7.14 *strain hardening:* the increase in hardness, and hence strength, resulting from plastic deformation at a temperature below the recrystallization range. Sometimes called "work hardening."

2.7.15 *temper:* the state of a metal or alloy involving its structure and mechanical properties. Temper varies from the annealed temper (soft) to spring temper.

2.7.16 *toughness:* the ability of a material to absorb considerable energy without fracturing.

2.7.17 *voids:* internal fissures in ferrous materials. They are sometimes called "chrom checks," "fish eyes," "shatter cracks," and "snow flakes."

2.7.18 *work hardening:* see para. 2.7.14, *strain hardening.*

2.8 Coatings and Finish Terminology

The following terms are commonly used in designating the various finishes applied to fasteners.

2.8.1 *anodizing:* the formation of an oxide film on the surface by means of an anodic treatment. This is commonly used on aluminum.

2.8.2 *black oxide:* a black finish on a fastener produced by immersing it in hot oxidizing salts or salt solutions.

2.8.3 *coating:* the application of some material such as a metal, organic compound, etc. to the surface of a fastener.

2.8.4 *chromate treatment:* a treatment of a fastener in a hexavalent chromium compound solution to produce a conversion coating.

2.8.5 *dichromate treatment:* a chromate conversion coating produced on fasteners in a hot solution of sodium dichromate at a specified temperature.

2.8.6 *dry film lubricant:* a dry solid substance that is applied to a fastener surface for the purpose of reducing friction or wear between the fastener and its mating surfaces. Natural dry film lubricants include graphite and MoS2.

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2.8.7 *electrogalvanizing:* the process of coating metal with zinc by electroplating.

2.8.8 *electroplating:* the process of electrodepositing a metal or alloy on a fastener serving as a cathode.

2.8.9 *finish:* a term commonly applied to the condition of the surface of a fastener as a result of chemical or organic treatment subsequent to fabrication. The term finish is also applied to some types of fasteners to indicate the condition of the surface as a result of mechanical operations and the degree of precision.

2.8.10 *flash plating:* a very thin deposit of metal, whose thickness is in the range of 0.00005 to 0.00015 in.

2.8.11 *galvanizing:* the process of coating metal with zinc by hot-dipping or immersion process sometimes referred to as hot-dip galvanizing.

2.8.12 *mechanical plating:* a plating process where fine metal powders are peened onto the fastener by tumbling or other mechanical means.

2.8.13 *oiled:* the term denoting the application of a suitable corrosion retarding oil to a fastener.

2.8.14 *organic compound:* a coating based on organic binders that are applied to fasteners for decorative, protective, or functional purposes. The general terms "organic coating" and "paint" are essentially interchangeable.

2.8.15 *passivating:* the process of dissolving ferrous particles and surface impurities from stainless steel by chemical means (normally a nitric acid dip) and to improve the corrosion resistance of the surface.

2.8.16 *phosphate coating:* the treatment of a metal with a dilute solution of phosphoric acid and other chemicals to produce a base layer of crystalline phosphate. Phosphate coatings generally consist of three principal types: zinc, iron, and manganese phosphate.

2.8.17 *pickling:* the process of removing surface oxides or impurities by chemical or electrochemical means.

2.8.18 *plain:* the term, as applied to finish of fasteners, is used to indicate that the fastener has had no supplementary surface treatment such as plating, coating, etc., other than being oiled.

2.8.19 *plating:* the application of a metallic deposit on the surface of the fastener by electrolysis, coating, etc., other than being oiled.

2.8.19.1 *plating build-up:* the term used to describe the disposition of more plating on edges or corners than on the other surfaces of the fastener.

2.8.20 *surface heat treatment:* a process that improves the hardness or other mechanical properties of the fastener in any surface area. (*Surface heat treatment* and *case hardened,* para. 2.7.4, are special forms of *surface treatment,* para. 2.8.21.)

2.8.21 *surface treatment:* any treatment that changes the chemical, physical, or mechanical properties of a surface. (See also para. 2.7.4, *case hardened* and para. 2.8.20, *surface heat treatment.*)

2.9 Quality Assurance Including Inspection Terminology

2.9.1 *acceptable quality level (AQL):* maximum percentage of defects that, for purposes of sampling inspection, can be considered satisfactory as a process average.

2.9.2 *applicable characteristics:* include all characteristics of a fastener that are described by engineering drawings and related standards and/or specifications.

2.9.3 *control plan:* a written plan outlining the fastener manufacturing process and its control points that provides an orderly documented procedure for controlling and minimizing process and product variation. Typically the control plan identifies actions at each phase of the manufacturing process including receiving, in-process manufacturing, and outgoing operations. Continuing versus periodic requirements are identified, and strategies provided for continued updating and improvement.

2.9.4 *designated characteristic:* required to be inspected and documented by the source for each lot.

2.9.5 *dud:* an incomplete, mutilated, or foreign part.

2.9.6 *in-process inspection:* inspection at each machine or processing station to verify conformance of the characteristics imparted by that machine or process.

2.9.7 *inspection level:* the relative importance assigned to a given fastener characteristic that relates to the sample size used for inspection of that characteristic for a given lot size.

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2.9.8 *lot:* a group of fasteners having the same geometry/configuration made of the same heat of material and processed together at the same time.

2.9.9 *lot number:* an identification assigned by a fastener manufacturer that identifies the number of pieces, processing, forming operations, and raw material heat number and plant and date of manufacture.

2.9.10 *major characteristic:* materially affects the usability of the fastener for its intended application.

2.9.11 *major defect:* a defect that could produce a failure or materially reduce or eliminate the usability of the fastener in the intended application.

2.9.12 *minor characteristic:* does not materially affect the usability of the fastener for its intended application.

2.9.13 *minor defect:* does not materially reduce the usability of the fastener.

2.9.14 *quality:* the suitability of a fastener for its intended application established by the accuracy of manufacture within specified tolerances, limits, and other requirements.

2.9.15 *quality assurance:* the selection and application of an inspection plan to establish the acceptability of a lot of fasteners.

2.9.16 *source:* the manufacturer or private label distributor of the fastener.

2.9.17 *third party accreditation:* certification of a quality system by a third party utilizing independent audits under the provisions of a fastener accreditation plan published by a consensus standards organization. See ASME FAP-1.

2.9.18 *zero acceptance:* a finding of zero defects when a statistically valid sample has been inspected for a given lot.

2.10 Packaging

2.10.1 *blister pack:* preformed hard plastic shell configured to contain hardware items and fixed to a backing card.

2.10.2 *bulk packing:* predetermined quantities of fasteners, uniformly processed, and placed into a single container of corrugated or plastic materials, properly sealed and labeled for marketing.

2.10.3 *carton:* small container, usually made of cardboard, containing a predetermined number of fasteners uniformly processed, sealed, and labeled for marketing purposes.

2.10.4 *case:* a container usually made of cardboard of a predetermined size for stacking cartons of fasteners in logical fashion with little or no void and sealed and labeled for marketing purposes.

2.10.5 $\frac{1}{4}$ *keg:* standard industry bulk container of inside dimensions 9 in. × 9 in. × $6\frac{5}{8}$ in. yielding 535 cu. in. of volume for fasteners uniformly processed, sealed, and labeled for marketing.

2.10.6 *package:* act or process of packing fasteners that are prepared for storage or shipment. A unit of a product uniformly processed, wrapped, or sealed in a container and labeled for marketing; that in which anything is packed; a box, case, carton, etc. in which fasteners are packed.

2.10.7 *packaged goods:* predetermined number of uniformly processed fasteners placed in cartons and/or cases sealed and labeled for marketing purposes.

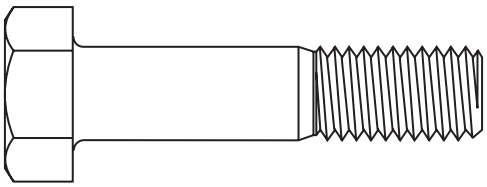
2.10.8 *poly bag:* flexible plastic material formed in a bag shape to contain specific fastener parts. This bag is normally heat sealed.

3 PRODUCT FAMILIES

3.1 Externally Threaded Products

3.1.1 Bolts

3.1.1.1 *bolt:* an externally threaded product designed for insertion through holes in assemblies to mate with a nut and normally intended to be tightened or released by turning that nut. The only bolt that has a washer face is the heavy hex structural bolt.



Bolt

3.1.1.2 *anchor bolt:* a bar or rod with one end bent or having a welded attachment to expand or enlarge its imbedded contact with the concrete for the purpose of stress distribution resulting from the loading transmitted from the other threaded end. The threaded

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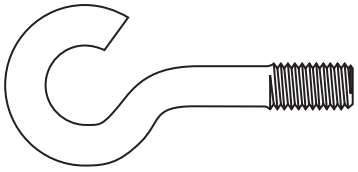
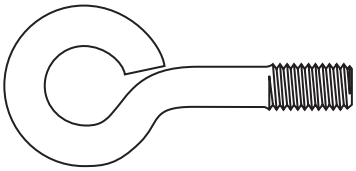
end projects above the concrete and generally holds a structural plate in position to which other structural members are attached.

3.1.1.3 *bent bolt:* formed from a cylindrical rod having one or both ends threaded and bent into configurations called "U," "eye," "hook," or "J."

3.1.1.3.1 *eye bolt:* has a closed or open anchor ring for its head with threads only on its straight shank.

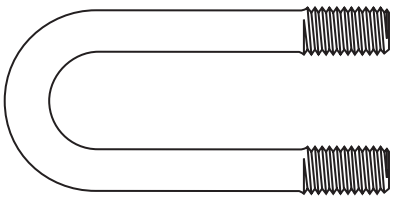


Eye Bolt, Open Anchor Ring

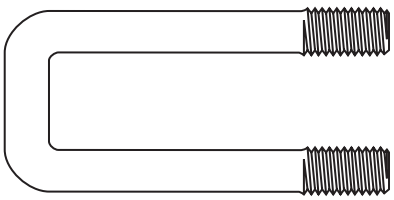


Eye Bolt, Closed Anchor Ring

3.1.1.3.2 *U-bolt:* has a round or square bend with threads on both ends of its shanks.

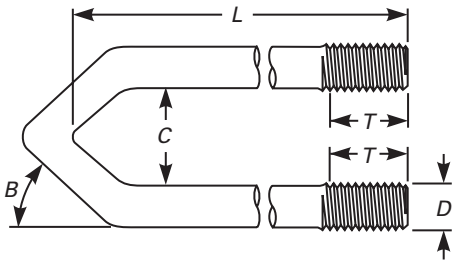


U-Bolt, Round Bend

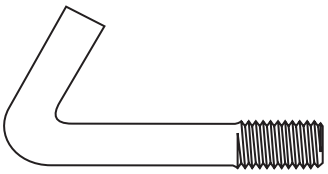


U-Bolt, Square Bend

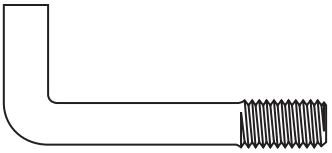
3.1.1.3.3 *U-Bolt, Vee Bend:*



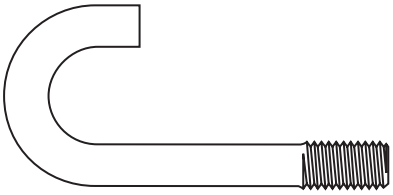
3.1.1.3.4 *hook bolt:* may have a round, square, right angle, or acute angle bend with threads only on one end that is that of the unbent shank.



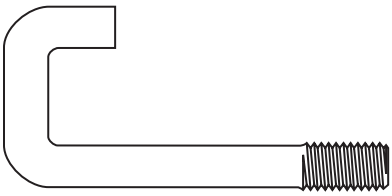
Hook Bolt, Acute Angle Bend



Hook Bolt, Right Angle Bend



Hook Bolt, Round Bend



Hook Bolt, Square Bend

3.1.1.3.5 *J-bolt:* has an offset round bend approximating a semicircle with threads on the straight shank.

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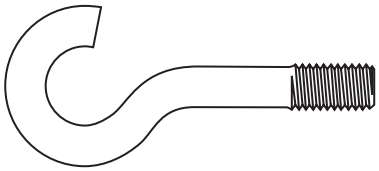
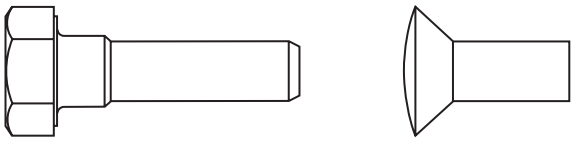


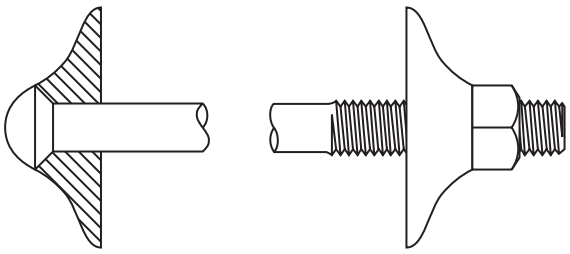
J-Bolt, Offset Round Bend

3.1.1.4 *bolt blank:* a rod or bar that has a head configuration formed but has no threads and is intended to be cut off as necessary and threaded at a time other than that of the initial forming operation.



Bolt Blank or Screw Blank

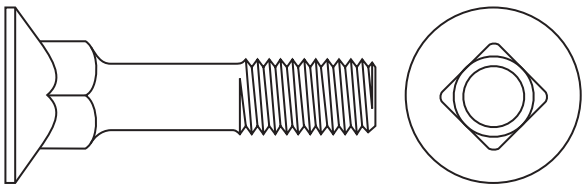
3.1.1.5 *building roof bolt:* used to provide a water tight seal on building roofs and features a specialized washer that is extruded during tightening to form a water tight joint.



Bridge or Roof Bolt

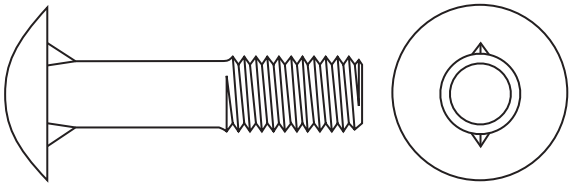
3.1.1.6 *carriage bolt:* has a circular, oval, or flat head with a square, fin, or ribbed neck intended to prevent rotation during tightening.

3.1.1.6.1 *countersunk head square neck bolt:* has a flat top, conical bearing surface, and a square shoulder under the head.



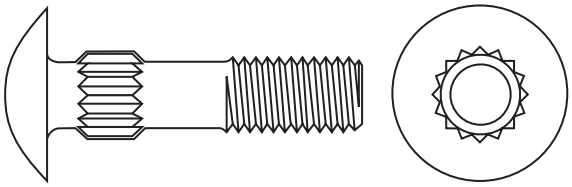
Countersunk Head Square Neck Bolt

3.1.1.6.2 *round head fin neck bolt:* has two fins, 180 deg apart, under the head.



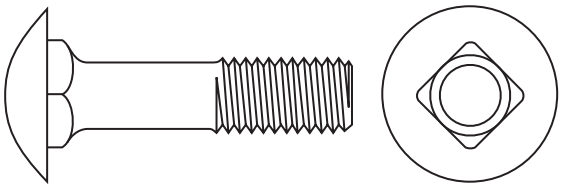
Round Head Fin Neck Bolt

3.1.1.6.3 *round head ribbed neck bolt:* has a ribbed or serrated shoulder under the head.



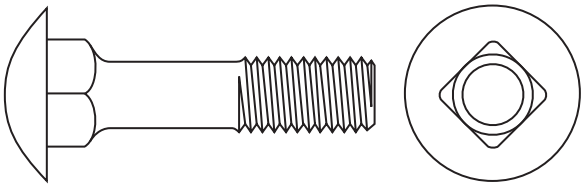
Round Head Ribbed Neck Bolt

3.1.1.6.4 *round head short square neck bolt:* has a short square shoulder under the head. It is designed for use in sheet metal where a full square shoulder would project through and present an obstruction.



Round Head Short Square Neck Bolt

3.1.1.6.5 *round head square neck bolt:* has a square shoulder under the head. It is designed for use in wood.



Round Head Square Neck Bolt

3.1.1.7 *connecting rod bolt:* a bolt commonly having a chamfered, round head with a flat side or other feature for preventing the bolt from turning. It is occasionally provided with a transverse hole through the thread and a chamfer or oval point. The bolt is

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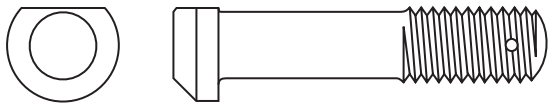
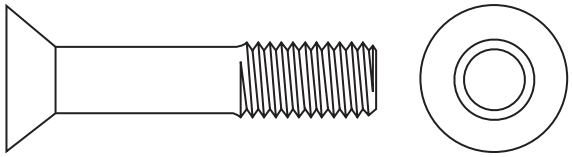
designed for use in assembling the connecting rod and bearing cap of a reciprocating engine.



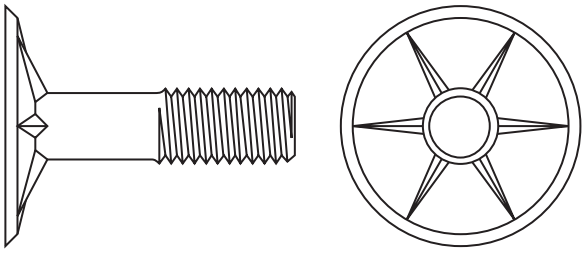
Connecting Rod Bolt

3.1.1.8 *countersunk bolt:* a bolt having an unslotted circular flat top and a conical bearing surface tapering inward from the top.

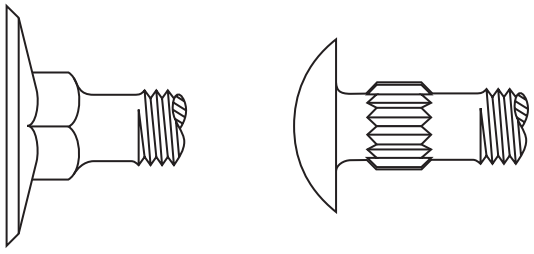


Countersunk Bolt

3.1.1.9 *elevator bolt:* has a thin circular head of large diameter with an oval or flat head profile and a means similar to the carriage bolt to prevent rotation when installed in flooring or similar application.



