ASME B18.29.1-2010

[Revision of ASME B18.29.1-1993 (R2007)]

Helical Coil Screw Thread Inserts — Free Running and Screw Locking (Inch Series)

AN AMERICAN NATIONAL STANDARD

ASME

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Three Park Avenue • New York, NY • 10016 USA

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

ASME issues written replies to inquiries concerning interpretations of technical aspects of this document. Periodically, certain actions of the ASME B18 Committee may be published as Cases. Cases and interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.

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

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FOREWORD

Although this is the first ASME standard covering helical coil screw thread inserts, they have been in use for many years. The helical coil screw thread insert was invented in the 1930s and found initial acceptance in aircraft manufactured and serviced by the Allied Air Forces during World War II.

Since that time, applications for helical coil inserts have come into broad usage in aerospace, automotive, and industrial original equipment design, production salvage (repair), and in-service repair.

Although this usage did include metric spark plug sizes, the regular metric series was delineated in Europe in the 1950s, and came into production in the inch-using countries in the 1960s.

Subcommittee 29, Threaded Inserts, met initially in May 1989 after authorization by the ASME B18 Committee to proceed with development of standards covering screw thread inserts.

Following approval by the B18 Committee, the proposal was submitted to the American National Standards Institute for approval. The 1993 edition was approved by ANSI on February 4, 1993.

In 2008, an update of this Standard was initiated by the ASME B18.29 Subcommittee. After needed revisions and additions were clearly identified, ballots were properly undertaken. Ballots resulted in changes related to the ballot comments. In 2009, this Standard was approved by the B18.29 Subcommittee and the B18 Committee.

This revision was approved by the American National Standards Institute (ANSI) on February 25, 2010.

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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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
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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.

HELICAL COIL SCREW THREAD INSERTS— FREE RUNNING AND SCREW LOCKING (INCH SERIES)

1 INTRODUCTORY NOTES

1.1 Scope

1.1.1 This Standard delineates the dimensional data for the inch series helical coil screw thread inserts and the threaded holes into which they are installed. Both free-running and screw-locking types having unified fine and unified coarse thread series from size #1 through 1½ in. are covered. Appendices that describe insert selection, STI (screw thread insert) taps, gages and gaging, insert installation, and removal tooling are also included.

1.1.2 The inclusion of dimensional data in this Standard is not intended to imply that all products described are stock sizes. Consumers should consult with manufacturers concerning availability.

1.2 References

The latest editions of the following documents form a part of this Standard to the extent specified herein.

Army A-A-59158, Tools for Inserting and Extracting Helical Coil Wire Screw Thread Inserts

Publisher: IHS Inc., 15 Inverness Way East, Englewood, CO 80112 (www.ihs.com)

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

ASME B1.2, Gages and Gaging for Unified Inch Screw Threads

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

ASME B18.18.2, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

ASME B46.1, Surface Texture, Surface Roughness, Waviness, and Lay

ASME B47.1, Gage Blanks

ASME B94.9, Taps: Ground and Cut Threads

ASME Y14.5M, Dimensioning and Tolerancing

ASME Y14.36, Surface Texture Symbols

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

ASTM E 290, Standard Test Methods for Bend Testing of Material for Ductility

ASTM B 209-02, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM A 370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428 (www.astm.org)

SAE AMS4120, Aluminum Alloy, Rolled or Cold Finished Bars, Rods, and Wire, 4.4Cu–1.5Mg–0.60Mn (2024), Solution Heat Treated and Naturally Aged (T4), Solution Heat Treated, Cold Worked, and Naturally Aged (T351)

SAE AS5272, Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting Procurement Specification

SAE AS8879, Screw Threads — UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter

SAE J417, Hardness Tests and Hardness Number Conversions.

Publisher: Society of Automotive Engineers (SAE International), 400 Commonwealth Drive, Warrendale, PA 15096-0001 (www.sae.org)

1.3 Description

Helical coil inserts are screw thread bushings coiled from wire of diamond shaped cross-sections. The inserts are screwed into STI tapped holes to form nominal size internal threads. Inserts are installed by torquing through a diametral tang. This tang is notched for removal after installation.

