ASME B18.31.5-2011

Bent Bolts (Inch Series)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Bent Bolts (Inch Series)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

Three Park Avenue • New York, NY • 10016 USA

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

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FOREWORD

The ASME B18 Standards Committee for the Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners (formerly American National Standards Committee B18) was organized in March 1922 as Sectional Committee B18 under the aegis of the American Engineering Standards Committee (later the American Standards Association, then the United States of America Standards Institute, and, as of October 6, 1969, the American National Standards Institute, Inc.) with the Society of Automotive Engineers and ASME as joint sponsors.

In 1995 the SAE Ship Systems and Equipment Committee that was preparing fastener part standards for the shipbuilding industry asked the ASME B18 Committee if there was an interest in developing dimensional standards for studs. At the December 1995 B18 meeting in Atlanta, Georgia, it was reported that a survey by ASME showed considerable interest in establishing a subcommittee to develop stud standards, and 11 representatives indicated their willingness to serve on the subcommittee. Subcommittee (SC) 31, titled "Studs," was established, and drafts of SAE U.S. Customary and SI (Metric) stud standards were distributed for review.

In April 2008, B18 SC 31 had completed work on ASME B18.31.2, which covered the studs from the Industrial Fasteners Institute (IFI) publication, IFI-136, Studs and Bent Bolts. At that meeting in Salt Lake City, Utah, B18 SC 31 approved a motion to create a bent bolt standard incorporating the bent bolts covered by IFI-136. IFI-136 was developed through the procedures of the IFI. The standard for studs and bent bolts was originally published in *Fastener Standards*, 5th edition, 1970.

In 1986, these standards were updated, modestly revised, and reissued as IFI-136. In 2002, another revision was completed, and the standard was issued as a third revision.

At the December 2008 meeting in Indian Rocks Beach, Florida, the scope of the new bent bolt standard was discussed at length with a decision made as to the thread forms, diameters, and bent bolt configurations that would be covered by the new standard.

At the April 2009 meeting in Las Vegas, Nevada, B18 SC 31 and the B18 Board approved changing the SC name from "Studs" to "Studs, Lifting Eyes, and Bent Bolts" to cover the additional standards being handled by the Subcommittee. During the Las Vegas meeting, extensive time was spent discussing and developing the part identification number (PIN) system to be used in the new standard. At that meeting, the working group was asked to consult with the chair of SC 24, Industry/Government Liaison, about putting the PIN system into an appendix of B18.31.5. The chair of SC 24 agreed with the plan to keep the PIN system for bent bolts inside of the new bent bolt standard.

A draft of this Standard was sent out as part of the agenda for the November 2009, SC31 meeting in Las Vegas, Nevada. During that meeting, it was decided to indicate that unless otherwise specified by the purchaser, the bolt material would be carbon steel. It also was decided that a survey of the B18 Committee would be taken regarding the inclusion of the PIN system as part of the bent bolt document. The survey was completed, with the majority agreeing that the PIN system would remain in the appendix, as ASME B18.24 could not accommodate the multiple dimensions of the bent bolts. The PIN system only applies to bent bolts with dimensions identified in the Standard. All bent bolts covered in the Standard can be identified by a modified traditional method based on the method previously identified in IFI-136.

A draft was balloted before the April 2010 meeting in Nashville, Tennessee, and several disapprovals were resolved at the meeting. Additional members volunteered for the Working Group to determine and review tolerances for the dimensional tables. The draft was sent out for review to the four domestic manufacturers and two international manufacturers who had provided primary information for the dimensional tables and tolerances.

Further comments were reviewed during the April 2011 meeting in New Orleans, Louisiana. During that meeting it was decided that some configurations of bent bolts would be mentioned without dimensional tables being included. Recommendations for additional dimensions can be forwarded to ASME B18 SC 31 for consideration. A final draft was approved in July 2011.

This Standard was approved by the American National Standards Institute on November 1, 2011.

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

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

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CORRESPONDENCE WITH THE B18 COMMITTEE

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

Secretary, B18 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

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.

Proposing a Case. Cases may be issued for the purpose of providing alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the standard, the paragraph, figure or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the standard to which the proposed Case applies.

Interpretations. Upon request, the B18 Standards 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 an 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 that are necessary to explain the question; however, they should not contain proprietary names or information.

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

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

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

BENT BOLTS (INCH SERIES)

1 INTRODUCTORY NOTES

1.1 Scope

1.1.1 This Standard establishes general requirements for parts classified as bent bolts. Dimensional requirements are provided in tables for U-bolts of differing bends, eyebolts, hook bolts of differing bends, and J-bolts. General requirements are provided for offset round bend, J-bolts, square bend hook bolts, vee bend U-bolts, and slant U-bolts.

1.1.2 Two methods are identified for designating (ordering) bent bolts covered by this Standard. For configurations covered by dimensional tables, Nonmandatory Appendix A provides a Part Identification Number (PIN) system that allows ordering the parts in several materials and finishes. For configurations without dimensional requirements or of sizes not covered in the tables, a standard system for identifying the dimensions, material, and finish is provided.

1.1.3 The inclusion of dimensional data in this Standard reflects generally available configurations. It is not intended to imply that all of the products described herein are stock production sizes, particularly in materials other than low carbon steel. Consumers should consult with manufacturers concerning lists of stock production sizes and materials.

1.2 Dimensions

All dimensions in this Standard are in inches, unless otherwise specified. When plating or coating is specified, the finished product dimensions apply before plating or coating unless otherwise specified by the purchaser.

1.3 Options

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

1.4 Terminology

The following terms used in this Standard are identified in this Standard below or in para. 2.1. The definition of other terms used in this Standard may be found in ASME B18.12.

1.4.1 L-hook bolt is also known as a hook bolt, right angle bend as defined in ASME B18.12.

1.4.2 J-hook bolt is also known as a hook bolt, round bend as defined in ASME B18.12.

1.4.3 Roof top vee bolt is also known as a U-bolt, vee bend as defined in ASME B18.12.

1.4.4 U-bolt, slant bend requires a bend from the high point of one leg to the high point of the second leg. The angle of bend and the height requirement for each leg are determined by the purchaser. The bolt has threads on both ends of its shanks.

1.5 Referenced Standards

Unless otherwise specified, the standards referenced shall be the most recent at the time of order placement.

ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B1.3, Screw Thread Gaging Systems for Dimensional Acceptability — Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)

ASME B18.12, Glossary of Terms for Mechanical Fasteners

ASME B18.18, Quality Assurance for Fasteners

ASME B36.10M, Welded and Seamless Wrought Steel Pipe

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900 (www.asme.org)

ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications

ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

ASTM A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service

ASTM A675/A675M, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

ASTM B695, Coatings of Zinc Mechanically Deposited on Iron and Steel

ASTM F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

ASTM F1470, Standard Guide for Specified Mechanical Properties and Performance Inspection
ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1941, Specification for Electrodeposited Coatings on Threaded Fasteners [Unified Inch Screw Threads (UN/UNR)]
ASTM F2329, Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

SAE J429, Mechanical and Material Requirements for Externally Threaded Fasteners
Publisher: Society of Automotive Engineers (SAE International), 400 Commonwealth Drive, Warrendale, PA 15096-0001 (www.sae.org)

2 GENERAL DATA

2.1 Bent Bolts

The bent bolts covered by this Standard include those listed in paras. 2.1.1 through 2.1.5 and are presented in Figs. 1 through 4. Bent bolt configurations are pictured in this Standard either labeled as part of a table or as an individual figure.

2.1.1 U-Bolts. Two standard styles of bent U-bolts of varying leg lengths are covered. U-bolts, round bend (Table 1), are often used for holding pipe and thus are commonly defined by the nominal pipe size (reference ASME B36.10M) for which they are intended. U-bolts, square bends (Table 2), are predominantly used for hanging duct work and thus are commonly defined by the dimensions of duct work for which they are intended.

2.1.2 Alternate Configurations of U-Bolts. In addition to the U-bolt configurations listed in para. 2.1.1, there are two additional types of U-bolts. U-bolts, vee bend, also called roof top vee bolts, are shown in Fig. 3. U-bolts, slant bend, are of the configuration shown in Fig. 4.

2.1.3 Light-Duty Bent Eyebolts. These eyebolts can be found in two head styles: an eyebolt, closed anchor ring style (Table 3), and an eyebolt, open anchor ring style (Table 4). These bolts are not for lifting purposes.

2.1.4 Hook Bolts. Hook bolts can be found in many hooked or bent styles including right angle bend (also known as an L-hook), as shown in Table 5. An acute angle bend (most commonly a 63-deg bend) is shown in Table 6. A round bend (also known as a J-hook) is shown in Table 7, and a square bend is shown in Fig. 2.

2.1.5 J-Bolts. J-bolts have an offset round bend approximating a semicircle as shown in Fig. 1.

2.2 Length

The defining length of the bent bolt is measured from the extreme end of the bolt to the highest point inside the bend as illustrated in the respective tables.

2.3 Threads

The nominal bolt size is the nominal size (basic major diameter) of the threaded portion.

Threads shall be cut or rolled Unified Coarse (UNC) or Unified Fine (UNF), Class 2A according to ASME B1.1. Unless otherwise specified by the purchaser, dimensional acceptability of screw threads shall be determined based on System 21 as specified in ASME B1.3. Uncoated threads will be evaluated using Class 2A GO and NOT GO gages.

Threads plated in accordance with ASTM F1941 shall be evaluated after plating using Class 3A GO gages and Class 2A NOT GO gages.

Threads hot-dip coated in accordance with ASTM F2329 or with mechanically deposited zinc in accordance with ASTM B695 shall not exceed the maximum limit of pitch and major diameter of Class 2A by more than the following amounts:

Diameter, in.	Oversize Limit, in.
1/4	0.016
5/16 and 3/8	0.017
7/16 and 1/2	0.018
9/16 through 3/4	0.020
7/8	0.022
1 through 1 1/4	0.024
1 3/8 through 1 1/2	0.027
1 3/4 through 4	0.050

The gaging limit for bolts after coating shall be verified by assembly of a nut tapped as nearly as practical to the amount oversize shown in the above table. In the case of dispute, a calibrated GO thread ring gage of the same oversized requirements shown above shall be used. Assembly of the gage, or the oversized nut as described, must be possible with hand effort following application of light machine oil to prevent galling and damage to the gage or nut.

The full thread length shall be measured, parallel to the axis of the thread, from the extreme end of the bolt to the last complete (full form) thread. The transition from full thread to no thread shall be within three thread pitches of the basic full thread length.

2.4 Bend Diameters

The outside of the bent portion shall have no cracks. Unless otherwise specified, the cross-sectional area of the bend shall be the manufacturer's option. Inside diameters or bend radii shall be as agreed between the buyer and manufacturer, as each dimension depends on material characteristics. While a common rule is that a low carbon steel round bar of a given diameter can be bent into a radius equal to half of its diameter, users

are encouraged to consult the product manufacturer or ASTM A675/A675M for additional guidance.

2.5 Ends

For bolts made with UNC threads, the ends shall be chamfered or the first thread rolled undersize. For bolts made with UNF threads, the ends shall be chamfered.

2.6 Materials

Unless otherwise specified, the products in this Standard shall be made of low carbon steel as defined here as steel with less than 0.28% carbon. The minimum tensile strength for carbon steel shall be 36,000 psi unless a specific material specification is invoked or a higher tensile strength is specified by the purchaser.

Nonmandatory Appendix A provides PIN designators for some commonly used materials for parts illustrated in this Standard. This Standard does not supersede or change any requirements of those standards referenced in Nonmandatory Appendix A. Parts ordered using the PIN designators must still meet the requirements of the associated standards. Nonmandatory Appendix A does not limit the material options that can be ordered using the modified traditional system for identifying bent bolts provided in para. 2.9.2.

2.7 Finishes

The purchaser shall designate the required finish. Unless otherwise specified, plain finish steel shall be coated with a light oil to protect from corrosion during transportation and storage.

It is recommended that electroplated bolts be finished in accordance with ASTM F1941. Hot-dip zinc coating shall be in accordance with ASTM F2329. For other coated products, the purchaser shall specify the coating and thickness. A number of coatings are identified in Nonmandatory Appendix A.

Unless otherwise specified by the purchaser, coating thickness and embrittlement testing conformance shall be determined in accordance with the specified coating standard. If the number of samples to be tested is not identified in the coating specification, the number of samples shall be as required by ASTM F1470.

2.8 Workmanship

Workmanship and surface discontinuities shall conform to the requirements in the referenced product material standard (see para. 2.6). When the engineering application or the application requirements necessitate that surface discontinuities be more closely controlled, the purchaser shall specify the applicable limits in the original inquiry and purchase order.

When a referenced fastener product or material standard does not address cracks and bends, there shall be none that are visible without magnification.

2.9 Designation

Bent bolts covered in this Standard may be designated (ordered) by either of two methods. For standard bent bolts to the dimensions shown in the tables, the bolts may be ordered by the PIN system identified in Nonmandatory Appendix A. The modified traditional designation as identified in para. 2.9.2 must be used when the desired bolt configuration is not defined in the tables of this Standard. This modified traditional designation method can be used for configurations identified in the tables, but the PIN method identified in para. 2.9.1 is recommended.