Countersunk, Ribbed Head



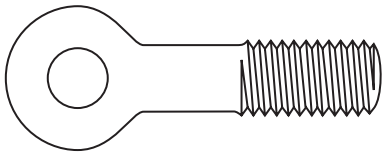
Countersunk Head, Square Neck

Round Head, Ribbed Neck

Elevator Bolts

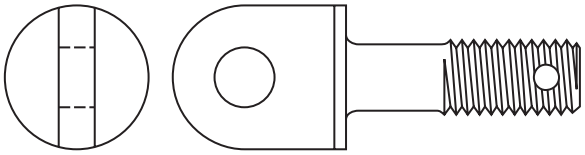
3.1.1.10 *expansion bolt:* see para. 3.4.4, *expansion fastener.*

3.1.1.11 *eye bolt:* a bolt having a head in the form of an open or closed anchor ring or of a flattened or pierced section. (See also para. 3.1.1.3.1, *eye bolts.*)



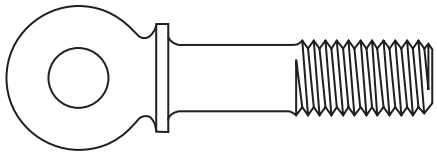
Eye Bolt

3.1.1.11.1 *aircraft eye bolt:* has a somewhat different design than the drop bolt pictured in para. 3.1.1.11.3 but basically performs the same function for aircraft applications as the drop bolt does for marine applications.



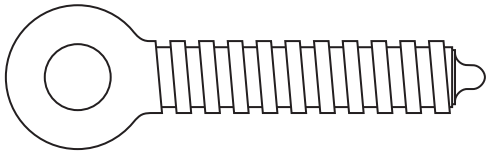
Aircraft Eye Bolt

3.1.1.11.2 *collared eye bolt or shouldered eye bolt:* has a collar or shoulder machined or formed at the juncture of the "head eye" with the bolt shank to limit the amount of penetration into the mating part.



Collared Eye Bolt

3.1.1.11.3 *drop bolt:* a type of eye bolt commonly threaded with either an Acme or Unified form of thread, and assembled with a wing nut or hexagon nut. The shank may be drilled for a cotter pin. The bolt is used for clamping purposes, particularly for bulkhead doors and porthole covers on ships. (See also para. 3.1.1.11.1, *aircraft eye bolt.*)



Drop Bolt

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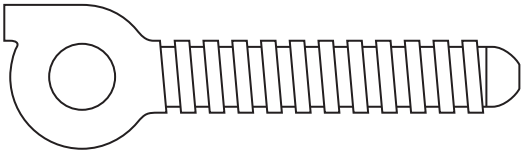
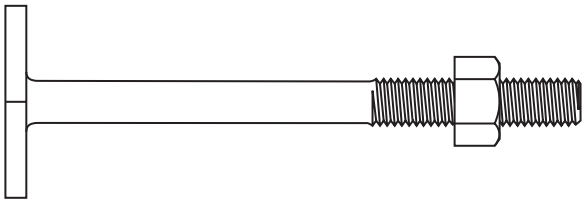


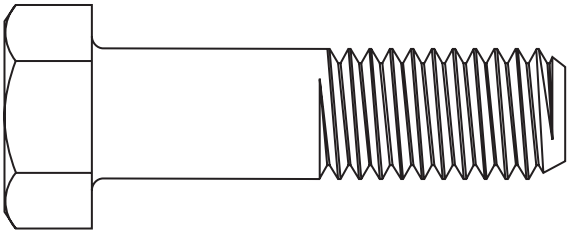
Shoulder Head Type Drop Bolt

3.1.1.12 *fire-brick anchor bolt:* has a large low square head. It is designed for use as a masonry support.



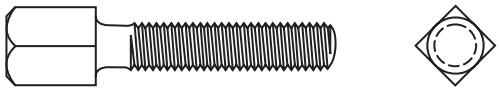
Fire-Brick Anchor Bolt

3.1.1.13 *fitting-up bolt:* has a square or hex head and a coarse pitch, 60 deg stub thread. It is designed for use in the preliminary placement/assembly of structural steel.



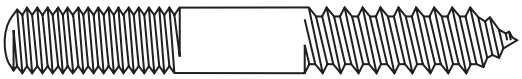
Fitting-Up Bolt

3.1.1.14 *forcing bolt:* resembles a square head set screw but having a high head. It is used for adjusting and locating purposes when there is considerable resistance to motion.



Forcing Bolt

3.1.1.15 *hanger bolt:* one end is gimlet pointed and has wide spaced threads similar to a lag bolt for wood installation. The other end has unified coarse threads for use with a nut. The center section may be plain or made with a square or ribbed shoulder.

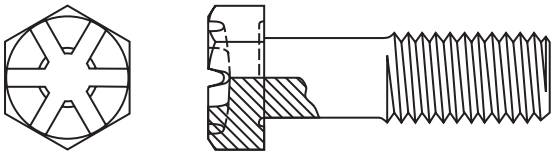


Plain Body Type Hanger Bolt



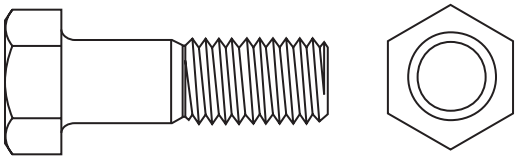
Ribbed Shoulder Body Type Hanger Bolt

3.1.1.16 *head locking bolt:* has added deflection as the result of the design of the head. (See also para. 3.1.2.9, *head locking screw;* para. 3.1.2.10, *insert screw;* and para. 3.1.2.23, *thread locking screw.*)



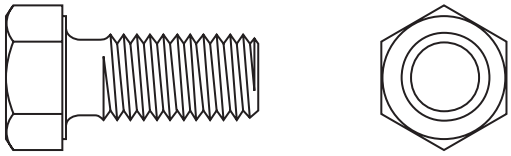
Head Locking Bolt

3.1.1.17 *hexagon head bolt:* has a hexagon shaped head for external wrenching that is intended to resist bolt rotation while it is being tightened up with a nut.



Hexagon Head Bolt

3.1.1.18 *high strength structural bolt:* has a heavy hex head configuration, controlled thread length, a washer face under its head and distinctive markings in accordance with ASTM Standard A 325, A 325M, A 490, or A 490M.



Clearance Type High Strength Bolt

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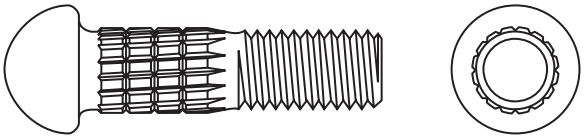
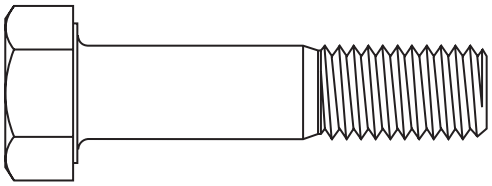
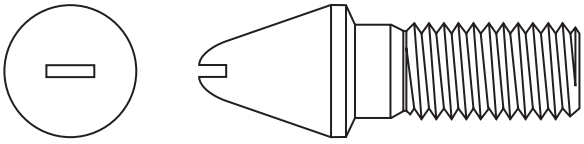


Bound-Body Type High Strength Bolt



Heavy Hex Structural Bolt

3.1.1.19 *hood latch bolt:* has a truncated, cone shaped, slotted, or plain head. It is designed for use in the latching mechanism of automobile engine compartment hoods.

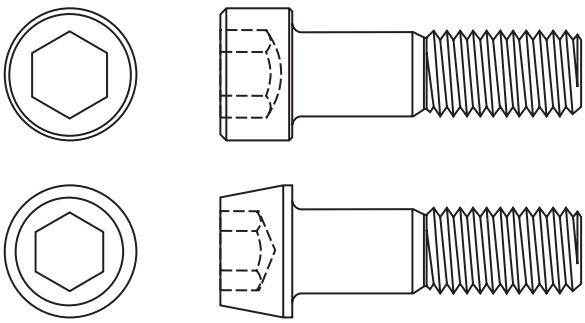


Hood Latch Bolt

3.1.1.20 *hook bolt:* a bent bolt (see para. 3.1.1.3) having a threaded and unthreaded end. The unthreaded end is bent to form a hook.

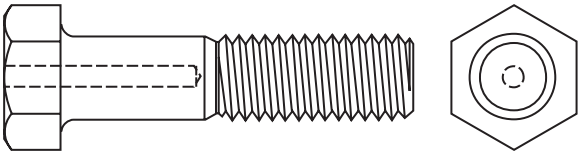
3.1.1.21 *interference body bolt:* see para. 3.1.1.32, *interference fit body bolt.*

3.1.1.22 *internal wrenching bolt:* has a large cylindrical head with flat top, flat bearing surface, and hexagon socket. The bolt is designed for use in high strength, high temperature applications such as steam turbines. A bolt designated as an Internal Wrenching Bolt is used in aircraft. It has a head that is a truncated cone, indicative of a large radius between the shank and the head, requiring the use of a countersunk washer.



Internal Wrenching Bolts

3.1.1.23 *internally relieved body bolt:* has an axial hole drilled through the head and through a portion of its body.

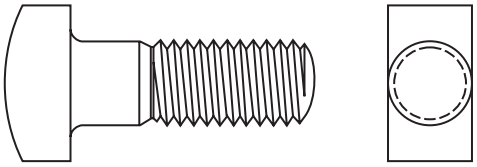


Internally Relieved Body Bolt

3.1.1.24 *J-bolt:* see para. 3.1.1.3.5.

3.1.1.25 *machine bolt:* has a conventional head such as a square, hexagon, button, or countersunk type, and a cylindrical body below the head. It is designed for general use in machine and other types of construction. Machine bolts are supplied with nuts unless otherwise specified.

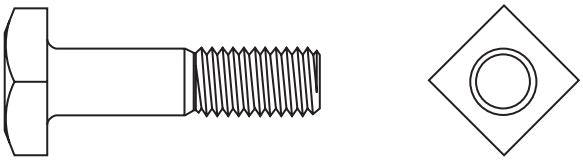
3.1.1.26 *meter bolt:* has a rectangular (T) head equal in width to the body diameter and two or three times as long as it is wide. The bolt is commonly made of silicon bronze. It is designed to hold gas and water meters together.



Meter Bolt

3.1.1.27 *mine roof bolt:* has threads at one end and a device (expansion shell) that expands upon tightening to hold it in a drilled hole and prevent rotation. A bearing plate or plate washer on the exposed end serves to distribute the loading over a broad area providing roof support.

3.1.1.28 *planer bolt:* has a large, low, square head. It is designed for insertion in the T-slots of planer, shaper, or milling machine tables.



Planer Bolt

3.1.1.29 *plow bolt:* has a countersunk head with a feature under the head or on the shank to prevent rotation.

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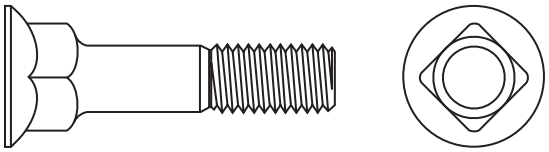
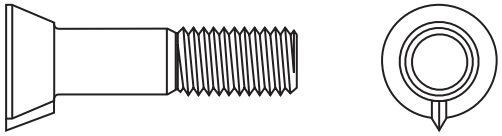
3.1.1.29.1 *round countersunk head square neck plow bolt (no. 3 head):* has a round countersunk head with an 80 deg head angle (90 deg head angle for metric) and a short square neck to prevent rotation.



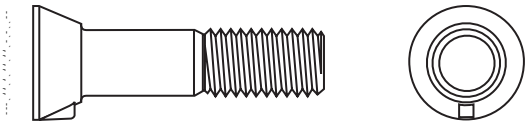
Round Countersunk Head Square Neck Plow Bolt

3.1.1.29.2 *round countersunk heavy key head plow bolt (no. 6 head):* has a round countersunk head with a 40 deg head angle and a triangular shaped key on one side to prevent rotation.



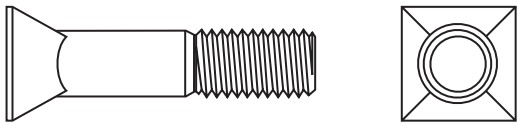
Round Countersunk Heavy Key Head Plow Bolt

3.1.1.29.3 *round countersunk reverse key head plow bolt (no. 7 head):* has a round countersunk head with a 60 deg head angle (90 deg head angle in metric for sizes less than M20) and a rectangular key on one side to prevent rotation.



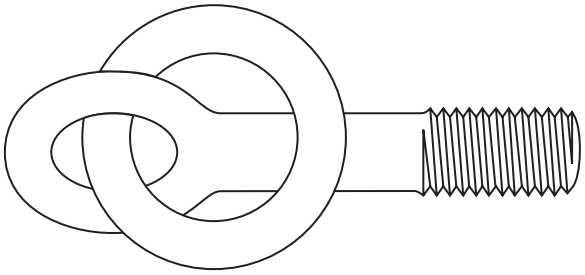
Round Countersunk Reverse Key Head Plow Bolt

3.1.1.29.4 *square countersunk head plow bolt (no. 4 head):* has a square pyramidal shaped head with an 80 deg head angle in which the corners of the square prevent rotation.



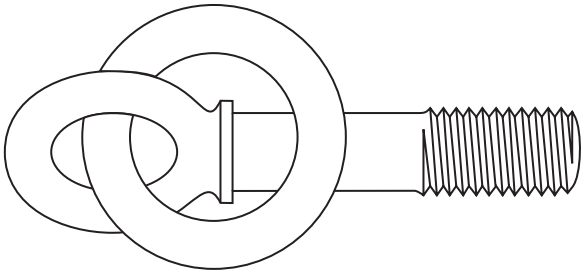
Square Countersunk Head Plow Bolt

3.1.1.30 *plain nut ring bolt:* a threaded eye bolt preassembled with a ring through the eye.



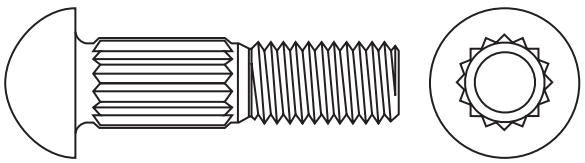
Plain Nut Ring Bolt

3.1.1.31 *shouldered nut ring bolt or collared nut ring bolt:* the same as the plain nut ring bolt above except that the bolt is a threaded collared or shouldered eye bolt. Used often in marine applications. (See also para. 3.1.1.11.2, *collared eye bolt or shouldered eye bolt.*)



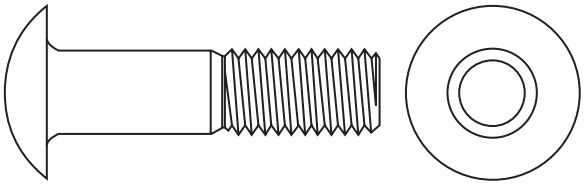
Collared Nut Ring Bolt

3.1.1.32 *interference fit body bolt:* a bolt having a button head, a ribbed shank, and a coarse thread, or a special thread. It is designed as a substitute for rivets in structural steel.



Interference Fit Body Bolt

3.1.1.33 *round head bolt:* a machine bolt having a plain circular head with an oval top.



Round Head Bolt

3.1.1.34 *reduced body bolt:* has all or a portion of the unthreaded shank whose diameter is less than the minimum pitch diameter of the thread.

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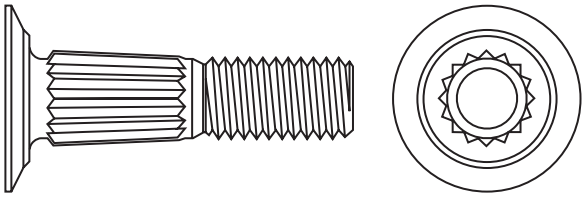
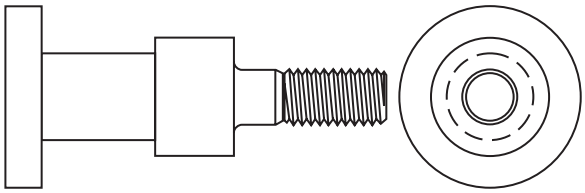
3.1.1.35 *seal bolt:* has straight or helical flutes on the body; the heads are of various designs. It is designed for railroad car floor and similar applications to prevent leakage of water.



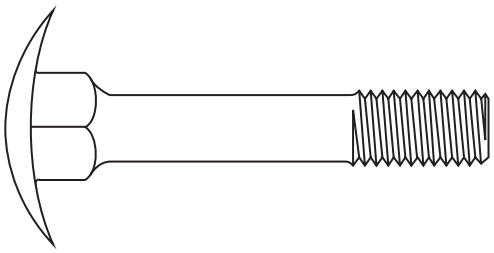
Seal Bolt

3.1.1.36 *securing bolt:* has a cylindrical head and a cylindrical shoulder on the shank. It is designed for use in securing ship decks.



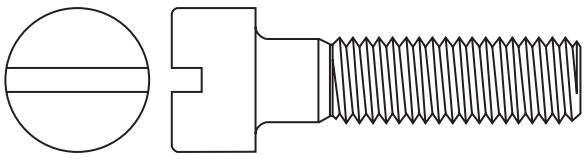
Securing Bolt

3.1.1.37 *shaft bolt:* a bolt having an elongated head curved to fit a round form and with or without a square neck.



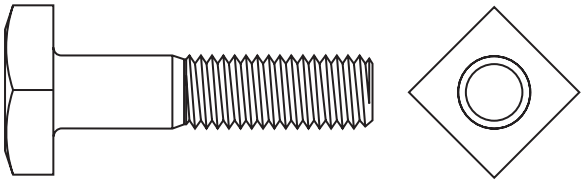
Shaft Bolt

3.1.1.38 *spring center bolt:* has a cylindrical slotted or unslotted head for holding the leaves of a vehicle spring together. When provided with a conical point (usually 80 deg included angle) it is known as a "universal spring center bolt." (See also para. 3.1.2, *screws.*)



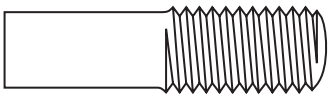
Spring Center Bolt

3.1.1.39 *square head bolt:* has a square shaped external wrenching head of standard proportions.