2.9.1 Designation by PIN. The PIN system for designating parts is contained in Nonmandatory Appendix A. Where dimensional tables have been developed for this Standard, the tables will include PIN fields to be used to identify the diameter and other characteristics in the system identified in Nonmandatory Appendix A. Using this system allows the bolt to be designated and ordered simply by the PIN. If dimensions other than those covered by the tables are required, then it will be necessary to use the method outlined below to designate the requirements.

2.9.2 Modified Traditional System for Identifying Bent Bolts. The traditional system for identifying bent bolts has been defined in a standard issued by the Industrial Fasteners Institute (IFI). Many manufacturers use a similar method.

2.9.2.1 For this Standard the following modifications have been made to simplify and standardize the system. The modifications to bent bolts are as follows:

(a) The *D*, *L*, *C*, and *T* dimensions are used in the sequence shown for all configurations.

(b) Additional characters (*A*, *B*, *E*, *M*, and *N*) as identified for each configuration follow the *D*, *L*, *C*, and *T* dimensions in alphabetical order.

(c) The *R* designation is not listed for round hook and J-bolts, since this dimension is equivalent to *C*/2. The *R* radius is one-half the basic inside width *C*.

2.9.2.2 Bent bolts shall be designated by data in the sequence specified in part illustrations and as outlined as follows:

(a) product name

(b) product standard, ASME B18.31.5 nominal size (fractional or decimal equivalent), *D*

(c) threads per inch

(d) product length (end to internal bend), *L*

(e) internal measurement of bend, *C*

(f) thread length, *T*

(g) additional dimensional requirements *A*, *B*, *E*, *M*, and *N* when identified under the figure for applicable bolts

(h) material, including specification where necessary

(i) finish

2.9.2.3 Refer to the following examples that use the modified traditional system for identifying bent bolts:

(a) U-bolt, round bend per ASME B18.31.5, $\frac{3}{8}$-16 × $2\frac{1}{4}$ in. × $1\frac{1}{4}$ in. × $1\frac{1}{4}$ in., low carbon steel per SAE J429, Grade 1, FeZn 8C per ASTM F1941 or per PIN system AE315U06C022S1Z8.

(b) Closed eyebolt per ASME B18.31.5, $\frac{5}{16}$-18 × $3\frac{13}{16}$ in. × $\frac{5}{8}$ in. × $1\frac{1}{2}$ in., low carbon steel per SAE J429, Grade 1, plain or per PIN system AE31505C38S1.

(c) J-hook per ASME B18.31.5, $\frac{3}{8}$-16 × 8 in. × $\frac{3}{4}$ in. × $2\frac{1}{2}$ in. × $\frac{3}{4}$ in. × $\frac{1}{4}$ in., 304 Stainless Steel per ASTM F593. No PIN system is available for this product.

(d) Slant bolt, vee bend per ASME B18.31.5, $\frac{1}{2}$-13 × 4 in. × $2\frac{1}{2}$ in. × 1 in. × 45-deg bend, 4140 material, plain. No PIN system is available for this product.

2.10 Grade Symbol and Manufacturer's Marking

Low carbon steel bolts made to this Standard do not require marking, special packaging, or additional labeling unless otherwise specified by the purchaser. Bent bolts made of other materials shall follow the marking, packaging, and labeling requirements of the applicable bolt standard specified by the purchaser.

2.11 Inspection and Quality Assurance

Bolts shall be inspected to determine conformance with this Standard. Inspection requirements shall be specified by the purchaser in the original inquiry, purchase order, or the engineering drawings, or shall be as agreed upon between the purchaser and supplier prior to acceptance of the order. In the absence of a defined agreement, the requirements of ASME B18.18 shall apply.

2.12 Dimensional Characteristics

The dimensions indicated in the respective tables are considered standard and should be used whenever feasible. Bent bolts to dimensions other than those listed in the tables can be ordered using the designation system identified in para. 2.9.2. Tolerances for dimensions outside of the tables should be as agreed upon between the purchaser and supplier prior to acceptance of the order. Unless otherwise specified, products shall be furnished in accordance with ASME B18.18. Should a dimension be determined to have a variance, it shall be deemed conforming to this Standard if the user, who is the installer, accepts the variance based on fit, form, and function considerations.

If it is critical to the intended use of the product, the limits and the inspection technique to be used to evaluate shall be agreed upon between the purchaser and the supplier for other dimensional characteristics including but not limited to straightness, parallelism, and/or flatness.

2.13 Dimensional Tolerances

When dimensional tolerances are not identified in the tables for a particular configuration, the following tolerances shall apply unless otherwise specified or agreed to by the purchaser.

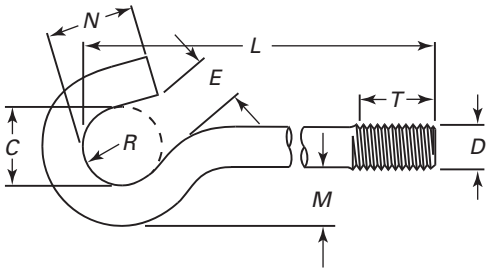
Dimension	Value of Dimension, in.	Tolerance, in.
Length, *L*	Up to 2.5	±0.060
	>2.5 to 6.0	±0.100
	>6.0 to 12	±0.120
	>12.0	±0.160
Inside width, *C*	Up to 2.5	+0.060/−0.030
	>2.5 to 6.0	+0.100/−0.050
	>6.0 to 12.0	+0.120/−0.060
	>12.0	+0.180/−0.090
Thread length, *T*	All	±1 thread pitch
Hook length, *A*	Up to 1.500	±0.030
	Over 1.500	±0.060
Opening, E	All	+0.150/−0.060
J-bolt offset, *M*	All	±0.060
J-bolt hook length, *N*	All	+0.060/−0.030

2.14 Hot Bending

For hot bending of non–heat-treated bent bolts of low carbon steel, the temperature of the bar in the bend location shall not exceed 1,300°F.

For hot bending of heat-treated bent bolts of low carbon steel, the temperature of the bend location shall be at least 50°F less than the minimum tempering temperature permitted in its heat treating.

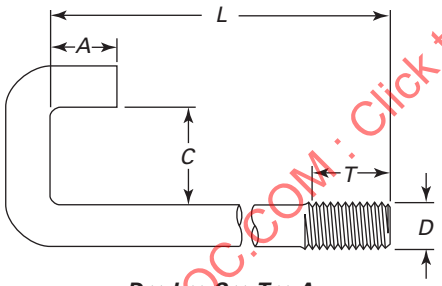
Fig. 1 Dimensions of J-Bolts, Offset Round Bend
(Courtesy of Industrial Fasteners Institute)



D* × *L* × *C* × *T* × *E* × *M* × *N

GENERAL NOTE: Until standard dimensions are developed, J-bolts, offset round bend should be ordered by dimensions shown in Fig. 1 as required in para. 2.9.2. The *R* dimension is *C*/2. When the additional dimensions *E*, *M*, and *N* are not critical to the application, the bolt may be ordered as an eyebolt, open anchor ring.

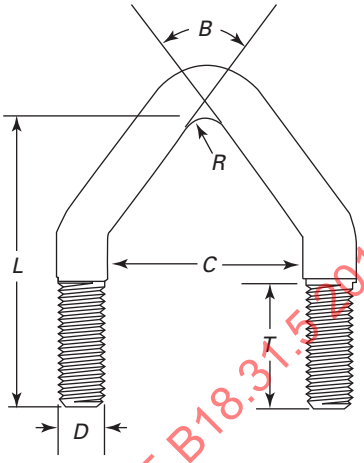
Fig. 2 Dimensions of Hook Bolts, Square Bends
(Courtesy of Industrial Fasteners Institute)



D* × *L* × *C* × *T* × *A

GENERAL NOTE: Until standard dimensions are developed, hook bolts, square bends should be ordered by dimensions shown above in accordance with para. 2.9.2.

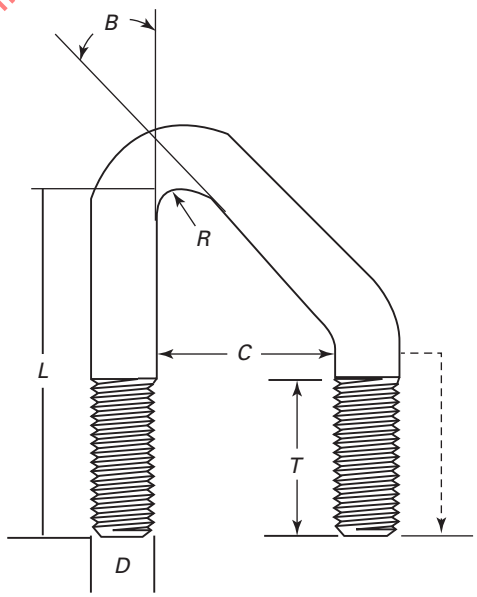
Fig. 3 Dimensions of U-Bolts, Vee Bend



D* × *L* × *C* × *T* × *B

GENERAL NOTE: Until standard dimensions are developed, U-bolts, vee bend should be ordered by dimensions shown in Fig. 3 as required in para. 2.9.2.

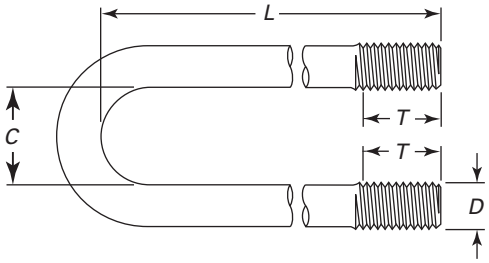
Fig. 4 Dimensions of Slant U-Bolts



D* × *L* × *C* × *T* × *B

GENERAL NOTE: Until standard dimensions are developed, U-bolts, slant bend should be ordered by dimensions shown in Fig. 4 as required in para. 2.9.2. If the angle *B* is not specified, the manufacturer shall select an angle between 45 deg and 60 deg.

Table 1 Dimensions of U-Bolts, Round Bend



D × L × C × T

PIN Fields		Diameter, *D*, and UNC Thread	Inside Length, *L*			Inside Width, *C* [Note (2)]			Thread Length, *T*		Nominal Pipe Size
3, *D*	5, *LCT*	[Note (1)]	Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.	
04	012	1/4-20	1.250	1.280	1.220	0.563	0.593	0.533	0.810	0.690	1/4
04	013	1/4-20	1.250	1.280	1.220	0.750	0.780	0.720	0.685	0.565	3/8
04	022	1/4-20	2.250	2.280	2.220	0.750	0.780	0.720	1.560	1.440	3/8
04	017	1/4-20	1.750	1.780	1.720	1.000	1.030	0.970	1.060	0.940	1/2
04	020	1/4-20	2.000	2.030	1.970	1.000	1.030	0.970	1.060	0.940	3/4
04	031	1/4-20	3.125	3.155	3.095	1.000	1.030	0.970	1.560	1.440	3/4
04	023	1/4-20	2.250	2.280	2.220	1.125	1.155	1.095	1.310	1.190	3/4
04	027	1/4-20	2.750	2.780	2.720	1.125	1.155	1.095	1.435	1.315	1
04	034	1/4-20	3.438	3.468	3.408	1.125	1.155	1.095	2.435	2.315	1
04	030	1/4-20	3.000	3.030	2.970	1.250	1.280	1.220	1.435	1.315	1 1/4
04	032	1/4-20	3.250	3.280	3.220	1.250	1.280	1.220	1.435	1.315	1 1/2
05	021	5/16-18	2.188	2.218	2.158	1.375	1.405	1.345	1.435	1.315	1/2
05	022	5/16-18	2.188	2.218	2.158	1.375	1.405	1.345	1.060	0.940	3/4
05	023	5/16-18	2.188	2.218	2.158	1.500	1.530	1.470	1.060	0.940	1
05	026	5/16-18	2.688	2.718	2.658	1.500	1.530	1.470	1.185	1.065	1 1/4
05	045	5/16-18	4.500	4.530	4.470	1.750	1.780	1.720	2.060	1.940	1 1/4
05	027	5/16-18	2.688	2.718	2.658	1.750	1.780	1.720	1.060	0.940	1 1/2
05	047	5/16-18	4.750	4.780	4.720	1.750	1.780	1.720	3.060	2.940	1 1/2
05	032	5/16-18	3.188	3.218	3.158	1.750	1.780	1.720	1.060	0.940	2
05	056	5/16-18	5.625	5.685	5.565	2.000	2.030	1.970	3.060	2.940	2
05	037	5/16-18	3.688	3.718	3.658	2.000	2.030	1.970	1.060	0.940	2 1/2
06	022	3/8-16	2.250	2.280	2.220	2.000	2.030	1.970	1.310	1.190	1/2
06	023	3/8-16	2.250	2.280	2.220	2.000	2.030	1.970	1.310	1.190	3/4
06	025	3/8-16	2.500	2.530	2.470	2.500	2.530	2.470	1.310	1.190	1
06	027	3/8-16	2.750	2.780	2.720	2.500	2.530	2.470	1.185	1.065	1 1/4
06	026	3/8-16	2.625	2.655	2.595	2.500	2.530	2.470	1.310	1.190	1 1/2
06	031	3/8-16	3.125	3.155	3.095	3.000	3.030	2.970	1.310	1.190	2
06	036	3/8-16	3.625	3.655	3.595	3.000	3.030	2.970	1.310	1.190	2 1/2
06	066	3/8-16	6.625	6.685	6.565	3.000	3.030	2.970	3.060	2.940	2 1/2
06	041	3/8-16	4.125	4.155	4.095	3.000	3.030	2.970	1.310	1.190	3
06	055	3/8-16	5.500	5.560	5.440	3.500	3.530	3.470	2.310	2.190	3 1/2
08	045	1/2-13	4.500	4.530	4.470	3.500	3.530	3.470	1.685	1.565	2 1/2
08	050	1/2-13	5.000	5.060	4.940	3.500	3.530	3.470	1.560	1.440	3
08	085	1/2-13	8.500	8.590	8.410	4.000	4.030	3.970	3.060	2.940	3
08	055	1/2-13	5.500	5.560	5.440	4.000	4.030	3.970	1.560	1.440	3 1/2