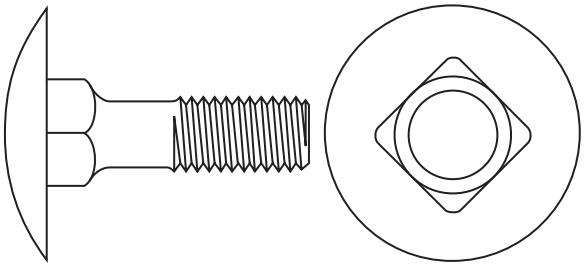
Square Head Bolt

3.1.1.40 *stay bolt:* an iron or mild steel rod, commonly having a reduced diameter body or sometimes a continuous thread. It is designed for use in bracing the flat surfaces of boilers, particularly in fire-box boilers, and in all boilers of the locomotive type to tie the fire-box to the external shell. The bolts are screwed through tapped holes in the sheets or plates and allowed to project far enough at each end to permit riveting cold with shallow round heads.



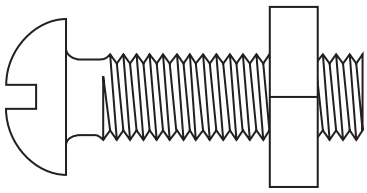
Stay Bolt

3.1.1.41 *step bolt:* a round head square neck bolt having an extra large head diameter and thin head. This fastener is designed for use in fastening flooring, step treads, etc.



Step Bolt

3.1.1.42 *stove bolt:* a former commercial standard having fractional sizes of $\frac{1}{8}$-32, $\frac{5}{32}$-28, $\frac{3}{16}$-24, $\frac{7}{32}$-22, and $\frac{1}{4}$-18. It is now supplied as the equivalent machine screw with nut. (See also para. 3.1.2.13, *machine screw.*)



Stove Bolt

3.1.1.43 *stripper bolt:* see para. 3.1.2.20, *socket head shoulder screw.*

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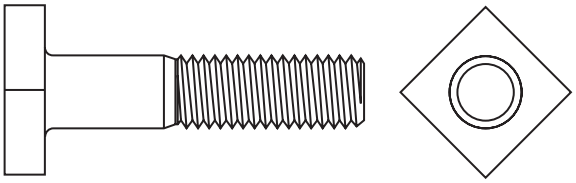
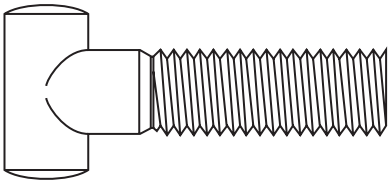
3.1.1.44 *structural bolt:* see para. 3.1.1.25, *machine bolt.*

3.1.1.45 *T-bolt:* a finished bolt with a square head. It is designed for holding fixtures and other accessories in the T-slots of machine tools.

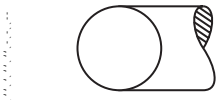


T-Bolt

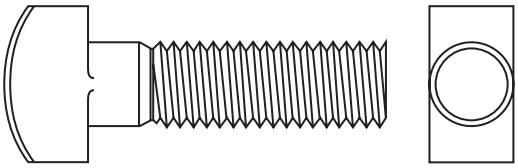
3.1.1.46 *round section T-bolt:* has an oblong head consisting of a cylindrical rod, usually of the same diameter as the bolt, which is forged or welded perpendicular to the body. Such bolts are commonly used as ends for automotive gasoline tank straps or for clamping purposes.



Round Section T-Bolt

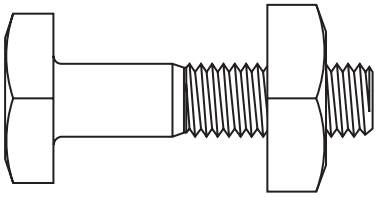


3.1.1.47 *T-head bolt:* a bolt similar to a machine bolt, which has an oblong head with a convex cylindrical top.



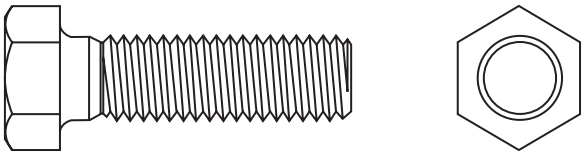
T-Head Bolt

3.1.1.48 *tank bolt:* a medium strength square head bolt.



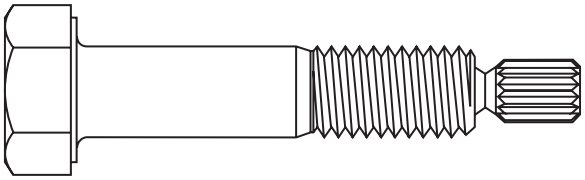
Tank Bolt

3.1.1.49 *tap bolt:* a square or hexagon head machine bolt, threaded relatively close to the head.



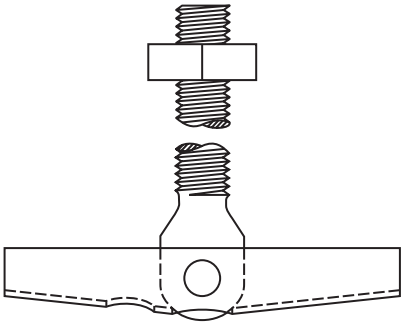
Tap Bolt

3.1.1.50 *tension control bolt:* a round or hexagon head bolt manufactured with a 12-spline drive and control groove on the threaded end. The fastener is tightened using a special wrench that simultaneously engages the nut and spline. The spline is designed to shear off when a pre-determined clamp load has been achieved.



Tension Control Bolt

3.1.1.51 *toggle bolt, head anchored:* a toggle bolt having a U-shaped wing rotatably attached to the head so that it can be aligned with the shank and pushed through a hole. It is used as a fastener in a hole that is accessible only from one side.



Head Anchored Toggle Bolt

3.1.1.52 *track bolt:* a steel bolt having a circular head with oval or mushroom top, an oval or elliptical neck that fits into an oval hole in a rail joint bar to prevent the bolt from turning, and a chamfer point. It is designed for joining railroad rails.

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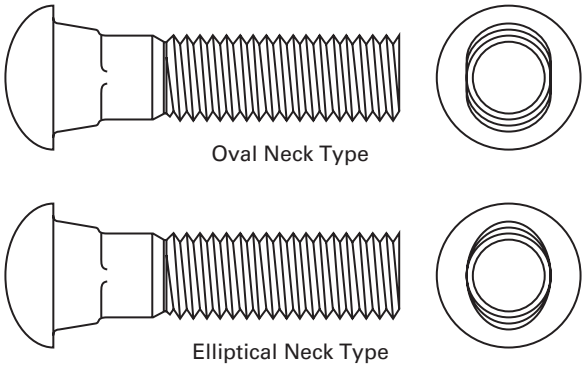
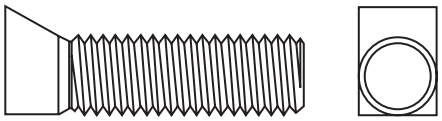


Track Bolts

3.1.1.53 *wedge bolt:* a bolt having a head of tapered rectangular section, one side of the head being tangent to the body of the bolt and the opposite side being at an angle to the body. It is available in long and short tapers. It is used principally in cultivators.



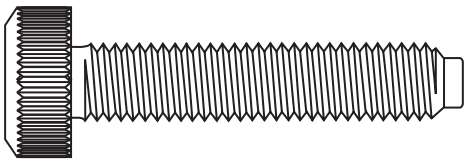
Wedge Bolt

3.1.1.54 *wheel bolt:* a bolt with a conical bearing surface designed to mate with the conical bearing surface on the wheel being attached. Used for attaching wheels in the transportation industry. (See also para. 3.1.3.9, *wheel stud*.)

3.1.2 Screws

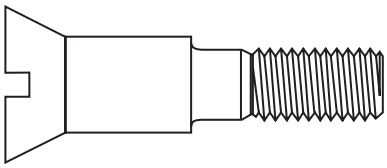
3.1.2.1 *screw:* a headed and externally threaded mechanical device having capabilities that permit it to be inserted into holes in assembled parts, of mating with a preformed internal thread or forming its own thread and of being tightened or released by wrenching its head. Refer to Table 2 for a listing of type designations for tapping screws and metallic drive screws.

3.1.2.2 *adjusting screw:* a special headed screw used for adjusting or locating. (See also para. 3.1.2.11, *knurled head screw*.)



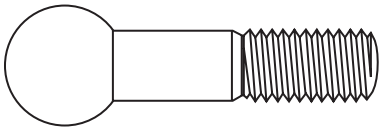
Adjusting Screw

3.1.2.3 *anchor light mounting screw:* a slotted flat countersunk head type of shoulder screw.



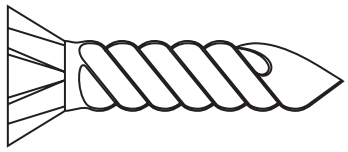
Anchor Light Mounting Screw

3.1.2.4 *ball head screw:* a screw having an approximately spherical head generally used for ball and socket swivel applications.



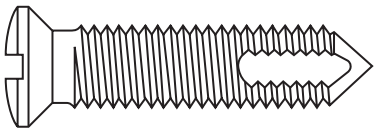
Ball Head Screw

3.1.2.5 *bobbin screw:* a type of flat head wood drive screw having a smaller head diameter than the standard drive screw; it may have locking serrations on, or fins under, the countersunk portion of the head. It is designed for holding the heads and bodies of textile bobbins together.



Bobbin Screw

3.1.2.6 *bone screw:* a corrosion resistant screw having a Unified, wood screw, or tapping screw thread form; designed to be used in surgery for the fixation of fractured or grafted bones.



Bone Screw

3.1.2.7 *cap screw:* a screw with a closely controlled body diameter, a washer faced bearing surface, and a flat chamfered point that facilitate its installation into tapped holes. Cap screws usually have hexagon, splined socket, hexagon socket, button, flat, fillister, or round head styles.

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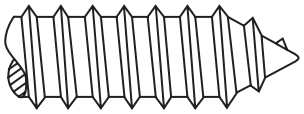
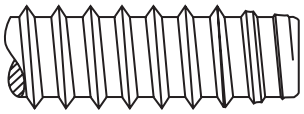
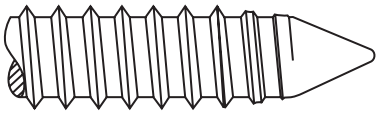
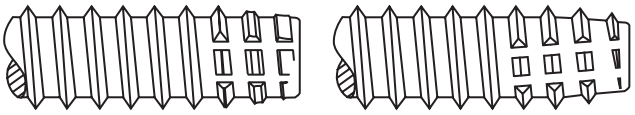
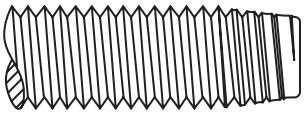
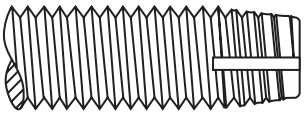
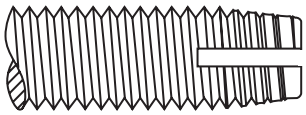
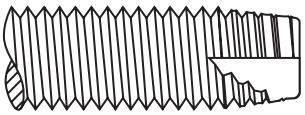
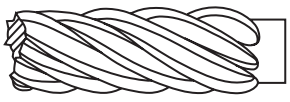
TABLE 2 TYPE DESIGNATIONS FOR TAPPING SCREWS AND METALLIC DRIVE SCREWS

Pictorial Representation	ANSI/ASME Designation	Manufacturer's Designation
	AB	AB
	B	B
	BP	BP
	BF	BF
	BT	25
 *Not recommended for new designs*	C	C
	D	1
	F	F
	G	G
	T	23
	U	U

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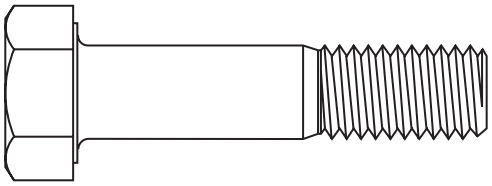
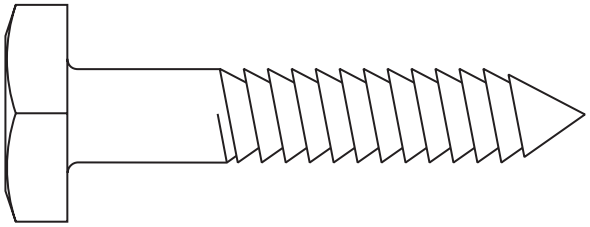


Cap Screw

3.1.2.8 *fetter drive screw:* a lag screw having a buttress type thread known as the fetter drive thread. It is designed for attaching hardware to wooden poles used in electric power lines.



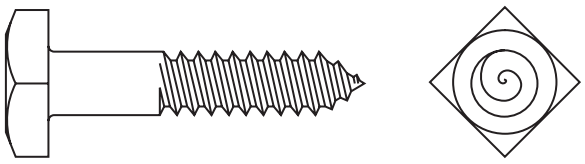
Fetter Drive Screw

3.1.2.9 *head locking screw:* has a head of such design that it resists forces tending to loosen it.

3.1.2.10 *insert screw:* designed for permanent assembly of the head or shank within a cast or molded material such as hard rubber, organic plastics, or die castings. The head or shank or both are provided with serrations, knurling, or other projections or indentations to prevent its rotation in the molded material.

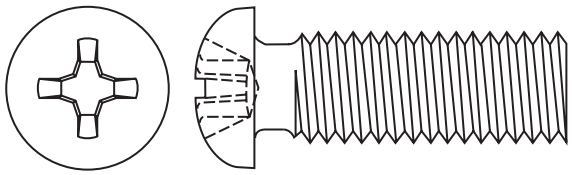
3.1.2.11 *knurled head screw:* has a circular head whose periphery is knurled or serrated and, therefore, manually turned without tools. (See also para. 3.1.2.2, *adjusting screw.*)

3.1.2.12 *lag screw:* has a distinct point, wide spaced threads, and a hex or square head that facilitates the driving into a drilled hole while forming a mating thread.



Lag Screw

3.1.2.13 *machine screw:* has a slotted, recessed, or wrenching head and threaded for assembly with a preformed internal thread. Machine screws are generally available in the following standard head styles: binding, fillister, 80 deg and 100 deg flat, flat trim, hexagon, hexagon washer, oval, oval trim, pan, round, and truss (90 deg for metric). They are also made in numerous special head styles to suit particular requirements. They are generally furnished with plain points but for special purposes may have chamfered, header, pilot, or other type points. ("Machine screw with nut" has practically replaced the term "stove bolt.")



Machine Screw

3.1.2.14 *metallic drive screw (Type U):* a hardened screw having a blunt or sharp pilot point, single or multiple threads of steep lead angle, and generally furnished with a round or flat head. It is used with a clearance hole in one of the parts to be fastened and designed for assembly by impact in sheet metal, castings, fiber, plastics, etc.

3.1.2.15 *miniature screw:* less than 0.06 in. or 1.6 mm in diameter, having a slotted head, and threaded for assembly with a preformed internal thread. Miniature screws are generally available in the following standard head styles: fillister, pan, 100 deg flat, and binding. They are generally furnished with chamfer points.

3.1.2.16 *one-way head screw:* a round head screw that is slotted but has side clearances at diagonally opposite sides of the slot so that the screw can be driven only in the direction of assembly; designed to prevent tampering or theft. (Sometimes called "tamper proof screws.")

3.1.2.17 *ornamental head screw:* has a head of artistic design, for use when an improved appearance is desired.

3.1.2.18 *set screw:* a hardened screw with or without a head, threaded the entire length and having a formed point designed to bear on a mating part. Set screws are regularly furnished in square head, headless slotted, hexagon socket and spline socket styles in combination with the set screw point styles illustrated and described below.



Set Screw

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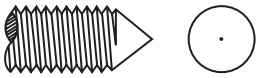
3.1.2.18.1 *cone point:* a sharp conical shaped point whose angle is dependent on the screw length.

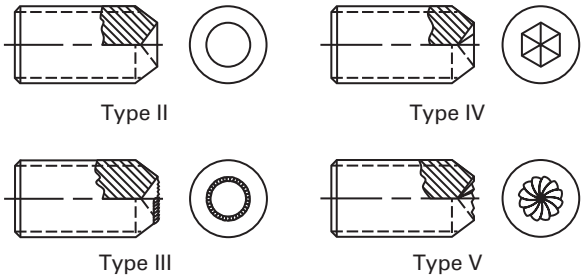


Cone Point

3.1.2.18.2 *cup point:* a truncated, conical point with a conical recess in the truncated portion. There are many variations of this point, such as knurled outer cone, hexagonal recess, etc. Designed to provide good holding power with slight penetration.

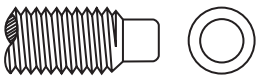


Cup Point



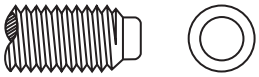
Cup Point Knurl Types

3.1.2.18.3 *full dog point:* a cylindrical point whose diameter is smaller than the minor diameter of the thread, commonly one half the nominal diameter in length, having a flat end with slightly rounded edges and a chamfer between the point and the thread. Fasteners having a full dog point are designed to project into a fairly deep hole or slot.



Full Dog Point

3.1.2.18.4 *half dog point:* a dog point having only half the length of the full dog point. It serves the same purpose as the full dog point for short length screws or projection into shallow holes or slots.



Half Dog Point

3.1.2.18.5 *flat point:* a truncated, conical point with a flat surface on the truncated portion; designed for holding with minimum penetration.



Flat Point

3.1.2.18.6 *oval point:* a point whose radius is greater than half the nominal diameter.



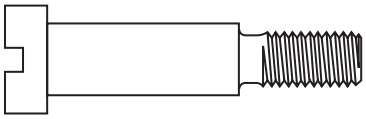
Oval Point

3.1.2.18.7 *spherical point:* a point whose radius is equal to half the nominal diameter.



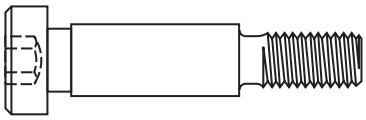
Spherical Point

3.1.2.19 *shoulder screw:* a slotted, flat fillister head screw having a cylindrical shoulder under the head to serve as a bearing or spacer.



Shoulder Screw

3.1.2.20 *socket head shoulder screw:* a socket head screw having a cylindrical shoulder under the head to serve as a bearing or spacer, and a necked portion between the thread and the shoulder. (Formerly called "stripper bolt.")



Socket Head Shoulder Screw

3.1.2.21 *shuttle screw:* a slotted fillister head screw having a short thread and full diameter body. The underside of the head is sometimes countersunk and the point may be slotted to permit adjustment from either side of the shuttle. Designed for use in textile shuttles.

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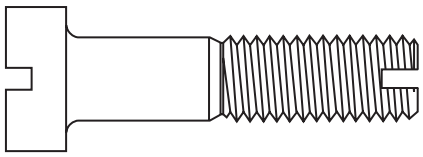
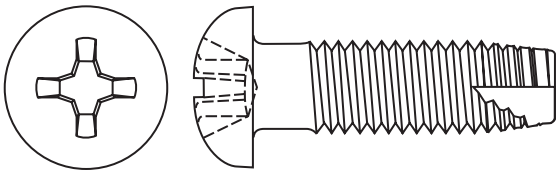


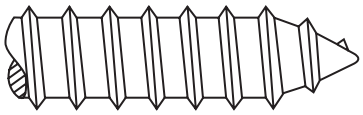
Shuttle Screw

3.1.2.22 *tapping screw:* has a slotted, recessed, or wrenching head and is designed to form or cut a mating thread in one or more of the parts to be assembled. Tapping screws are generally available in various combinations of the following head and screw styles: fillister, flat, flat trim, hexagon, hexagon washer, oval, oval trim, pan, round, and truss head styles with thread-forming screws, Types A, B, BA, BP, and C, or thread cutting screws, Types D, F, G, T, BF, BG, and BT as illustrated and described below. See Table 2 for type designations for tapping screws and metallic drive screws.



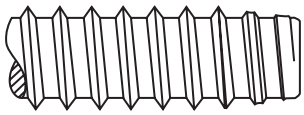
Tapping Screw

3.1.2.22.1 *Type A:* has a gimlet point applied to a thread-forming screw having a coarse-spaced thread.



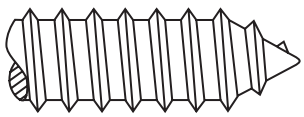
Type A

3.1.2.22.2 *Type B:* has a blunt, tapered, thread-forming point with incomplete entering threads applied to a screw having a spaced thread.



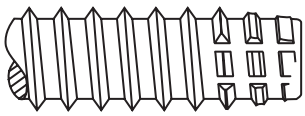
Type B

3.1.2.22.3 *Type AB:* has a gimlet point applied to a thread-forming screw having a spaced thread.



Type AB

3.1.2.22.4 *Type BF:* has a blunt, tapered, thread-cutting point with incomplete entering threads and multiple flutes, applied to a screw having a spaced thread.



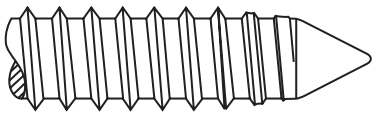
Type BF

3.1.2.22.5 *Type BG:* has a slotted, blunt, tapered, thread-cutting point with incomplete entering threads, applied to a screw having a spaced thread.



Type BG

3.1.2.22.6 *Type BP:* has a sharp, conical, or pinched point applied to a Type B screw.



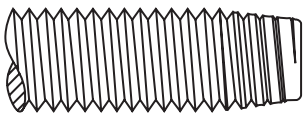
Type BP

3.1.2.22.7 *Type BT:* has a blunt, tapered, thread-cutting point with incomplete entering threads and a wide, milled, cutting slot, applied to a screw having a spaced thread.



Type BT

3.1.2.22.8 *Type C:* has a blunt, tapered, thread-forming point with incomplete entering threads applied to a screw having Unified diameter-pitch combination threads approximating Unified form.



Type C

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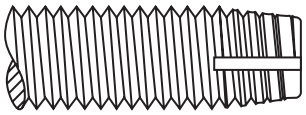
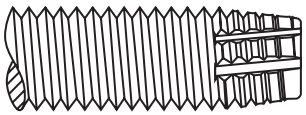
3.1.2.22.9 *Type D:* has a blunt, tapered, thread-cutting point with incomplete entering threads and one flute, applied to a screw having Unified diameter-pitch combination threads approximating Unified form.



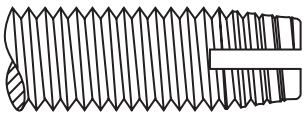
Type D

3.1.2.22.10 *Type F:* has a blunt, tapered, thread-cutting point with incomplete entering threads and multiple flutes, applied to a screw having threads of machine screw diameter pitch combinations approximating Unified form or metric coarse thread series.



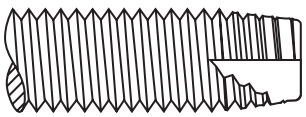
Type F

3.1.2.22.11 *Type G:* has a slotted, blunt, tapered, thread-cutting point with incomplete threads, applied to a screw having threads of machine screw diameter pitch combinations approximating Unified form or metric coarse thread series.



Type G

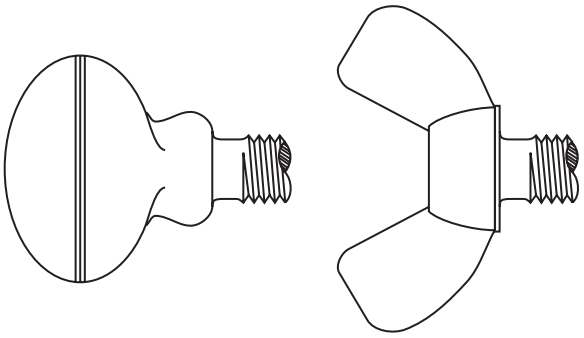
3.1.2.22.12 *Type T:* has a blunt, tapered, thread-cutting point with incomplete entering threads and a wide, milled, cutting slot, applied to a screw having Unified diameter-pitch combination threads approximating Unified form.



Type T

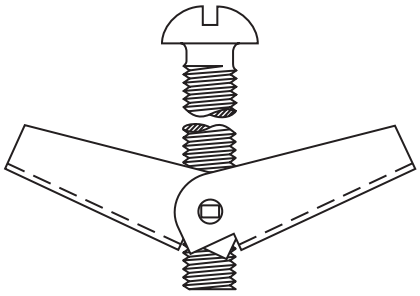
3.1.2.23 *thread locking screw:* has a thread designed to produce interference with its mating thread.

3.1.2.24 *thumb or wing screw:* has a flattened or wing-shaped head, designed for manual turning without a driver or wrench.



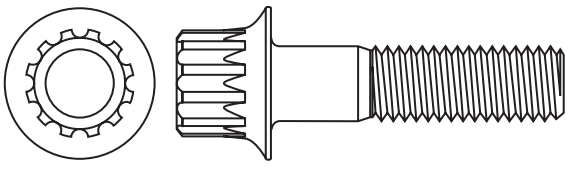
Thumb Screw **Wing Screw**

3.1.2.25 *toggle screw:* a screw having a U-shaped wing rotatably attached to a nut so that it can be aligned with the shank and pushed through a hole. It is used as a fastener in a hole that is accessible only from one side. Toggle screws are generally furnished with round, flat, or truss head slotted machine screws.



Toggle Screw

3.1.2.26 *12-spline flange screw:* a highly engineered screw having a 12-spline flange head configuration that offers reduced bearing stress, lower stress concentration in head-to-shank fillets and reduced raw material required when compared to a standard hex head design. Additionally, the design provides for a 225% wrenching torque capacity of the threaded section torsional strength.



12-Spline Flange Screw

3.1.2.27 *watch screw:* see para. 3.1.2.15, *miniature screw.*

3.1.2.28 *welding screw:* see para. 3.1.3.8, *projection weld stud.*

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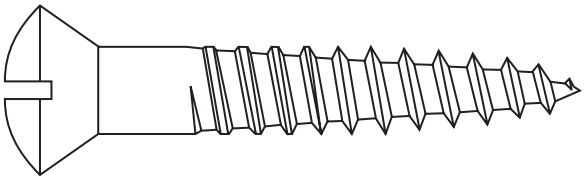
3.1.2.29 *wood drive screw:* a thread forming screw having a cone or pinch point, multiple threads of steep lead angle, a reduced diameter body, and generally available with flat, oval, or round head styles designed for rapid assembly in wood.

3.1.2.30 *wood screw:* a thread forming screw having a slotted or recessed head, gimlet point, and a sharp crested, coarse pitch thread, and generally available with flat, oval, and round head styles. It is designed to produce a mating thread when assembled into wood or other resilient materials.

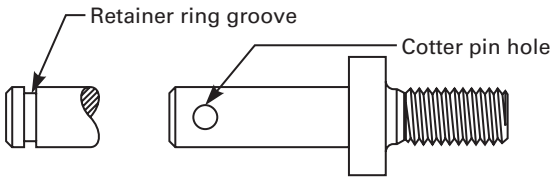


Wood Screw

3.1.3 Studs

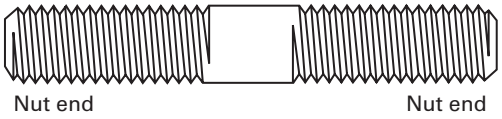
3.1.3.1 *stud:* a cylindrical fastener, externally threaded on either one or both ends or over its entire length, designed for insertion through holes in assembled parts to either mate with a nut or into a threaded hole or into a hole to form its own thread.

3.1.3.2 *collar stud:* threaded on one end having a collar of a diameter larger than the thread, and a retaining ring groove (see figure below) used to carry gears, cam rolls, and rocker levers.



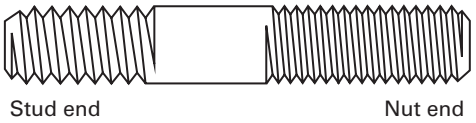
Collar Stud

3.1.3.3 *double end stud:* has equal length threads on each end to accommodate a nut and is threaded to class 2A or class 6g. Length of stud is measured overall.



Double End Stud (Clamping Type)

3.1.3.4 *interference-thread double end stud (tap-end stud):* similar to double-end studs, except that one end has a class NC5 or class UNC-3A thread (for metric coarse threads with class 6g tolerances). This type of stud is designed to be installed in a tapped hole.

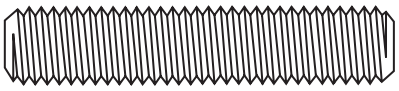


Double End Stud (Interference Thread Type)

3.1.3.5 *continuous thread stud:* threaded from end to end and is often used for flange bolting with two nuts applied.

(a) Type 1: General Purpose Studs. The length of this type of stud is measured from end to end. Threads are UNC-2A or class 6g.

(b) Type 2: Studs for Temperature–Pressure Piping. These studs are made to the dimensional standard requirements of ANSI/ASME B16.5 and have a length that is measured from first thread to first thread, excluding both point lengths.

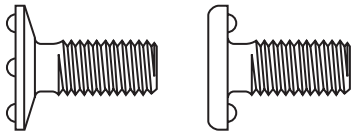


Continuous Thread Stud

3.1.3.6 *stud bolt:* see para. 3.1.3.5, *continuous thread stud.*

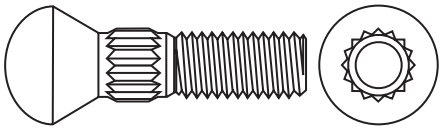
3.1.3.7 *weld stud:* see para. 3.1.3.8, *projection weld stud.*

3.1.3.8 *projection weld stud:* externally threaded component with round head of varied configuration having one or more integrally formed projections under or on top of the head suitable for resistance welding to a joint surface.



Welding Stud

3.1.3.9 *wheel stud:* a threaded stud consisting of a round head with serrations under the head for attaching the stud in place. Used for attaching wheels in the transportation industry. (See para. 3.1.1.54, *wheel bolt*.)



Wheel Studs

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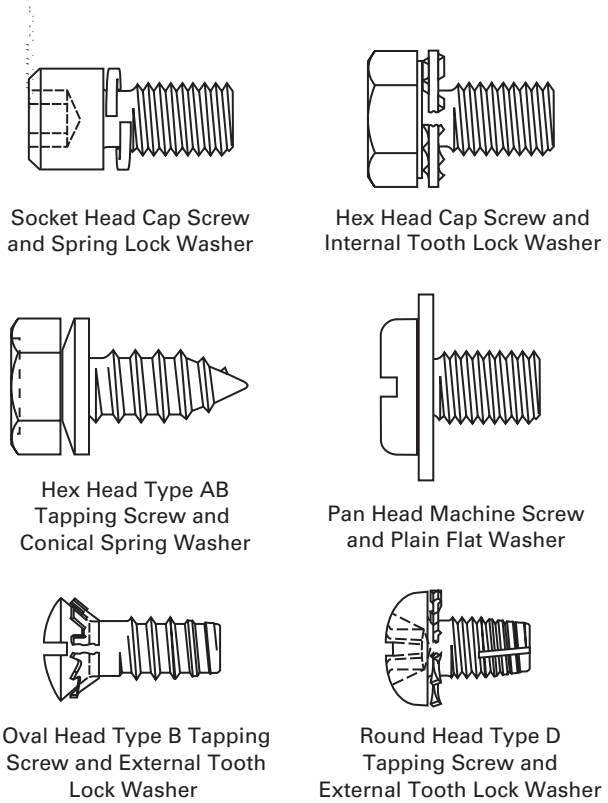
TABLE 3 SCREW AND WASHER ASSEMBLY COMBINATIONS

Screw Head Style	Tooth Lock Washer		Helical Spring Lock Washer	Conical Spring Washer	Plain Washer
	External	Internal			
Fillister head	...	X	X	X	X
Flat head	X	...	...	...	...
Hexagon head	X	X	X	X	X
Hexagon washer head	X	X	X	X	X
Oval head	X	...	...	...	...
Pan head	X	X	X	X	X
Round head	...	...	...	...	...
Truss head	...	...	...	...	...
Socket screw	...	...	X	...	...
Cap screw	X	X	X	X	X

3.1.4 *screw and washer assembly (sems):* a preassembled screw and washer unit in which the washer is retained free to rotate under the screw head by the rolled thread. These units expedite assembly operations and ensure the presence of a washer in each assembly. They are generally available in various combinations of head styles and washer types. (See Table 3.)



Screw and Washer Assemblies (Sems)

3.2 Internally Threaded Products

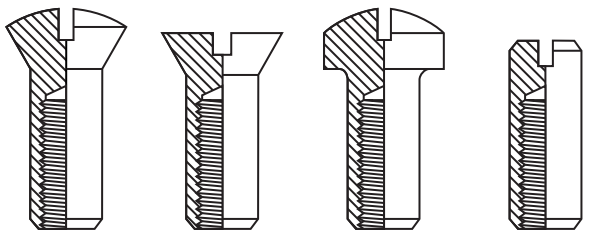
3.2.1 Nuts

3.2.1.1 *nut:* a perforated block having an internal or female screw thread, designed to assemble with an external or male screw thread such as those on a bolt or other threaded part. Its intended function is fastening, adjusting, transmitting motion, or transmitting power with a large mechanical advantage and nonreversible motion.

3.2.1.2 *acorn nut:* see para. 3.2.1.12, *crown nut*.

3.2.1.3 *anchor nut:* see para. 3.2.1.10, *clinch nut*.

3.2.1.4 *barrel nut (1):* a blind internally threaded fastener externally shaped like a machine screw. The threads extend inside almost to the head.



Barrel Nut (1)

3.2.1.5 *barrel nut (2):* a cylindrical nut tapped at right angles to the cylinder axis. This type of barrel nut is intended to fit in a hole formed at right angles to its mating screw.

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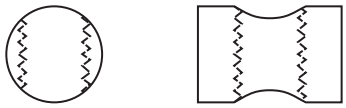


Barrel Nut (2)

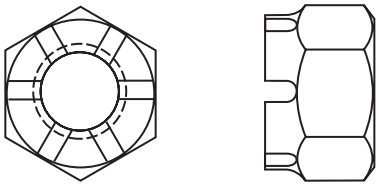
3.2.1.6 *cage nut:* see para. 3.2.1.8, *captive nut*.

3.2.1.7 *cap nut:* see para. 3.2.1.12, *crown nut*.

3.2.1.8 *captive nut:* consists of a threaded member, usually a square nut, held loosely in a shaped sheet metal box. The variations in mating assembly parts are usually overcome by this type nut since it can float laterally.

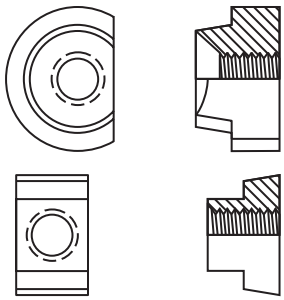
3.2.1.9 *castle nut:* a slotted hexagon nut having a cylindrical portion at the slotted end equal in length to the slot depth and slightly smaller in diameter than the hexagon width.

This nut is designed for the insertion of a cotter pin to secure the nut in place when it is used with a drilled shank fastener. This nut was formerly known as a "castellated nut."



Castle Nut

3.2.1.10 *clinch nut:* a solid nut having a pilot or other feature to be inserted in a preformed hole. The pilot may be clinched, staked, or expanded to retain the nut and prevent rotation. It is available in a large variety of types, some of which are capable of piercing the holes for assembly. It is sometimes designated "anchor nut."

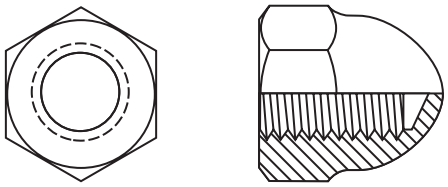


Clinch Nuts

3.2.1.11 *conduit nut:* a thin nut, usually stamped. It may be square with scalloped corners or hexagonal or octagonal in shape.

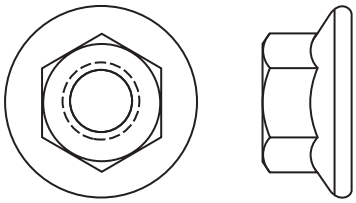
3.2.1.12 *crown nut:* a hexagon nut having an acorn shaped top and a blind threaded hole.

Crown nuts are generally furnished in two types, high crown and low crown. It is sometimes designated as an "acorn nut" or "cap nut."



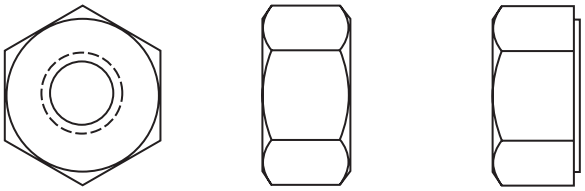
Crown Nut

3.2.1.13 *flange nut:* an integral nut and washer designed for increased bearing area.