Table 1 Dimensions of U-Bolts, Round Bend (Cont'd)

PIN Fields		Diameter, *D*, and UNC Thread	Inside Length, *L*			Inside Width, *C* [Note (2)]			Thread Length, *T*		Nominal Pipe Size
3, *D*	5, *LCT*	[Note (1)]	Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.	
08	060	1/2-13	6.000	6.060	5.940	4.500	4.530	4.470	1.560	1.440	4
08	072	1/2-13	7.250	7.310	7.190	5.625	5.685	5.565	2.060	1.940	5
08	084	1/2-13	8.375	8.465	8.285	6.750	6.810	6.690	2.060	1.940	6
08	104	1/2-13	10.375	10.465	10.285	8.750	8.840	8.930	2.060	1.940	8
12	138	3/4-10	13.813	13.933	13.693	10.875	10.965	11.055	4.060	3.940	10
14	161	7/8-9	16.063	16.183	15.943	12.875	12.995	12.755	4.310	4.190	12
14	173	7/8-9	17.313	17.433	17.193	14.125	14.245	14.005	4.310	4.190	14
14	193	7/8-9	19.313	19.433	19.193	16.125	16.245	16.005	4.310	4.190	16
16	217	1-8	21.688	21.808	21.568	18.125	18.245	18.005	4.810	4.690	18

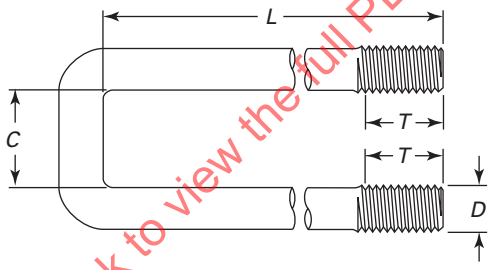
GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTES:

(1) UNC threads are standard for low strength materials, but UNF threads are usually available on special order.

(2) Dimension *C* should be measured at point 1/2*L* from the threaded end.

Table 2 Dimensions of U-Bolts, Square Bends



D* × *L* × *C* × *T

PIN Fields		Diameter, *D*, and UNC Thread	Inside Length, *L*			Inside Width, *C* [Note (2)]			Thread Length, *T*	
3, *D*	5, *LCT*	[Note (1)]	Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.
05	027	5/16-18	2.688	2.718	2.658	2.000	2.030	1.970	1.560	1.440
05	047	5/16-18	4.688	4.718	4.658	2.000	2.030	1.970	3.060	2.940
05	030	5/16-18	6.688	6.748	6.628	2.000	2.030	1.970	3.060	2.940
06	020	3/8-16	2.000	2.030	1.970	2.625	2.655	2.595	1.560	1.440
06	021	3/8-16	2.000	2.030	1.970	4.625	4.655	4.595	3.060	2.940
06	022	3/8-16	2.000	2.030	1.970	6.625	6.685	6.565	3.810	3.690
06	040	3/8-16	4.000	4.030	3.970	2.625	2.655	2.595	1.560	1.440
06	041	3/8-16	4.000	4.030	3.970	4.625	4.655	4.595	3.060	2.940
06	042	3/8-16	4.000	4.030	3.970	6.625	6.685	6.565	3.810	3.690
06	060	3/8-16	6.000	6.060	5.940	4.625	4.655	4.595	3.060	2.940
06	061	3/8-16	6.000	6.060	5.940	6.625	6.685	6.565	3.810	3.690
06	062	3/8-16	6.000	6.060	5.940	8.625	8.715	8.535	5.685	5.565
06	080	3/8-16	8.000	8.090	7.910	4.625	4.655	4.595	3.060	2.940
06	081	3/8-16	8.000	8.090	7.910	6.625	6.685	6.565	3.810	3.690
06	082	3/8-16	8.000	8.090	7.910	8.625	8.715	8.535	5.685	5.565

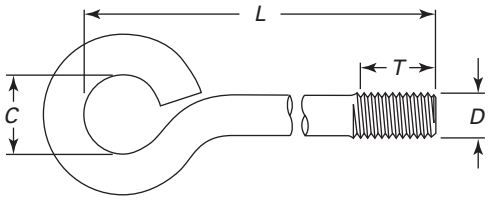
GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTES:

(1) UNC threads are standard for low strength materials, but UNF threads are usually available on special order.

(2) Dimension *C* should be measured at point 1/2*L* from the threaded end.

Table 3 Dimensions of Eyebolts, Closed Anchor Ring



$D \times L \times C \times T$

PIN Fields		Diameter, *D*, and UNC Thread	Inside Length, *L*			Inside Width, *C* [Note (2)]			Thread Length, *T*	
3, *D*	5, *LCT*	[Note (1)]	Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.
03	015	10-24	1.500	1.530	1.470	0.375	0.385	0.365	0.935	0.815
03	018	10-24	1.813	1.843	1.783	0.313	0.323	0.303	1.310	1.190
03	025	10-24	2.500	2.530	2.470	0.375	0.385	0.365	1.060	0.940
03	035	10-24	3.500	3.530	3.470	0.375	0.385	0.365	1.560	1.440
04	018	1/4-20	1.750	1.780	1.720	0.500	0.515	0.485	0.935	0.815
04	023	1/4-20	2.250	2.280	2.220	0.500	0.515	0.485	1.310	1.190
04	028	1/4-20	2.750	2.780	2.720	0.500	0.515	0.485	1.310	1.190
04	033	1/4-20	3.250	3.280	3.220	0.500	0.515	0.485	1.310	1.190
04	038	1/4-20	3.750	3.780	3.720	0.500	0.515	0.485	1.560	1.440
04	048	1/4-20	4.750	4.780	4.720	0.500	0.515	0.485	2.560	2.440
04	058	1/4-20	5.750	5.810	5.690	0.500	0.515	0.485	3.060	2.940
04	068	1/4-20	6.750	6.810	6.690	0.500	0.515	0.485	4.060	3.940
05	018	5/16-18	1.813	1.843	1.783	0.625	0.640	0.610	0.935	0.815
05	028	5/16-18	2.813	2.843	2.783	0.625	0.640	0.610	1.310	1.190
05	038	5/16-18	3.813	3.843	3.783	0.625	0.640	0.610	1.560	1.440
05	048	5/16-18	4.813	4.843	4.783	0.625	0.640	0.610	2.560	2.440
06	021	3/8-16	2.125	2.155	2.095	0.750	0.765	0.735	0.935	0.815
06	031	3/8-16	3.125	3.155	3.095	0.750	0.765	0.735	1.310	1.190
06	036	3/8-16	3.625	3.655	3.595	0.750	0.765	0.735	1.560	1.440
06	041	3/8-16	4.125	4.155	4.095	0.750	0.765	0.735	1.560	1.440
06	051	3/8-16	5.125	5.185	5.065	0.750	0.765	0.735	2.560	2.440
06	061	3/8-16	6.125	6.185	6.065	0.750	0.765	0.735	3.060	2.940
06	071	3/8-16	7.125	7.185	7.065	0.750	0.765	0.735	4.060	3.940
08	035	1/2-13	3.500	3.530	3.470	1.000	1.015	0.985	1.560	1.440
08	055	1/2-13	5.500	5.560	5.440	1.000	1.015	0.985	2.560	2.440
08	075	1/2-13	7.500	7.560	7.440	1.000	1.015	0.985	4.060	3.940
12	083	3/4-10	8.250	8.340	8.160	0.875	0.890	0.860	3.060	2.940
12	103	3/4-10	10.250	10.340	10.160	0.875	0.890	0.860	3.060	2.940
12	133	3/4-10	13.250	13.370	13.130	0.875	0.890	0.860	3.060	2.940

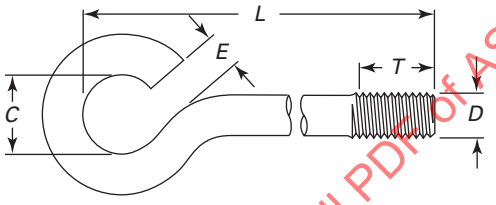
GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTES:

(1) UNC threads are standard for low strength materials, but UNF threads are usually available on special order.

(2) Dimension *C* should be measured at maximum diameter of the inner circle.

Table 4 Dimensions of Eyebolts, Open Anchor Ring



D* × *L* × *C* × *T* × *E

PIN Fields		Diameter, *D*, and UNC Thread [Note (1)]	Inside Length, *L*			Inside Width, *C* [Note (2)]			Thread Length, *T*		Open Length, *E*	
3, *D*	5, *LCT*		Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.	Max.	Min.
03	028	10-24	2.813	2.843	2.783	0.313	0.323	0.303	2.373	2.253	0.198	0.178
03	038	10-24	3.813	3.843	3.783	0.313	0.323	0.303	3.373	3.253	0.198	0.178
03	058	10-24	5.813	5.873	5.753	0.313	0.323	0.303	5.373	5.253	0.198	0.178
04	028	1/4-20	2.750	2.780	2.720	0.500	0.510	0.490	2.060	1.940	0.323	0.303
04	038	1/4-20	3.750	3.780	3.720	0.500	0.510	0.490	3.060	2.940	0.323	0.303
04	058	1/4-20	5.750	5.810	5.690	0.500	0.510	0.490	5.060	4.940	0.323	0.303

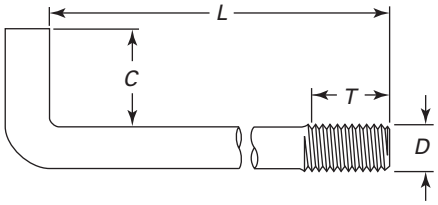
GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTES:

(1) UNC threads are standard for low strength materials, but UNF threads are usually available on special order.

(2) Dimension *C* should be measured at maximum diameter of the inner circle.

Table 5 Dimensions of Hook Bolts, Right Angle Bend



D × *L* × *C* × *T*

PIN Fields		Diameter, *D*, and UNC Thread [Note (2)]	Inside Length, *L*			Inside Width, *C*			Thread Length, *T*	
3, *D*	5 [Note (1)], *LCT*		Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.
06	060	3/8-16	6.000	6.125	5.875	1.000	1.125	0.875	1.625	1.375
06	080	3/8-16	8.000	8.125	7.875	1.000	1.125	0.875	1.625	1.375
06	100	3/8-16	10.000	10.125	9.875	1.000	1.125	0.875	1.625	1.375
06	120	3/8-16	12.000	12.125	11.875	1.000	1.125	0.875	1.625	1.375
06	140	3/8-16	14.000	14.125	13.875	1.000	1.125	0.875	1.625	1.375
06	160	3/8-16	16.000	16.125	15.875	1.000	1.125	0.875	1.625	1.375
08	060	1/2-13	6.000	6.125	5.875	1.000	1.125	0.875	2.125	1.875
08	080	1/2-13	8.000	8.125	7.875	1.000	1.125	0.875	2.125	1.875
08	100	1/2-13	10.000	10.125	9.875	1.000	1.125	0.875	2.125	1.875
08	120	1/2-13	12.000	12.125	11.875	1.000	1.125	0.875	2.125	1.875
08	140	1/2-13	14.000	14.125	13.875	1.000	1.125	0.875	2.125	1.875
08	160	1/2-13	16.000	16.125	15.875	1.000	1.125	0.875	2.125	1.875
08	180	1/2-13	18.000	18.125	17.875	1.000	1.125	0.875	2.125	1.875
10	060	5/8-11	6.000	6.125	5.875	2.000	2.125	1.875	4.188	3.812
10	080	5/8-11	8.000	8.125	7.875	2.000	2.125	1.875	4.188	3.812
10	100	5/8-11	10.000	10.125	9.875	2.000	2.125	1.875	4.188	3.812
10	120	5/8-11	12.000	12.125	11.875	2.000	2.125	1.875	4.188	3.812
10	140	5/8-11	14.000	14.125	13.875	2.000	2.125	1.875	4.188	3.812
10	160	5/8-11	16.000	16.125	15.875	2.000	2.125	1.875	4.188	3.812
10	180	5/8-11	18.000	18.125	17.875	2.000	2.125	1.875	4.188	3.812
12	080	3/4-10	8.000	8.188	7.812	3.000	3.188	2.812	4.250	3.750
12	100	3/4-10	10.000	10.188	9.812	3.000	3.188	2.812	4.250	3.750
12	120	3/4-10	12.000	12.188	11.812	3.000	3.188	2.812	4.250	3.750
12	140	3/4-10	14.000	14.188	13.812	3.000	3.188	2.812	4.250	3.750
12	160	3/4-10	16.000	16.188	15.812	3.000	3.188	2.812	4.250	3.750
12	180	3/4-10	18.000	18.188	17.812	3.000	3.188	2.812	4.250	3.750
12	240	3/4-10	24.000	24.250	23.750	3.000	3.188	2.812	4.250	3.750
16	100	1-8	10.000	10.188	9.812	3.500	3.688	3.312	6.250	5.750
16	120	1-8	12.000	12.188	11.812	3.500	3.688	3.312	6.250	5.750
16	140	1-8	14.000	14.188	13.812	3.500	3.688	3.312	6.250	5.750
16	160	1-8	16.000	16.188	15.812	3.500	3.688	3.312	6.250	5.750
16	180	1-8	18.000	18.188	17.812	3.500	3.688	3.312	6.250	5.750
16	240	1-8	24.000	24.250	23.750	3.500	3.688	3.312	6.250	5.750