Flange Nut

3.2.1.14 *hexagon nut:* has a hexagonal shape and may or may not have a washer face. The six parallel sides serve as wrenching flats. Hexagon nuts are available in various dimensional series, such as finished hexagon, heavy hexagon, regular hexagon, and in various thicknesses, such as standard, jam or thin, and thick. (See also para. 3.2.1.19, *machine screw nut.*)



Hexagon Nut

3.2.1.15 *internal wrenching nut:* a cylindrical nut, one end of which has a socket of suitable form for wrenching purposes.

3.2.1.16 *jam nut:* a hex nut having a reduced thickness—usually 63–70% of the hex nut thickness. It is used to provide resistance to loosening in combination with thicker nuts.

3.2.1.17 *knurled nut:* a cylindrical nut having a portion or portions of its cylindrical surface knurled.

3.2.1.18 *lock nut:* there are two basically different types of lock nuts: (1) a prevailing-torque type that

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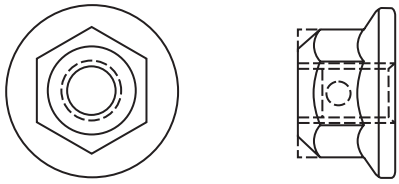
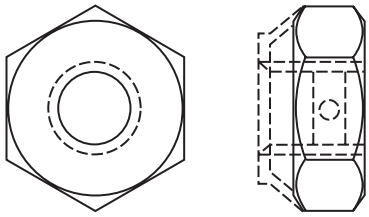
resists relative bolt-nut movement with or without an axially applied load to the bolt-nut combination, and (2) a free-running type that exhibits a locking ability when there is an axial load applied to the base of the nut. The "locking" or stopping action of the nut is accomplished by thread deformation, or clamping, or by the addition of nonmetallic inserts. The free-running type usually has a design feature that adds to the elastic elongation of the bolt-nut combination.



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



Prevailing Torque Lock Nut

3.2.1.19 *machine screw nut:* a hexagon or square nut of proportions suitable for use with a machine screw.

3.2.1.20 *micro slotted nut:* the same as para. 3.2.1.26, *slotted nut,* except that there are more slots.

3.2.1.21 *planer head bolt nut:* a thin, hexagonal, case hardened nut, having a flat and chamfered top, designed for use with a planer head bolt on machine tools.

3.2.1.22 *plate nut:* consists of an internally threaded unit and a plate, which is designed to hold the threaded unit in place relative to the work. The threaded unit may be integral with the plate or held by a retainer and may have conventional or locking threads. Two-piece plate nuts are generally of the floating type in which the threaded unit has a limited movement with respect to the plate and normal to the thread axis to facilitate alignment with the mating fastener. Plates may be of the following types:

(a) the hole type, for riveting, nailing, or otherwise fastening the plate to work

(b) the boss type, having weld embossments for resistance welding the plate to work (the embossments may be on the top of the plate—internal boss—or on the bottom of the plate—external boss)

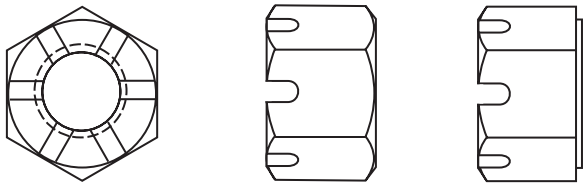
(c) the prong type, having projections to grip soft materials such as wood. Some forms of plate nuts are designated "tee nuts."

3.2.1.23 *round nut:* a plain cylindrical nut having no features for wrenching it onto a mating thread.

3.2.1.24 *skein nut:* an internally and externally threaded nut. The outside thread is a wood screw thread for insertion into wood components, and the inside is a thread suitable for machine screws or bolts. The end is usually slotted for driving.

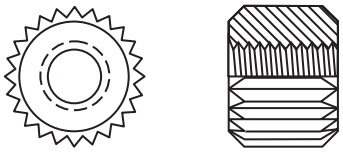
3.2.1.25 *sleeve nut:* an internally threaded fastener, externally shaped like a machine screw. It is essentially the same as "barrel nut" except that the threads extend throughout its entire length.

3.2.1.26 *slotted nut:* a hexagon nut having opposed slots through the centers of the flats. The slots are on the end opposite the bearing surface and are perpendicular to the axis of the nut. Slotted nuts are designed for the insertion of a cotter pin to secure the nut in place when it is used with a drilled shank fastener.



Slotted Nut

3.2.1.27 *spline nut:* a cylindrical nut having external splines or serrations that hold it in place when forced into a hole of slightly smaller diameter. It may also be cast in place in plastic or low strength metallic die cast alloys.



Spline Nut

3.2.1.28 *spring nut:* fabricated from thin spring steel having an impression designed to accommodate the mating thread. It is used in place of a solid nut. Spring nuts are available in many shapes and styles.

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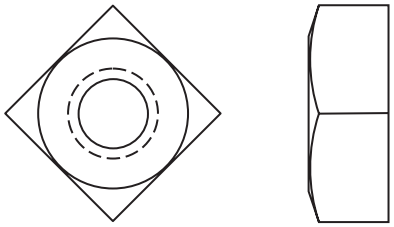
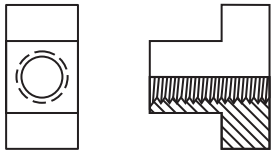
3.2.1.29 *square nut:* has a square shape and is generally manufactured without a washer face. The four parallel sides serve as wrenching flats. These nuts are available in the regular and heavy series with varying proportions.



Square Nut

3.2.1.30 *stamped nut:* a hexagon nut, sometimes with an integral washer, stamped from thin spring steel, having prongs formed to engage the mating thread. It is used in place of a solid nut in low-stress applications or as a retaining nut against a solid nut.

3.2.1.31 *T-nut:* a square finished nut having the form of a "T" to fit a T-slot in a machine tool.



T-Nut

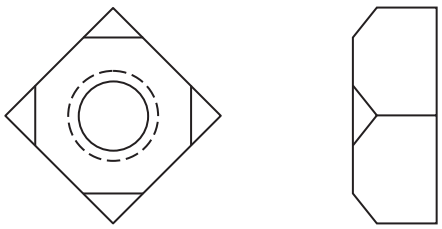
3.2.1.32 *tee-nut:* see para. 3.2.1.22, *plate nut.*

3.2.1.33 *thick nut:* see para. 3.2.1.14, *hexagon nut.*

3.2.1.34 *thin nut:* see para. 3.2.1.14, *hexagon nut.*

3.2.1.35 *thumb nut:* see para. 3.2.1.41, *wing nut.*

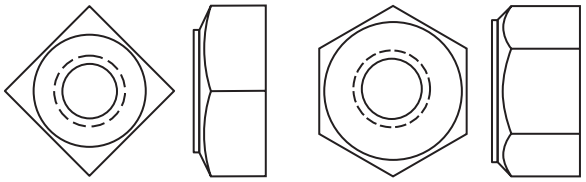
3.2.1.36 *track-bolt nut:* a square nut designed for use with a track bolt on railroads. It is available in two standard types: one with a standard 45 deg chamfer, the other with a 60 deg chamfer. There is also an alternate type of thick square nut with 60 deg chamfer for the $^{15}/_{16}$, 1, and $1^{1}/_{8}$ in. sizes.



Track-Bolt Nut

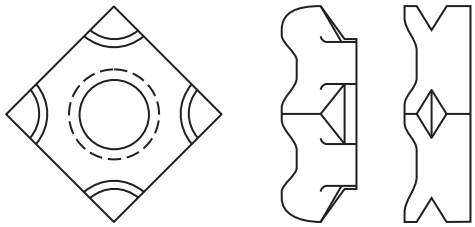
3.2.1.37 *tri-slot nut:* a slotted nut having three large slots. It may be used in place of a castle nut or a slotted nut of the same dimensions.

3.2.1.38 *washer crown nut:* a regular hexagon or square nut with a washer crown on the top of the nut.



Washer Crown Nuts

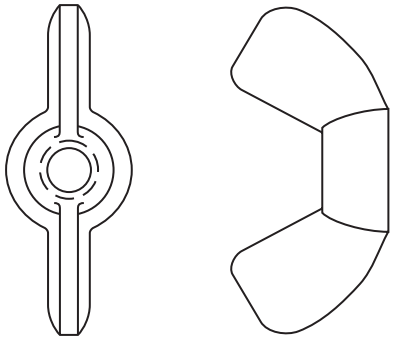
3.2.1.39 *weld nut:* a solid nut provided with lugs, annular rings, or embossments to facilitate its attachment to a metal part by resistance welding.



Weld Nuts

3.2.1.40 *wheel nut:* a nut consisting of an ordinary hex nut with a conical or spherical bearing surface designed to mate with the conical or spherical bearing surface on the wheel being attached.

3.2.1.41 *wing nut:* a nut having "wings" designed for manual turning. It may be forged, machined, stamped, or cast. It is sometimes called thumb nut.



Thumb or Wing Nut

3.2.2 Inserts

3.2.2.1 *threaded insert:* an internally threaded bushing designed to be assembled with soft or brittle materials to provide a threaded hole having greater

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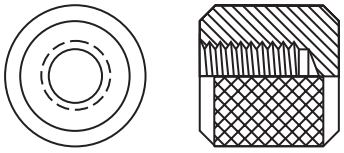
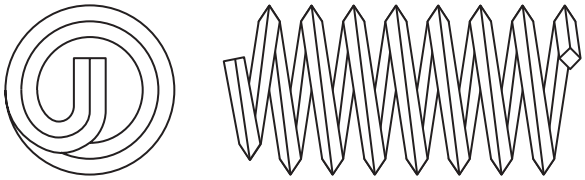
strength, hardness, and wear resistance. They are normally available as free-running into which a mating screw assembles without resistance, and screw locking in which residual locking torque is applied to the mating screw.



Thread Insert

3.2.2.2 *helical coil screw thread insert:* formed of wire of diamond shaped cross section coiled into a helix that forms an internal thread when screwed into a tapped hole of the appropriate size and pitch. Helical coil inserts are available in both free running and screw locking configurations.



Helical Thread Insert

3.2.2.3 *key locked insert:* threaded on its exterior surface to be screwed into tapped holes in the workpiece. They are locked in place by keys that are driven into slots in their external thread and broach through the threads of the workpiece.

3.2.2.4 *keyring locked insert:* essentially the same as a key locked insert except that the keys rather than being individual and separate are attached together by a ring.

3.2.2.5 *molded in insert:* has knurls or other configurations on its external surfaces that lock them in place. They are positioned in molds or dies such that the molten plastic or metal will flow around them.

3.2.2.6 *post molded insert:* has knurls or other configurations on its external surfaces that lock them in place after having been pressed or ultrasonically assembled into molded or drilled holes in plastics or soft metals.

3.2.2.7 *self-tapping insert:* has external threads that cut or form a mating thread when assembled into an untapped drilled or cored hole.

3.2.2.8 *solid bushing insert:* internally threaded sleeve designed to be assembled into a workpiece by one of several different methods.

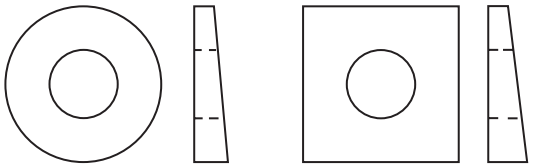
3.3 Nonthreaded Products

3.3.1 Washers

3.3.1.1 *washer:* a thin cylinder having a centrally located hole and is used with other fasteners as a spacer, a load distribution device, hardened seat, or to increase resistance to loosening in a fastened joint.

3.3.1.2 *belleville washer:* see para. 3.3.1.6, *conical spring washer.*

3.3.1.3 *bevel washer:* a flat, square, or circular washer with a definite taper between opposite bearing faces.

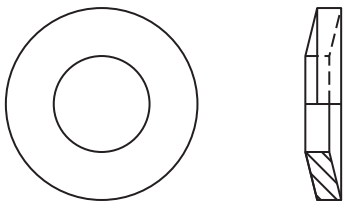


Bevel Washer

3.3.1.4 *C washer:* see para. 3.3.1.12, *open or horseshoe washer.*

3.3.1.5 *cone lock washer:* see para. 3.3.1.6, *conical spring washer.*

3.3.1.6 *conical spring washer:* a hardened circular steel washer formed with a slight dish and having edges sheared parallel to the centerline. This type of washer is designed to store energy and also provides a sealing effect as the sharp edges are tightened into the bearing surfaces. This washer is also known as "belleville washer" and "cone lock washer."



Conical Spring Washer

3.3.1.7 *direct tension indicator washer:* designed to indicate the achievement of a predetermined clamp load by the amount it compresses.

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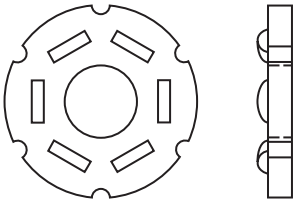
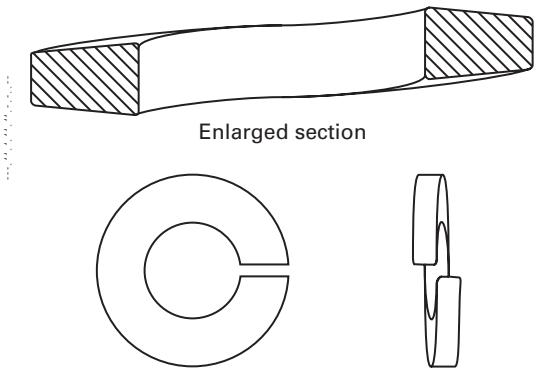


Direct Tension Indicator Washer

3.3.1.8 *finish washer:* a formed circular washer designed to accommodate the head of a flat or oval head screw and provide additional bearing area on the material being fastened. Finish washers are available in the raised type and flush type.

3.3.1.9 *flat washer:* see para. 3.3.1.13, *plain washer.*

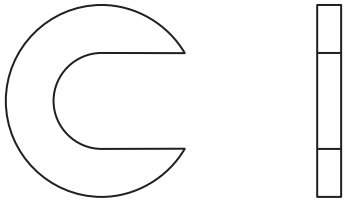
3.3.1.10 *helical spring lock washer:* a coiled, hardened, split circular washer made from wire or rod having a trapezoidal section. It is designed so the deformation caused by loading the trapezoid section increases the spring rate in a bolted joint to compensate for developed looseness and loss of tension between the parts of an assembly and to function as a hardened thrust bearing. It also distributes the load over a larger area for some head styles.



Helical Spring Lock Washer

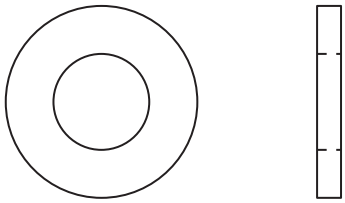
3.3.1.11 *lockplate:* a flat plate fastened to an assembled element with screws, or held by lanced ears. The lockplate provides projections that are bent into place against a flat of the screw head, effectively preventing rotation of the head.

3.3.1.12 *open or horseshoe washer:* a flat circular washer having a slot of width equal to the hole diameter and extending from the hole to the periphery. It is designed for installation on or removal from the shank of the fastener without removing the fastener from the assembly. This washer is also known as a "C washer."



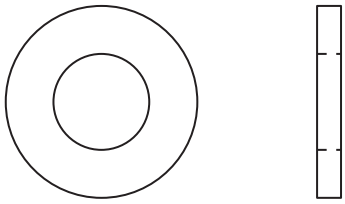
Open or Horseshoe Washer

3.3.1.13 *plain washer:* a flat, circular, or square washer with a central hole designed to fit around a bolt or screw and under the head or nut.



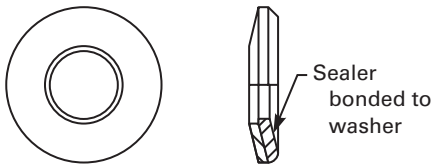
Plain Washer

3.3.1.14 *riveting burr:* a small plain washer that is assembled with a small rivet before peening the end to provide a large area of contact on the part.



Riveting Burr

3.3.1.15 *sealing washer:* made of relatively soft materials and is of various designs. This washer is sometimes used in connection with metallic washers to which it can be bonded.



Sealing Washer

3.3.1.16 *square grip washer:* a modified square or plain washer having a square hole. The sides of the hole and the outside corners of the washer are bent at right angles to one face of the washer to form grips that prevent rotation of square neck fasteners when assembled on soft materials such as wood.

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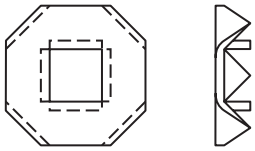
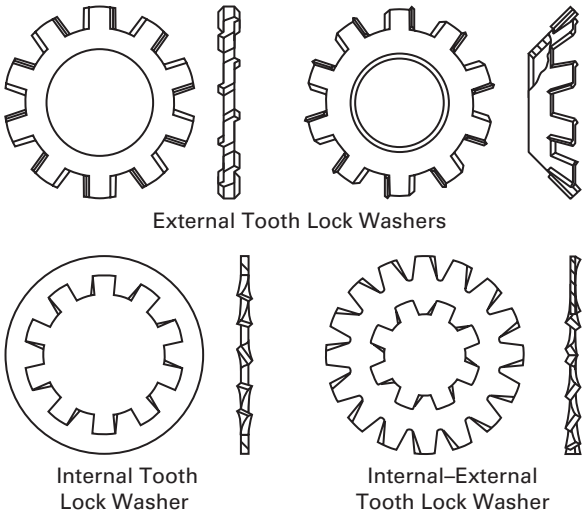


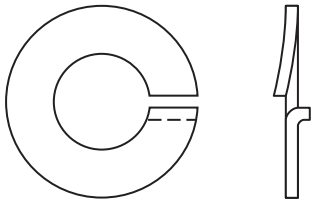
Square Grip Washer

3.3.1.17 *tooth lock washer:* a hardened circular washer, having twisted or bent prongs or projections that are deformed when assembled. The prongs, on which the pressure is localized, resist loosening of the fastener. It is generally furnished in external tooth, internal tooth, and internal-external tooth types as illustrated.



Tooth Lock Washer

3.3.1.18 *wood grip washer:* a modified circular plain washer having the annulus cut and the ends bent to form a grip. It is designed for use on soft materials such as wood.