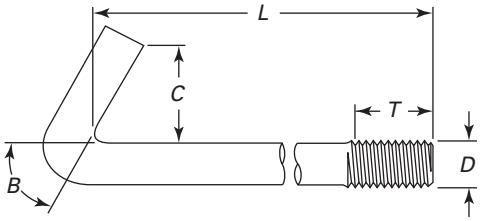
GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTES:

(1) Field 5 is the length in tenths of an inch. Other lengths are not considered standard but may be ordered using the appropriate length for Field 5 as the inside length and thread length are fixed for a specific diameter. If *C* or *T* dimensions other than those listed in the table are required, the alternate designation system described in para. 2.1 must be used to designate the required configuration.

(2) UNC threads are standard for low strength materials, but UNF threads are usually available on special order. Use Field 4 to designate thread configuration.

Table 6 Dimensions of Hook Bolts, Acute Angle Bend



D* × *L* × *C* × *T* × *B

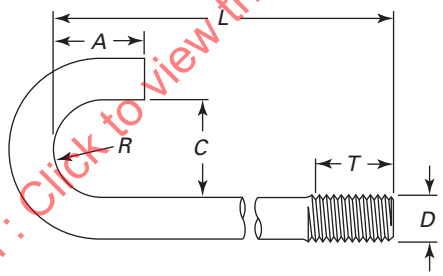
PIN Fields		Diameter, *D*, and UNC Thread	Inside Length, *L*			Inside Width, *C*			Thread Length, *T*		Reference Bend Angle, *B*,
3, *D*	5, *LCTB*	[Note (1)]	Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.	deg
08	035	1/2-13	3.500	3.530	3.470	1.250	1.280	1.220	2.560	2.440	63
08	055	1/2-13	5.500	5.560	5.440	1.250	1.280	1.220	3.060	2.940	63
10	045	5/8-11	4.500	4.530	4.470	1.250	1.280	1.220	2.810	2.690	63
10	065	5/8-11	6.500	6.560	6.440	1.250	1.280	1.220	3.560	3.440	63

GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTE:

(1) UNC threads are standard for low strength materials, but UNF threads are usually available on special order.

Table 7 Dimensions of Round Bend Hook Bolts



D* × *L* × *C* × *T* × *A

PIN Fields		Diameter, *D*, and UNC Thread	Inside Length, *L*			Inside Width, *C*			Thread Length, *T*		Reference	Hook Length, *A*	
3, *D*	5, *LCTA*	[Note (1)]	Basic	Max.	Min.	Basic	Max.	Min.	Max.	Min.	Radius, *R*	Max.	Min.
06	038	3/8-16	3.750	3.780	3.720	0.625	0.655	0.595	2.310	2.190	0.312	1.030	0.970
06	050	3/8-16	5.000	5.060	4.940	0.625	0.655	0.595	2.310	2.190	0.312	1.030	0.970
06	070	3/8-16	7.000	7.060	6.940	0.625	0.655	0.595	2.310	2.190	0.312	1.030	0.970
08	080	1/2-13	8.000	8.090	7.910	1.000	1.030	0.970	3.060	2.940	0.500	1.280	1.220

GENERAL NOTE: Illustration courtesy of Industrial Fasteners Institute.

NOTE:

(1) UNC threads are standard for low strength materials, but UNF threads are usually available on special order.

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NONMANDATORY APPENDIX A
PART IDENTIFYING NUMBER SYSTEM FOR BENT BOLTS

A-1 PART IDENTIFYING NUMBERS (PINs) FOR SELECTED BENT BOLTS

PINs are provided herein for selected bent bolts for common logistics identification among designers, fastener manufacturers, construction and repair activities, and equipment operators. PINs are required for military applications and provide a concise method of identifying parts in all applications. PINs are provided for only those bent bolts of configurations and materials most commonly used. For part configurations and materials not covered, an alternate method of identifying parts is identified in this Standard. Bolts with different dimensions will be considered for addition in future revisions. Inclusion in this Standard does not guarantee availability.

A-2 THE PIN SYSTEM

Figure A-1 illustrates the PIN system. The system consists of seven fields in the order identified in Fig. A-1. There are no blank spaces in the PIN. The two-digit number for Field 3, the diameter of the bolt, and Field 5, representing other dimensional characteristics, are found in the dimensional table for the applicable bent bolt configuration. The Field 3 diameter is generally the diameter in sixteenths of an inch. Although Field 5 represents all the remaining dimensions of the applicable bolt, it is generally the length of the bolt in tenths of an inch. For example, 027 would represent a length of 2.75 in. If another bolt is of the same diameter and general configuration with the same length but a different width, it may be designated by 028.

A-2.1 PIN Coverage for Additional Lengths

For some configurations as indicated in the tables, the PIN field permits lengths other than those listed as standard to be designated.

A-2.2 Identification of Materials and Finishes

Table A-1 identifies materials covered by the PIN system with a two-character field. Table A-2 identifies finishes covered by the PIN with a three-character field, although use of the second and third characters is optional.