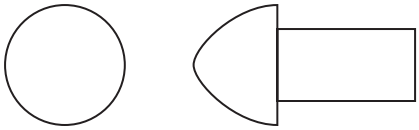


Wood Grip Washer

3.3.2 Rivets: Solid, Split, and Tubular

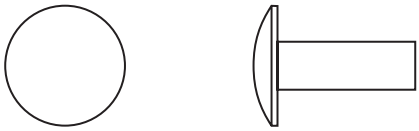
3.3.2.1 *rivet:* a headed metal fastener of malleable material used to join parts of structures and machines by inserting the shank through the aligned holes in each piece and forming a head on the headless end by upsetting.

3.3.2.2 *large rivet:* a solid rivet having a body diameter of $\frac{1}{2}$ in. (or 12 mm) or more and a head of one of the following forms: button, high button, cone, countersunk, or pan. Large rivets are usually driven at forging heat.



High Button Head Large Rivet

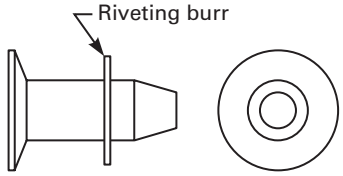
3.3.2.3 *small rivet:* a rivet, usually solid, having a body diameter of less than $\frac{1}{2}$ in. (or 12 mm) and a head of one of the following forms: button, countersunk, flat, oval, pan, or truss. Small rivets are usually driven cold.



Oval Head Small Rivet

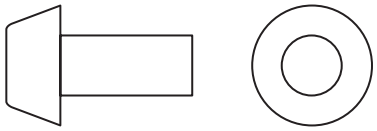
3.3.2.4 *rivet head styles:* the many head styles applied to the various types of rivets are illustrated and described in para. 2.3.2, *nonthreaded fasteners.*

3.3.2.5 *belt rivet:* a small solid rivet having a flat top, countersunk head, and chamfer point. It is used with a riveting burr for joining leather.



Belt Rivet

3.3.2.6 *boiler rivet:* a large rivet with a cone head.



Boiler Rivet

3.3.2.7 *brake lining rivet:* see para. 3.3.2.16, *tubular rivet.*

3.3.2.8 *compression rivet:* consists of two parts: a solid rivet and a deep-drilled tubular rivet. The diameters of the solid shank and the drilled hole are selected so as to produce a compression or pressed fit

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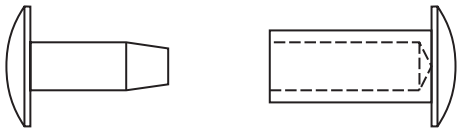
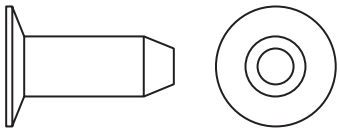
when the two parts are assembled. Rivets of this type may also have flat heads. This rivet is sometimes referred to as "cutlery rivet."



Compression Rivet

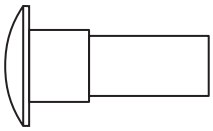
3.3.2.9 *Coopers' rivet:* a small solid rivet having a flat top, countersunk head, and chamfer point. It is used for joining the ends of barrel hoops.



Coopers' Rivet

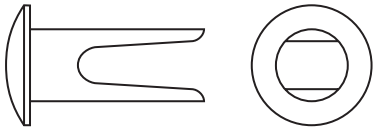
3.3.2.10 *cutlery rivet:* see para. 3.3.2.8, *compression rivet.*

3.3.2.11 *shoulder rivet:* a solid or tubular rivet having a shoulder under the head.



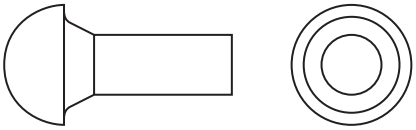
Shoulder Rivet

3.3.2.12 *split rivet:* a small rivet having a split end for securing by spreading the ends. It is commonly furnished with an oval or countersunk head.



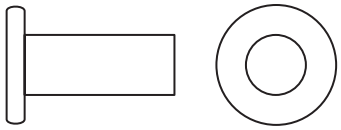
Split Rivet

3.3.2.13 *swell-neck rivet:* a large solid rivet having an enlarged, tapered neck under the head for tightly fitting a hole in a part.



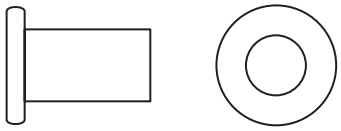
Swell-Neck Rivet

3.3.2.14 *tank rivet:* a small solid rivet designed for use in sheet metal. It commonly has a button, countersunk, flat, or truss head.



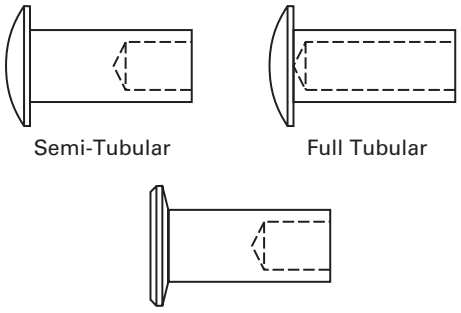
Tank Rivet

3.3.2.15 *tinners' rivet:* a small solid rivet having a head of the same form as a flat head rivet but larger in diameter. It is designed for use in sheet metal work.



Tinners' Rivet

3.3.2.16 *tubular rivet:* a small rivet having a coaxial cylindrical or tapered hole in the headless end. It is commonly furnished with a countersunk, flat, oval, or truss head. (See also para. 2.3.2, *nonthreaded fasteners.*) The top of the flat top countersunk head may be slightly chamfered as shown. Tubular rivets are designed to be secured by splaying or curling the end. They are further classified as semi-tubular, which have hole depths that do not exceed 112% of the mean shank diameter, measured on the wall; and full tubular, which have hole depths that do exceed 112% of the mean shank diameter.



Tubular Rivets

3.3.3 Blind Rivets and Blind Fasteners

3.3.3.1 *blind fastener:* a mechanical device that has the capability to join component parts in an assembly where access for fastener installation and activation is available from one side only.

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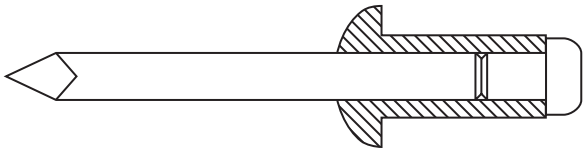
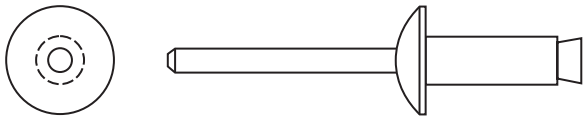
3.3.3.2 *blind rivet:* a blind fastener that has a self-contained mechanical or other feature that permits the formation of an upset on the blind end of the rivet and expansion of the rivet shank during rivet setting to join the component parts of an assembly.



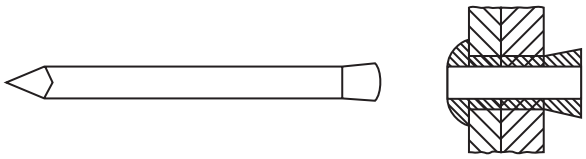
Blind Rivet

3.3.3.2.1 *pull mandrel blind rivet:* a multiple piece assembly consisting of at least a rivet body and a mandrel. In the setting operation the rivet is inserted into the components to be joined, the mandrel is gripped, pulled axially, and its head upsets the rivet body forming a blind head. Pull mandrel blind rivets are further classified as follows:

3.3.3.2.2 *pull through mandrel blind rivet:* a pull mandrel type of blind rivet where during the setting operation the mandrel is pulled completely through the rivet body thus leaving a hollow rivet.

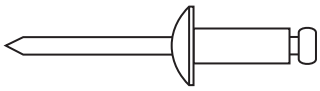


Pull Through Mandrel Blind Rivet

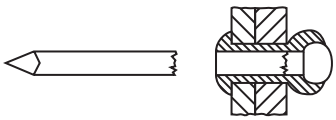


Set Pull Through Mandrel Blind Rivet

3.3.3.2.3 *break mandrel blind rivet:* a pull mandrel type of blind rivet where during the setting operation the mandrel is pulled into or against the rivet body and breaks at or near the junction of the mandrel and its upset end.



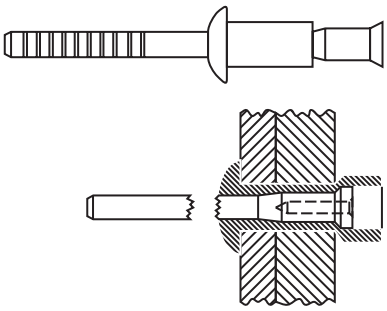
Break Mandrel Blind Rivet



Set Break Mandrel Blind Rivet

3.3.3.2.4 *nonbreak mandrel blind rivet:* a pull mandrel type of blind rivet where during the setting operation the mandrel is pulled into or against the rivet body, but does not break. This type requires the mandrel to be dressed in a subsequent operation.

3.3.3.2.5 *structural self-plugging pull mandrel blind rivet:* a pull mandrel type of blind rivet where during the setting operation the mandrel is pulled into or against the rivet body and breaks at a point within or above the rivet head with the entrapped length of mandrel being retained in the rivet body.



Multi-Grip Flush Break Self-Plugging Pull Mandrel Blind Rivet

3.3.3.2.6 *structural flush break pull mandrel blind rivet:* a pull mandrel type of blind rivet where during the setting operation the mandrel is pulled into or against the rivet body and breaks at a point within or above the rivet head. Flush break means that the break plane of the mandrel occurs above the junction of rivet shank and head, thus the shear plane(s) of the joint will occur through rivet shank and mandrel.

3.3.3.2.7 *multi-grip flush break pull, positive lock mandrel blind rivet:* a pull mandrel type of blind rivet where during the setting operation the mandrel is pulled into the rivet body and breaks essentially flush with the top of the rivet head. Because the break plane of the mandrel occurs above the junction of rivet shank and head, the shear plane(s) of the joint will occur through rivet shank and mandrel. Multi-grip means the rivet has the design capability to join component parts having a broad range of thicknesses. Positive lock means that during rivet setting an intentional deformation occurs in the rivet mandrel and/or body that provides a mechanical resistance to mandrel removal from the body.

3.3.4 Pins

3.3.4.1 *pin:* a straight cylindrical or tapered fastener, with or without a head, designed to perform a semi-permanent attaching or locating function.

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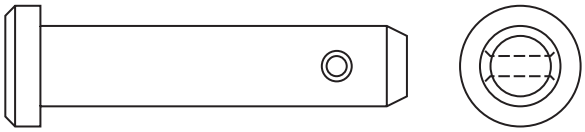
3.3.4.2 *clevis pin:* a solid cylindrical pin having a cylindrical head on one end with chamfered point usually with a drilled hole for a cotter pin or groove for a retaining ring on the headless end; designed for use with clevises and rod ends.



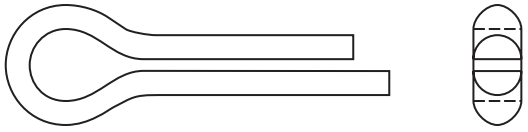
Clevis Pin

3.3.4.2.1 *headless clevis pin:* a solid pin having a chamfer point and drilled hole for a cotter pin on both ends; designed for use with clevises and rod ends.

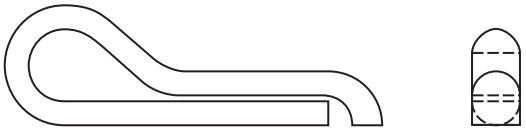


Headless Clevis Pin

3.3.4.3 *cotter pin:* a double bodied pin made by bending a length of semicircular wire approximately in half, forming a loop that provides a head. After installation each half of the body can be bent to keep the pin in place.



Extended Prong Square Cut Type



Hammer Lock Type

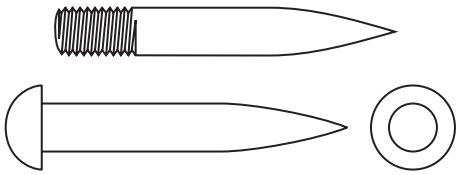
Cotter Pin

3.3.4.4 *dowel pin:* a solid headless straight pin whose diameter is closely controlled. Hardened and ground dowel pins have one end chamfered and the other end radiused to form a crown. Unhardened ground pins have both ends chamfered.



Dowel Pin

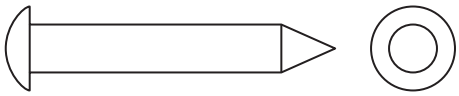
3.3.4.5 *hand drive pin:* a small diameter, sharp pointed-end pin that can be installed with small special hand tools and a hammer into concrete, light steel, etc. The end that protrudes after installation may be plain, headed, or threaded.



Hand and Power Drive Pins

3.3.4.6 *power drive pin:* of the same type as the "hand drive pin" except that it is larger in diameter and for heavier loads. The power for driving is usually a ballistic powder charge.

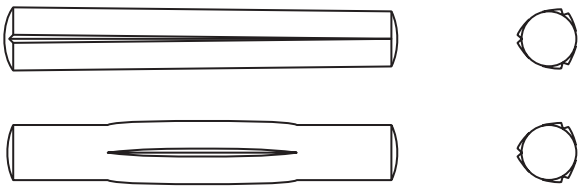
3.3.4.7 *escutcheon pin:* a pin having a semispherical head with a flat bearing surface formed on one end and a long cone or pinch point on the other.



Escutcheon Pin

3.3.4.8 *grooved pin:* a solid cylindrical pin with three longitudinal grooves, manufactured from bar or coil stock. The three grooves are pressed into the cylindrical body to expand its diameter to a size greater than its nominal diameter in a precisely controlled way. Material is displaced, but not removed, from the pin in the process.

When a grooved pin is pressed into a hole the size of the pin's nominal diameter, the constraining action of the hole will compress the expanded material in a spring-like manner and produce a holding force. This unique locking action is accomplished without permanent deformation of either the base material or the pin.



Grooved Pins

3.3.4.9 *spring pin:* a hollow, headless pin, having controlled length with rounded or chamfered ends, formed to a diameter somewhat greater than that of the hole into which it is to be assembled. Spring pins are available in two styles, slotted and coiled as illustrated.

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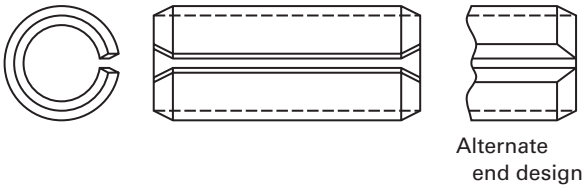
3.3.4.9.1 *coiled spring pin:* a fastener made by coiling thin material into a cylindrical shape. The pin is installed into a slightly smaller hole and is retained by the spring action of the coils. The coils allow for radial movement after installation and will absorb shock and vibration. The pin is well suited for installation into wide tolerance and mismatched holes.



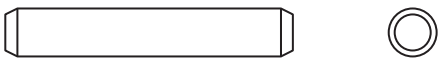
Coiled Spring Pin

3.3.4.9.2 *slotted spring pin:* a headless hollow cylindrical tube having a longitudinal slot down the entire length with chamfered or rounded ends to aid installation. Produced to a controlled outside diameter slightly greater than the hole in which it will be installed. Compressed as it is installed, the pin applies continuous pressure toward the sides of the hole wall. The pressure provides tension in a radial manner to prevent loosening created by vibration or shock.



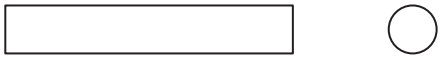
Slotted Spring Pin

3.3.4.10 *chamfered straight pin:* a solid headless pin, having controlled diameter and length, the ends of which are chamfered and approximately square with the axis of the fastener.



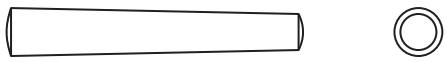
Chamfered Straight Pin

3.3.4.11 *square end straight pin:* a solid headless pin, having controlled diameter and length, the ends of which are nonchamfered and approximately square with the axis of the fastener.



Square End Straight Pin

3.3.4.12 *taper pin:* a headless, solid pin having controlled diameter, length, and taper, with crowned ends.

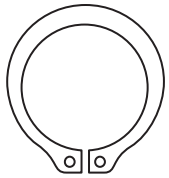


Taper Pin

3.3.5 Retaining Rings

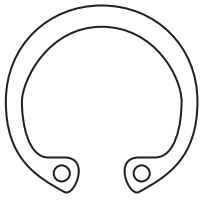
3.3.5.1 *retaining ring:* a precision-engineered fastener designed to provide an accurately located shoulder for positioning and securing components in an assembly. External types are expanded to spread them over a shaft and internal types compressed to fit into a bore/housing. When the ring is seated, it forms a removable shoulder for accurately locating and fastening parts in the assembly.

3.3.5.2 *basic external ring (Type NA1):* designed to fit tightly in the groove of a shaft by expanding the lugs with an assembly plier and installing in an axial direction.



Basic External Ring (Type NA1)

3.3.5.3 *basic internal ring (Type NA2):* designed to fit tightly in the groove of a housing or bore by compressing the lugs with an assembly plier and installing in an axial direction.



Basic Internal Retaining Ring (Type NA2)

3.3.5.4 *E-ring external (Type NA3):* designed to provide a large shoulder on smaller diameter shafts. Ring is installed radially in the groove of a shaft, usually by means of an assembly applicator.

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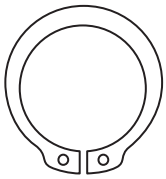
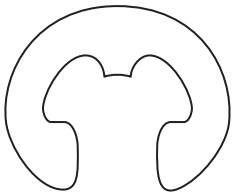
E-Ring External (Type NA3)

3.3.5.5 *heavy duty external ring (Type NA4):* provides higher thrust load capacity and a larger shoulder due to its extra thickness and increased section height than the basic external ring (para. 3.3.5.2). This ring is installed with an assembly plier in an axial direction.



Heavy Duty External Ring (Type NA4)

3.3.5.6 *reinforced E-ring (Type NA5):* a reinforced version of the E-ring (para. 3.3.5.4) designed to provide greater radial push-out forces and higher RPM limits. It is installed in a radial direction usually by means of an assembly applicator.



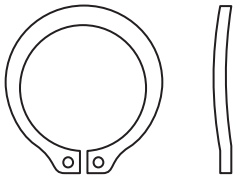
Reinforced E-Ring External (Type NA5)

3.3.5.7 *C-ring external (Type NA6):* its narrow section height and uniform shoulder makes this ring ideal for assemblies in which clearance dimensions are critical. Ring is installed in a radial direction usually by means of an assembly applicator.



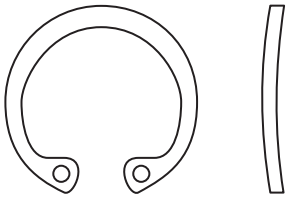
C-Ring External (Type NA6)

3.3.5.8 *bowed external ring (Type NA7):* a bowed version of basic external ring (para. 3.3.5.2) designed to take up end-play resiliently in an assembly. Ring is installed in an axial direction using assembly pliers.



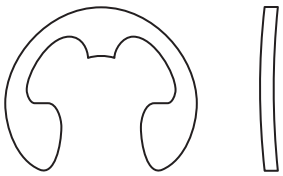
Bowed External Ring (Type NA7)

3.3.5.9 *bowed internal ring (Type NA8):* a bowed version of basic internal ring (para. 3.3.5.3) designed to take up end-play resiliently in an assembly. Ring is installed in an axial direction using assembly pliers.



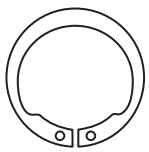
Bowed Internal Retaining Ring (Type NA8)

3.3.5.10 *bowed E-ring (Type NA9):* a bowed version of the E-ring (para. 3.3.5.4) designed to take up end-play resiliently in an assembly. Ring is installed in a radial direction usually by means of an assembly applicator.



Bowed E-Ring External (Type NA9)

3.3.5.11 *inverted external ring (Type NA10):* inverted lug design provides greater clearance and a higher uniform protruding shoulder. Ring is installed in an axial direction using assembly pliers.



Inverted External Ring (Type NA10)

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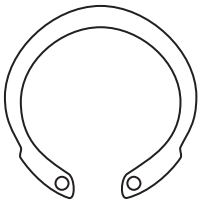
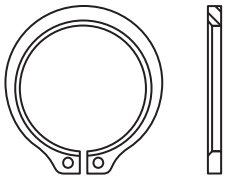
3.3.5.12 *inverted internal ring (Type NA11):* inverted lug design provides clearance and a higher uniform protruding shoulder. Ring is installed in an axial direction using assembly pliers.



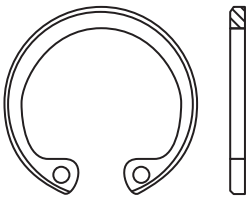
Inverted Internal Retaining Ring (Type NA11)

3.3.5.13 *beveled external ring (Type NA12):* beveled inside diameter edge design provides rigid end-play take up in assemblies. Ring is installed in an axial direction using assembly pliers.



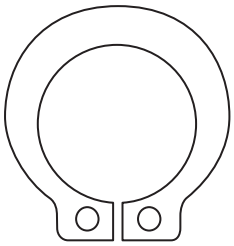
Beveled External Ring (Type NA12)

3.3.5.14 *beveled internal ring (Type NA13):* beveled outside diameter edge design provides rigid end-play take up in assemblies. Ring is installed in an axial direction using assembly pliers.



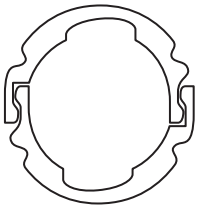
Beveled Internal Retaining Ring (Type NA13)

3.3.5.15 *external self-locking ring (Type NA14):* the frictional gripping power design of this ring is such that a groove is not required for its use. It is ideal for applications characterized by low thrust loads. Ring is installed in an axial direction using assembly pliers.



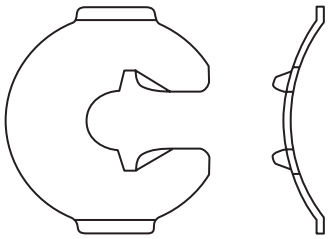
Self-Locking Ring (Type NA14)

3.3.5.16 *external interlocking ring (Type NA15):* a circular ring comprised of two halves that interlock into a groove that when assembled is dynamically balanced providing resistance to withstand high rotational speeds. Ring is installed in a radial direction using an assembly plier or assembly fixture.



External Interlocking Ring (Type NA15)

3.3.5.17 *external bowed locking prongs ring (Type NA16):* designed with two inside diameter prongs locking the ring positively in its groove. Additionally, bowed design provides resilient end-play take up in assemblies. Ring is installed in a radial direction using an assembly applicator.



External Bowed Locking Prong Ring (Type NA16)

3.3.5.18 *basic hand assembly tools for retaining rings:* all axially installed retaining rings use pliers for assembly and disassembly in an application. All radially installed retaining rings require the use of applicators for assembly.

3.3.5.18.1 *retaining ring assembly pliers:* designed with tips that can be inserted into the holes of retaining ring lugs are used to properly hold axially installed retaining rings during assembly and disassembly.

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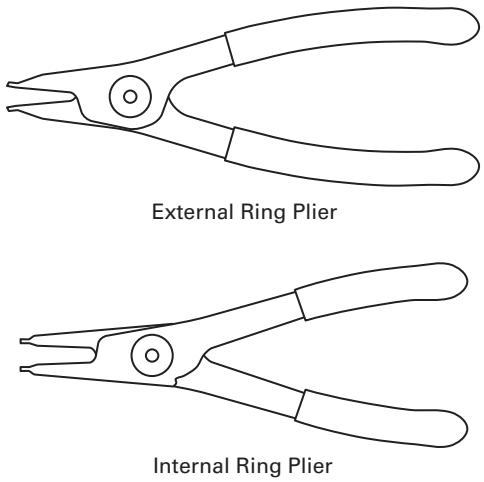
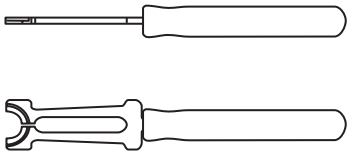


Retaining Ring Assembly Pliers

3.3.5.18.2 *retaining ring applicators:* applicators, having a fork-like blade designed to fit the contour of the ring, properly holds radially installed retaining rings during assembly.



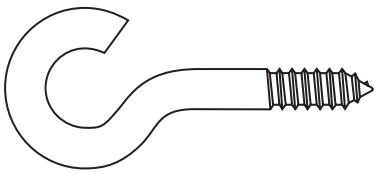
Retaining Ring Applicators

3.4 Miscellaneous Fasteners

3.4.1 *binding post:* a special type of subassembly used for clamping or holding electrical conductors in a rigid position. It commonly consists of a screw having a collar head or body with one or more clamping screws.

3.4.2 *binding post screw assembly:* a combination of a slotted machine screw and barrel nut.

3.4.3 *ceiling hook:* a fastener similar to an open eye bolt, except that it has lag screw threads.

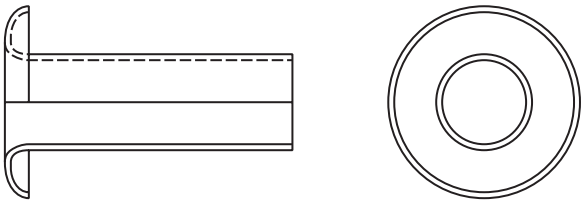


Ceiling Hook

3.4.4 *expansion fastener:* one type of expansion fastener consists of a machine screw, an expansion shield, and an expander nut. The shield body expands in a wedgelike manner when the expander nut is tightened. This fastener is commonly used in fastening to masonry.

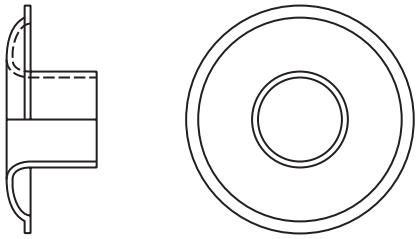
Another type of expansion fastener consists of a lag screw and an internally threaded split sleeve. It is designed for fastening to stone or concrete by inserting the sleeve into a hole in the stone or concrete and expanding to a tight fit in the hole by turning the lag screw.

3.4.5 *eyelet:* a flanged tubular fastener designed for securing by curling or expanding the tubular end.



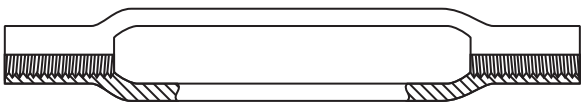
Eyelet

3.4.6 *grommet:* a large eyelet type fastener designed for securing by curling the tubular end over a washer to provide strength in holes through resilient materials.



Grommet

3.4.7 *turnbuckle:* is a loop or sleeve usually internally threaded with a left-hand thread at one end and a right-hand thread at the other end, intended for assembly with a threaded stud, eye, hook, or jaw at each end, used for applying tension to rods, wire rope, etc. Turnbuckles are sometimes made with a swivel feature at one end.



Turnbuckle

3.4.8 *wall anchor:* see para. 3.4.4, *expansion fastener.*

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INDEX

Acceptable Quality Level (AQL), 2.9.1
Acorn nut, 3.2.1.2
Actual fit, 2.4.12.1
Actual size, 2.4.1
Adjusting screw, 3.1.2.2
Aerospace fastener, 2.1.17
Aircraft eye bolt, 3.1.1.11.1
Aircraft fastener, 2.1.17
Allowance, 2.4.2
Alloy steel, 2.7.1
Anchor bolt, 3.1.1.2
Anchor light mounting screw, 3.1.2.3
Anchor nut, 3.2.1.3
Angularity, 2.4.3
Annealed, 2.7.2
Anodizing, 2.8.1
Applicable characteristics, 2.9.2

Ball head, 2.3.1.1
Ball head screw, 3.1.2.4
Barrel nut (1), 3.2.1.4
Barrel nut (2), 3.2.1.5
Basic external ring (Type NA1), 3.3.5.2
Basic hand assembly tools for retaining rings, 3.3.5.18
Basic internal ring (Type NA2), 3.3.5.3
Basic size, 2.4.4
Bearing face, 2.2.1
Belleville washer, 3.3.1.2
Belt rivet, 3.3.2.5
Bent bolt, 3.1.1.3
Bevel washer, 3.3.1.3
Beveled external ring (Type NA12), 3.3.5.13
Beveled internal ring (Type NA13), 3.3.5.14
Binding head, 2.3.1.2
Binding post, 3.4.1
Binding post screw assembly, 3.4.2
Black oxide, 2.8.2
Blank, 2.2.2, 2.5.1
Blind fastener, 3.3.3.1
Blind rivet, 3.3.3.2
Blister pack, 2.10.1
Bobbin screw, 3.1.2.5
Body, threaded fastener, 2.2.3
Body diameter, 2.4.5
Boiler rivet, 3.3.2.6
Bolt, 3.1.1.1
Bolt blank, 3.1.1.4
Boltmaker, 2.5.2
Bone screw, 3.1.2.6
Bound body, 2.2.3.1
Bow, 2.4.6
Bowed E-ring (Type NA9), 3.3.5.10
Bowed external ring (Type NA7), 3.3.5.8
Bowed internal ring (Type NA8), 3.3.5.9
Brake lining rivet, 3.3.2.7
Break mandrel blind rivet, 3.3.3.2.3
Broaching, 2.5.3
Building roof bolt, 3.1.1.5
Bulk packing, 2.10.2
Burnishing, 2.5.4
Burr, 2.5.5
Button head, 2.3.1.3, 2.3.2.1

C washer, 3.3.1.4
C-ring external (Type NA6), 3.3.5.7
Cage nut, 3.2.1.6
Camber, 2.4.6
Cap nut, 3.2.1.7
Cap screw, 3.1.2.7
Captive nut, 3.2.1.8
Carbon steel, 2.7.3
Carriage bolt, 3.1.1.6
Carton, 2.10.3
Case, 2.10.4
Case hardened, 2.7.4
Castle nut, 3.2.1.9
Ceiling hook, 3.4.3
Chamfer angle, 2.4.7
Chamfer point, 2.2.12.1
Chamfered straight pin, 3.3.4.10
Chip, 2.5.6
Chromate treatment, 2.8.4
Clevis pin, 3.3.4.2
Clinch nut, 3.2.1.10
Coating, 2.8.3
Coiled spring pin, 3.3.4.9.1
Coining, 2.5.7
Cold forming, 2.5.9

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Cold header, 2.5.8
Cold heading, 2.5.9
Cold heading stock, 2.7.5
Cold working fillets, 2.5.10
Collar, 2.2.4
Collar stud, 3.1.3.2
Collared eye bolt, 3.1.1.11.2
Collared nut ring bolt, 3.1.1.31
Commercial fastener, 2.1.1
Complete thread, 2.4.46.1
Compression fastener, 2.1.2
Compression rivet, 3.3.2.8
Concentric, 2.4.8
Concentricity, 2.4.8
Conduit nut, 3.2.1.11
Cone head, 2.3.2.3
Cone lock washer, 3.3.1.5
Cone point, 2.2.12.2, 3.1.2.18.1
Cone proof load, 2.6.1
Conical spring washer, 3.3.1.6
Connecting rod bolt, 3.1.1.7
Continuous thread stud, 3.1.3.5
Control plan, 2.9.3
Coopers' rivet, 3.3.2.9
Cotter pin, 3.3.4.3
Counterboring, 2.5.11
Countersink, 2.4.9
Countersinking, 2.5.12
Countersunk bolt, 3.1.1.8
Countersunk head, 2.3.1.6, 2.3.2.4
Countersunk head square neck bolt, 3.1.1.6.1
Crest truncation, 2.4.48.1
Cross drilled, 2.2.5
Crown nut, 3.2.1.12
Cup point, 3.1.2.18.2
Cut thread, 2.5.13
Cutlery rivet, 3.3.2.10

Decarburized, 2.7.6
Design size, 2.4.10
Designated characteristic, 2.9.4
Dichromate treatment, 2.8.5
Direct tension indicator washer, 3.3.1.7
Double end stud, 3.1.3.3
Dowel pin, 3.3.4.4
Drilling, 2.5.14
Drop bolt, 3.1.1.11.3
Dry film lubricant, 2.8.6
Ductility, 2.6.2
Dud, 2.9.5

E-ring external (Type NA3), 3.3.5.4
Eccentric, 2.4.11
Eccentricity, 2.4.11
Effective thread, 2.4.46.2
Electrogalvanizing, 2.8.7
Electroplating, 2.8.8
Elevator bolt, 3.1.1.9
Embossing, 2.5.15
Endurance limit, 2.1.3
Endurance strength, 2.1.3
Escutcheon pin, 3.3.4.7
Expansion bolt, 3.1.1.10
Expansion fastener, 3.4.4
External bowed locking prongs ring (Type NA16), 3.3.5.17
External interlocking ring (Type NA15), 3.3.5.16
External self-locking ring (Type NA14), 3.3.5.15
Externally relieved body, 2.2.3.2
Extruding, 2.5.16
Eye bolt, 3.1.1.3.1, 3.1.1.11
Eyelet, 3.4.5

Facing, 2.5.17
Fastener quality, 2.1.16
Fatigue strength, 2.6.3
Fetter drive screw, 3.1.2.8
Fillet radius, 2.2.6
Fillister head, 2.3.1.4
Fin, 2.2.7
Fin neck, 2.2.11.1
Finish, 2.8.9
Finish washer, 3.3.1.8
Fire-brick anchor bolt, 3.1.1.12
Fit, 2.1.18, 2.4.12
Fitting-up bolt, 3.1.1.13
Flange nut, 3.2.1.13
Flash, 2.5.18
Flash plating, 2.8.10
Flat fillister head, 2.3.1.5
Flat head, 2.3.1.7, 2.3.2.8
Flat point, 3.1.2.18.5
Flat top countersunk head, 2.3.2.5
Flat top countersunk head (with chamfered top), 2.3.2.6
Flat trim head, 2.3.1.8
Flat undercut head, 2.3.1.9
Flat washer, 3.3.1.9
Forcing bolt, 3.1.1.14
Forging, 2.5.1.9
Full dog point, 3.1.2.18.3
Full body, 2.2.3.3

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Galvanizing, 2.8.11
Gimlet point, 2.2.12.3
Globe head, 2.3.2.9
Grains, 2.7.7
Grinding, 2.5.20
Grip, 2.2.8
Grip gaging length, 2.2.9
Grommet, 3.4.6
Grooved pin, 3.3.4.8
Ground thread, 2.5.21

Half dog point, 3.1.2.18.4
Hand drive pin, 3.3.4.5
Hanger bolt, 3.1.1.15
Hardness, 2.6.4
Head, 2.2.10
Head angle, 2.4.13
Head diameter, 2.4.14
Head eccentricity, 2.4.15
Head height, 2.4.16
Head length, 2.4.17
Head locking bolt, 3.1.1.16
Head locking screw, 3.1.2.9
Head taper, 2.4.18
Head width, 2.4.19
Headed fastener, 2.1.4
Header, 2.5.22
Header point, 2.2.12.4
Heading, 2.5.23
Headless, 2.3.1.10
Headless clevis pin, 3.3.4.2.1
Headless fastener, 2.1.5
Heavy duty external ring (Type NA4), 3.3.5.5
Helical coil screw thread insert, 3.2.2.2
Helical spring lock washer, 3.3.1.10
Hexagon flange head, 2.3.1.13
Hexagon head, 2.3.1.11
Hexagon head bolt, 3.1.1.17
Hexagon nut, 3.2.1.14
Hexagon washer head, 2.3.1.12
High button head, 2.3.2.2
High strength fastener, 2.1.6
High strength structural bolt, 3.1.1.18
Hood latch bolt, 3.1.1.19
Hook bolt, 3.1.1.3.4, 3.1.1.20
Horseshoe washer, 3.3.1.12

In-process inspection, 2.9.6
Inclusions, 2.7.8
Incomplete thread, 2.4.46.3
Insert screw, 3.1.2.10
Inserts, 3.2.2
Inspection level, 2.9.7
Interference body bolt, 3.1.1.21
Interference fit body bolt, 3.1.1.32
Interference-thread double end stud (tap-end stud), 3.1.3.4
Internal wrenching bolt, 3.1.1.22
Internal wrenching nut, 3.2.1.15
Internally relieved body, 2.2.3.4
Internally relieved body bolt, 3.1.1.23
Inverted external ring (Type NA10), 3.3.5.11
Inverted internal ring (Type NA11), 3.3.5.12

J-bolt, 3.1.1.3.5, 3.1.1.24
Jam nut, 3.2.1.16

Key locked insert, 3.2.2.3
Keyring locked insert, 3.2.2.4
Knurled head screw, 3.1.2.11
Knurled nut, 3.2.1.17
Knurling, 2.5.24