A-3 IDENTIFICATION OF PART NUMBERING SYSTEM ON DRAWINGS

On drawings or parts lists where a column exists for identifying the manufacturer or its Commercial and Government Entity Code, indicate the CAGE Code "05047/B18.31.5" or "ASME B18.31.5." If no column exists or there is space only for the five-digit CAGE Code, then a note must indicate that the part numbers are defined in ASME B18.31.5.

Fig. A-1 Part Identification Number (PIN) System

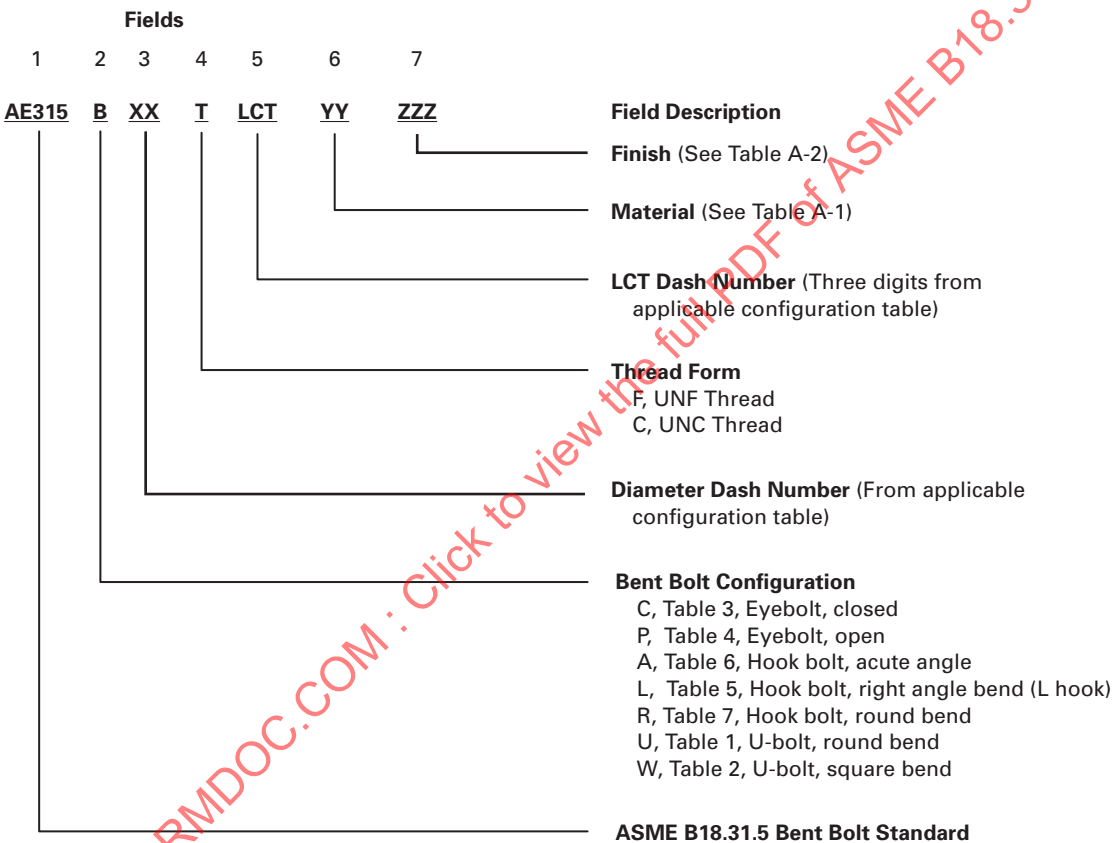

Table A-1 Materials for Bent Bolts

Field 5 Designator	Material Standard	Material Grade/Alloy	Description	UNS No.
		Nonferrous Materials		
A2	ASTM F468	Aluminum alloy 2024	. . .	A92024
A6	ASTM F468	Aluminum alloy 6061	. . .	A96061
A7	ASTM F468	Aluminum alloy 7075	. . .	A97075
B2	ASTM F468	Brass alloy 260 or 270	. . .	C26000 or C27000
L5	ASTM F468	Cu 655 [Note (1)]	Silicon bronze	C65500
N4	ASTM F468	Ni 400 [Note (2)]	Nickel–copper	N04400
		Stainless Steel Materials		
C3	ASTM F593	Alloy Group 1 or 2 cold worked	300 series stainless steel	As permitted by ASTM F593
C4	ASTM F593	Alloy 304 from Group 1 cold worked	304 stainless steel	S30400
C6	ASTM F593	Alloy Group 2 cold worked	316 stainless steel	S31600
		Carbon and Alloy Steel Materials		
S1	SAE J429	Grade 1	Low or medium carbon steel	. . .
S2	SAE J429	Grade 2	Low or medium carbon steel	. . .
S5	SAE J429	Grade 5	Medium carbon steel	. . .
S8	SAE J429	Grade 8	Medium carbon alloy steel	. . .
S3	ASTM F1554 [Note (3)]	Grade 36	Low carbon steel	. . .
S6	ASTM F1554 [Note (3)]	Grade 55	Low alloy steel	. . .
S7	ASTM A307	Grade A	Carbon steel	. . .
B7	ASTM A193/A193M	Grade 7	Chrome–molybdenum steel	. . .
L7	ASTM A320/A320M	Grade L7	Alloy steel for low temperature	. . .

NOTES:
(1) The higher strength alloy C651 may be substituted for alloy C655.
(2) Ni–Cu alloy 405 per ASTM F468 may be substituted for diameters greater than 0.750 in.
(3) This specification has dimensional requirements that should be referenced when ordering.

Table A-2 Finish Designations

Field 6 Designation	Type Coating	First Letter Designator	Thickness, in.	Second Letter Designator	Chromate Finish: Type	Chromate Finish: Third Letter Designator
	ASTM F1941 Electrodeposited Coatings					
Select the three designators that describe the coating [Note (1)]	Fe/Cd	D	0.0001	3	Clear	A
	Fe/Zn	Z	0.0002	5	Bright blue	B
	Fe/Zn–Co	C	0.0003	8	Yellow	C
	Fe/Zn–Ni [Note (2)]	N	0.0005	X	Opaque	D
					Black	E
					Organic	F
	ASTM F2329					
. . .	Hot-dip galvanizing	G	. . .	. . .	. . .	. . .
	ASTM B695					
. . .	Mechanically deposited zinc	M	. . .	. . .	. . .	. . .

NOTES:
(1) The second and third letter designators may be deleted if the purchaser wants to leave these characteristics as a manufacturer's option.
(2) For this type coating either opaque, black, or organic type chromate finish may apply.