Lag screw, 3.1.2.12
Laps, 2.7.9
Large rivet, 3.3.2.2
Left-hand thread, 2.2.16.2
Length, 2.4.20
Length of thread engagement, 2.4.21
Limits of size, 2.4.22
Lock nut, 3.2.1.18
Lockpins and collars, 2.1.7
Lockplate, 3.3.1.11
Lot, 2.9.8
Lot number, 2.9.9

Machine bolt, 3.1.1.25
Machine head, 2.3.2.10
Machine screw, 3.1.2.13
Machine screw nut, 3.2.1.19
Machining, 2.5.25
Major characteristic, 2.9.10
Major defect, 2.9.11
Maximum material condition, 2.4.23
Mechanical plating, 2.8.12
Mechanical properties, 2.1.8
Metallic drive screw (Type U), 3.1.2.14
Meter bolt, 3.1.1.26

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Micro slotted nut, 3.2.1.20
Milled from the bar, 2.5.26
Mine roof bolt, 3.1.1.27
Miniature screw, 3.1.2.15
Minor characteristic, 2.9.12
Minor defect, 2.9.13
Modified standard, 2.1.9
Molded in insert, 3.2.2.5
Multi-grip flush break pull, positive lock mandrel blind rivet, 3.3.3.2.7

Nail point, 2.2.12.5
Neck, 2.2.11
Needle point, 2.2.12.6
Nominal diameter body, 2.2.3.3
Nominal size, 2.4.24
Nonbreak mandrel blind rivet, 3.3.3.2.4
Nonstandard fastener, 2.1.10
Nut, 3.2.1.1
Nut former, 2.5.27
Nut thickness, 2.4.25
Nut width and length, 2.4.26

Oiled, 2.8.13
1/4 keg, 2.10.5
One-way head screw, 3.1.2.16
Open washer, 3.3.1.12
Organic compound, 2.8.14
Ornamental head screw, 3.1.2.17
Oval head, 2.3.1.14, 2.3.2.11
Oval point, 2.2.12.7, 3.1.2.18.6
Oval trim head, 2.3.1.15
Oval undercut head, 2.3.1.16

Package, 2.10.6
Packaged goods, 2.10.7
Pan head, 2.3.1.17, 2.3.2.12
Part Identifying Number (PIN), 2.1.12
Passivating, 2.8.15
Phosphate coating, 2.8.16
Physical properties, 2.1.11
Pickling, 2.8.17
Pilot point, 2.2.12.8
Pin, 3.3.4.1
Pinch point, 2.2.12.9
Pits, 2.7.10
Plain, 2.8.18
Plain nut ring bolt, 3.1.1.30
Plain point, 2.2.12.10
Plain washer, 3.3.1.13
Planer bolt, 3.1.1.28
Planer head bolt nut, 3.2.1.21
Plate nut, 3.2.1.22
Plating, 2.8.19
Plating build-up, 2.8.19.1
Plow bolt, 3.1.1.29
Point, 2.2.12
Point angle, 2.4.27
Point diameter, 2.4.28
Point length, 2.4.29
Point radius, 2.4.30
Pointing, 2.5.28
Polishing, 2.5.29
Poly bag, 2.10.8
Post molded insert, 3.2.2.6
Power drive pin, 3.3.4.6
Precision fastener, 2.1.13
Projection weld stud, 3.1.3.8
Proof load, 2.1.14, 2.6.5
Proof test, 2.1.15
Pull mandrel blind rivet, 3.3.3.2.1
Pull through mandrel blind rivet, 3.3.3.2.2
Punching, 2.5.30

Quality, 2.9.14
Quality assurance, 2.9.15

Recess depth, 2.4.31
Recess diameter, 2.4.32
Recess eccentricity, 2.4.33
Recess width, 2.4.34
Recessed head, 2.3.1.18
Reduced body bolt, 3.1.1.34
Reduced diameter body, 2.2.3.5
Reduced head, 2.3.1.19
Reference dimension, 2.4.35
Reinforced E-ring (Type NA5), 3.3.5.6
Retaining ring, 3.3.5.1
Retaining ring applicators, 3.3.5.18.2
Retaining ring assembly pliers, 3.3.5.18.1
Ribbed neck, 2.2.11.2
Ribs, 2.2.13
Right-hand thread, 2.2.16.1
Rivet, 3.3.2.1
Rivet head styles, 3.3.2.4; see also *nonthreaded fasteners,* 2.3.2
Riveting burr, 3.3.1.14
Rolled thread, 2.5.31
Root truncation, 2.4.48.2

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Round countersunk head, 2.3.1.20
Round countersunk head square neck plow bolt (no. 3 head), 3.1.1.29.1
Round countersunk heavy key head plow bolt (no. 6 head), 3.1.1.29.2
Round countersunk reverse key head plow bolt (no. 7 head), 3.1.1.29.3
Round head, 2.3.1.21
Round head bolt, 3.1.1.33
Round head fin neck bolt, 3.1.1.6.2
Round head ribbed neck bolt, 3.1.1.6.3
Round head short square neck bolt, 3.1.1.6.4
Round head square neck bolt, 3.1.1.6.5
Round nut, 3.2.1.23
Round section T-bolt, 3.1.1.46
Round top countersunk head, 2.3.2.7
Round washer head, 2.3.1.22
Runout, 2.4.36

Scale, 2.5.32
Screw, 3.1.2.1
Screw and washer assembly (sems), 3.1.4
Screw stock, 2.7.11
Seal bolt, 3.1.1.35
Sealing washer, 3.3.1.15
Securing bolt, 3.1.1.36
Self-tapping insert, 3.2.2.7
Set screw, 3.1.2.18
Shaft bolt, 3.1.1.37
Shank, 2.2.14
Shank diameter, 2.4.37
Shank length, 2.4.38
Shaving, 2.5.33
Shear fastener, 2.1.19
Shear head, 2.3.1.19
Shear strength, 2.6.6
Shot peening, 2.5.34
Shoulder, 2.2.15
Shoulder rivet, 3.3.2.11
Shoulder screw, 3.1.2.19
Shouldered eye bolt, 3.1.1.11.2
Shouldered nut ring bolt, 3.1.1.31
Shuttle screw, 3.1.2.21
Skein nut, 3.2.1.24
Sleeve nut, 3.2.1.25
Sliver, 2.5.35
Slot depth, 2.4.39
Slot eccentricity, 2.4.40
Slot width, 2.4.41
Slotted head, 2.3.1.23
Slotted nut, 3.2.1.26
Slotted spring pin, 3.3.4.9.2
Slotting, 2.5.36
Small rivet, 3.3.2.3
Socket depth, 2.4.42
Socket diameter, 2.4.43
Socket head, 2.3.1.24
Socket head shoulder screw, 3.1.2.20
Socket width, 2.4.44
Soft, 2.7.12
Solid bushing insert, 3.2.2.8
Source, 2.9.16
Special fastener, 2.1.10
Spherical point, 2.2.12.11, 3.1.2.18.7
Spline nut, 3.2.1.27
Split rivet, 3.3.2.12
Spring center bolt, 3.1.1.38
Spring nut, 3.2.1.28
Spring pin, 3.3.4.9
Square countersunk head, 2.3.1.25
Square countersunk head plow bolt (no. 4 head), 3.1.1.29.4
Square end straight pin, 3.3.4.11
Square grip washer, 3.3.1.16
Square head, 2.3.1.26
Square head bolt, 3.1.1.39
Square neck, 2.2.11.3
Square nut, 3.2.1.29
Stainless steel, 2.7.13
Stamped nut, 3.2.1.30
Standard fastener, 2.1.20
Stay bolt, 3.1.1.40
Steeple head, 2.3.2.13
Step bolt, 3.1.1.41
Stock fastener, 2.1.21
Stove bolt, 3.1.1.42
Strain hardening, 2.7.14
Stripper bolt, 3.1.1.43
Structural bolt, 3.1.1.44
Structural flush break pull mandrel blind rivet, 3.3.3.2.6
Structural self-plugging pull mandrel blind rivet, 3.3.3.2.5
Stud, 3.1.3.1
Stud bolt, 3.1.3.6
Substandard fastener, 2.1.22
Surface heat treatment, 2.8.20
Surface treatment, 2.8.21
Swell neck, 2.2.11.4
Swell-neck rivet, 3.3.2.13

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T-bolt, 3.1.1.45
T-head, 2.3.1.27
T-head bolt, 3.1.1.47
T-nut, 3.2.1.31
Tank bolt, 3.1.1.48
Tank rivet, 3.3.2.14
Tap bolt, 3.1.1.49
Taper, 2.4.45
Taper pin, 3.3.4.12
Tapping screw, 3.1.2.22
Tee-nut, 3.2.1.32
Temper, 2.7.15
Tensile strength, 2.1.23, 2.6.7
Tension control bolt, 3.1.1.50
Tension fastener, 2.1.24
Thick nut, 3.2.1.33
Thin nut, 3.2.1.34
Third party accreditation, 2.9.17
Thread, 2.2.16
Thread locking screw, 3.1.2.23
Thread runout, 2.4.46.4
Threaded fastener, 2.1.25
Threaded insert, 3.2.2.1
Thumb nut, 3.2.1.35
Thumb screw, 3.1.2.24
Tinners' rivet, 3.3.2.15
Toggle bolt, head anchored, 3.1.1.51
Toggle screw, 3.1.2.25
Tolerance, 2.4.47
Tooth lock washer, 3.3.1.17
Torsional strength, 2.6.8
Total thread, 2.4.46.5
Toughness, 2.6.9, 2.7.16
Track bolt, 3.1.1.52
Track-bolt nut, 3.2.1.36
Transfer header, 2.5.37
Tri-slot nut, 3.2.1.37
Trimming, 2.5.38
Truncate, 2.4.48
Truncation, 2.4.48
Truss (wagon box) head, 2.3.2.14
Truss head, 2.3.1.28
Tubular rivet, 3.3.2.16
Tumbling, 2.5.39
Turnbuckle, 3.4.7
12-point flange head, 2.3.1.29
12-spline flange screw, 3.1.2.26
12-spline head, 2.3.1.30

U-bolt, 3.1.1.3.2
U-bolt, vee bend, 3.1.1.3.3
Underhead fillet, 2.2.6
Upsetting, 2.5.40

Voids, 2.7.17

Wall anchor, 3.4.8
Warm forming, 2.5.41
Washer, 3.3.1.1
Washer assembly (Sems), 3.1.4
Washer crown nut, 3.2.1.38
Washer face, 2.2.17
Washer head, 2.3.1.31
Watch screw, 3.1.2.27
Wedge bolt, 3.1.1.53
Wedge tensile test, 2.1.26
Weld nut, 3.2.1.39
Weld stud, 3.1.3.7
Welding screw, 3.1.2.28
Wheel bolt, 3.1.1.54
Wheel nut, 3.2.1.40
Wheel stud, 3.1.3.9
Width across corners, 2.4.49
Width across flats, 2.4.50
Wing nut, 3.2.1.41
Wing screw, 3.1.2.24
Wood drive screw, 3.1.2.29
Wood grip washer, 3.3.1.18
Wood screw, 3.1.2.30
Work hardening, 2.7.18
Wrenching, 2.3.1.32

Yield strength, 2.1.27, 2.6.10

Zero acceptance, 2.9.18

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

Small Solid Rivets . . . . . B18.1.1-1972(R1995)
Large Rivets . . . . . B18.1.2-1972(R1995)
Metric Small Solid Rivets . . . . . B18.1.3M-1983(R1995)
Square and Hex Bolts and Screws (Inch Series) B18.2.1-1996
Square and Hex Nuts (Inch Series) . . . . . B18.2.2-1987(R1999)
Metric Hex Cap Screws B18.2.3.1M-1999
Metric Formed Hex Screws . . . . . B18.2.3.2M-1979(R1995)
Metric Heavy Hex Screws . . . . . B18.2.3.3M-1979(R1995)
Metric Hex Flange Screws . . . . . B18.2.3.4M-1984(R1995)
Metric Hex Bolts . . . . . B18.2.3.5M-1979(R1995)
Metric Heavy Hex Bolts . . . . . B18.2.3.6M-1979(R1995)
Metric Heavy Hex Structural Bolts . . . . . B18.2.3.7M-1979(R1995)
Metric Hex Lag Screws . . . . . B18.2.3.8M-1981(R1999)
Metric Heavy Hex Flange Screws B18.2.3.9M-2001
Square Head Bolts (Metric Series) B18.2.3.10M-1996
Metric Hex Nuts, Style 1 . . . . . B18.2.4.1M-2002
Metric Hex Nuts, Style 2 . . . . . B18.2.4.2M-1979(R1995)
Metric Slotted Hex Nuts . . . . . B18.2.4.3M-1979(R1995)
Metric Hex Flange Nuts . . . . . B18.2.4.4M-1982(R1999)
Metric Hex Jam Nuts . . . . . B18.2.4.5M-1979(R1998)
Metric Heavy Hex Nuts . . . . . B18.2.4.6M-1979(R1998)
Fasteners for Use in Structural Applications B18.2.6-1996
Metric 12-Spline Flange Screws B18.2.7.1M-2002
Clearance Holes for Bolt Screws and Studs B18.2.8-1999
Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series) B18.3-1998
Socket Head Cap Screws (Metric Series) . . . . . B18.3.1M-1986(R1993)
Metric Series Hexagon Keys and Bits . . . . . B18.3.2M-1979(R1998)
Hexagon Socket Head Shoulder Screws (Metric Series) . . . . . B18.3.3M-1986(R1993)
Hexagon Socket Button Head Cap Screws (Metric Series) . . . . . B18.3.4M-1986(R1993)
Hexagon Socket Flat Countersunk Head Cap Screws (Metric Series) . . . . . B18.3.5M-1986(R1993)
Metric Series Socket Set Screws . . . . . B18.3.6M-1986(R1993)
Round Head Bolts (Inch Series) . . . . . B18.5-1990(R1998)
Metric Round Head Short Square Neck Bolts B18.5.2.1M-1996
Metric Round Head Square Neck Bolts . . . . . B18.5.2.2M-1982(R1993)
Round Head Square Neck Bolts With Large Head (Metric Series) . . . . . B18.5.2.3M-1990(R1998)
Wood Screws (Inch Series) . . . . . B18.6.1-1981(R1997)
Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws B18.6.2-1998
Machine Screws and Machine Screw Nuts B18.6.3-1998
Thread Forming and Thread Cutting Tapping Screws and
Metallic Drive Screws (Inch Series) B18.6.4-1998
Metric Thread-Forming and Thread-Cutting Tapping Screws B18.6.5M-2000
Metric Machine Screws B18.6.7M-1999
General Purpose Semi-Tubular Rivets, Full Tubular Rivets, Split Rivets and Rivet Caps . . . . . B18.7-1972(R1992)
Metric General Purpose Semi-Tubular Rivets . . . . . B18.7.1M-1984(R1992)
Clevis Pins and Cotter Pins (Inch Series) B18.8.1-1994
Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series) B18.8.2-1995
Spring Pins – Coiled Type (Metric Series) B18.8.3M-1995
Spring Pins – Slotted (Metric Series) B18.8.4M-1994
Machine Dowel Pins – Hardened Ground (Metric Series) B18.8.5M-1994
Cotter Pins (Metric Series) B18.8.6M-1995
Headless Clevis Pins (Metric Series) B18.8.7M-1994
Headed Clevis Pins (Metric Series) B18.8.8M-1994
Grooved Pins (Metric Series) B18.8.9M-1998

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Spring Pins: Coiled Type, Spring Pins: Slotted, Machine Dowel Pins: Hardened Ground, and Grooved Pins (Metric Series) B18.8.100M-2000
Cotter Pins, Headless Clevis Pins, and Headed Clevis Pins B18.8.200M-2000
Plow Bolts (Inch Series) B18.9-1996
Track Bolts and Nuts . . . . . B18.10-1982(R1992)
Miniature Screws . . . . . B18.11-1961(R1992)
Glossary of Terms for Mechanical Fasteners B18.12-2001
Screw and Washer Assemblies — Sems (Inch Series) B18.13-1996
Screw and Washer Assemblies: Sems (Metric Series) B18.13.1M-1998
Forged Eyebolts . . . . . B18.15-1985(R1995)
Metric Lifting Eyes B18.15M-1998
Mechanical and Performance Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts . . . . . B18.16.1M-1979(R1995)
Torque-Tension Test Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts . . . . . B18.16.2M-1979(R1995)
Dimensional Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts B18.16.3M-1998
Inspection and Quality Assurance for General Purpose Fasteners . . . . . B18.18.1M-1987(R1999)
Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners . . . . . B18.18.2M-1987(R1999)
Inspection and Quality Assurance for Special Purpose Fasteners . . . . . B18.18.3M-1987(R1999)
Inspection and Quality Assurance for Fasteners for Highly Specialized Engineered Applications . . . . . B18.18.4M-1987(R1999)
Inspection and Quality Assurance Plan Requiring In-Process Inspection and Controls B18.18.5M-1998
Quality Assurance Plan for Fasteners Produced in a Third Party Accreditation System B18.18.6M-1998
Quality Assurance Plan for Fasteners Produced in a Customer Approved Control Plan B18.18.7M-1998
Lock Washers (Inch Series) B18.21.1-1999
Lock Washers (Metric Series) B18.21.2M-1999
Metric Plain Washers . . . . . B18.22M-1981(R1990)
Plain Washers . . . . . B18.22.1-1965(R1998)
Part Identifying Number (PIN) Code System Standard for B18 Externally Threaded Products B18.24.1-1996
Part Identifying Number (PIN) Code System Standard for B18 Internally Threaded Products B18.24.2-1998
Part Identifying Number (PIN) Code System Standard for B18 Nonthreaded Products B18.24.3-1998
Square and Rectangular Keys and Keyways B18.25.1M-1996
Woodruff Keys and Keyways B18.25.2M-1996
Square and Rectangular Keys and Keyways: Width Tolerances and Deviations Greater Than Basic Size B18.25.3M-1998
Tapered and Reduced Cross Section Retaining Rings (Inch Series) B18.27-1998
Helical Coil Screw Thread Inserts (Inch Series) — Free Running and Screw Locking B18.29.1-1993
Open-End Blind Rivets With Break Mandrels (Metric Series) B18.30.1M-2000

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