In the free state, the inserts are larger in diameter than the tapped hole into which they are installed. In the assembly operation, the torque applied to the tang reduces the diameter of the leading coil and permits it to enter the tapped thread. The remaining coils are reduced in diameter as they, in turn, are screwed into the tapped hole. When the torque or rotation is stopped, the coils expand with a spring-like action, anchoring the insert in place against the tapped hole.

1.4 Class of Fit

Since helical coil inserts are flexible, the class of fit of the final assembly is a function of the size of the tapped hole. Helical coil STI taps are available for both tolerance Classes 2B and 3B tapped holes. Tolerance Class 2B tapped holes provide maximum production tolerances, but result in lower locking torques when screw locking inserts are used. The higher and more consistent torques given in Table 5 are met by the screw locking inserts when assembled and tested in tolerance Class 3B tapped holes in accordance with section 2.

1.5 Compatibility

Assembled helical coil inserts will mate properly with items having UN external threads in accordance with ASME B1.1. In addition, due to the radius on the crest of the insert at the minor diameter, the assembled insert will mate with UNJ profile external threaded parts with controlled radius root threads per SAE AS8879.

1.6 Types of Inserts

1.6.1 Free-Running. The free-running insert provides a smooth, hard, and free-running thread.

1.6.2 Screw-Locking. The screw-locking insert provides a resilient locking thread produced by a series of chords on one or more of the insert coils.

2 STI TAPPED HOLE

The tapped hole into which the insert is installed shall be in accordance with ASME B1.1, except that diameters are larger to accommodate the wire cross-section of the insert. Dimensions of the STI tapped holes are shown in Table 1 and calculated per Note (3) of Table 1.

2.1 Screw Thread Designation

2.1.1 Designation for Tapped Hole. The drawing note for the STI threaded hole per Table 1 to accept the helical coil insert shall be in accordance with the following example:

EXAMPLE: 1/4-20 UNC-2B STI thread 0.430 min. depth, per ASME B18.29.1.

2.1.2 Designation for a Helical Coil Insert. Designation of the helical coil insert on parts lists, spares lists, purchase orders, etc., shall be in accordance with the following examples:

EXAMPLES:
(1) ASME B18.29.1, 1/4-20 UNC 0.375 long helical coil free-running insert.
(2) ASME B18.29.1, #10-32 UNF 0.380 long helical coil screw-locking insert.

2.1.3 Designation for STI Threaded Hole Including Installed Helical Coil Insert. The drawing note for the STI threaded hole per Table 1, having a helical coil insert installed, shall be in accordance with the following example:

EXAMPLES:
(1) 1/4-20 UNC-2B STI thread 0.430 deep.
(2) ASME B18.29.1, 1/4-20 UNC 0.375 long helical coil free-running insert.

2.2 Gages and Gaging

Acceptance of the threaded hole is determined by gaging with STI GO, NOT GO (HI), and plain cylindrical gages designed and applied in accordance with System 21 of ASME B1.3 (see Nonmandatory Appendix C).

3 HELICAL COIL INSERT

3.1 Insert Material

Chemical composition of the inserts is austenitic corrosion resistant (stainless) steel within the limits of Table 2.

3.2 Properties

3.2.1 Tensile Strength. Wire, before coiling into inserts, shall have tensile strength not lower than 150,000 psi, determined in accordance with ASTM A 370.

3.2.2 Bending. Wire shall withstand, without cracking, bending in accordance with ASTM E 290 at room temperature through an angle of 180 deg around a diameter equal to twice the cross-sectional dimension of the wire in the plane of the bend.

3.2.3 Workmanship. The formed wire shall be of uniform quality and temper; smooth, clean, free from kinks, waviness, splits, cracks, laps, seams, scale, segregation, and other defects that may impair the serviceability of the insert.

3.3 Coatings

3.3.1 Red Dye Identification. Screw-locking inserts are dyed red for identification. The red dye may completely or partially cover the insert. However, it must be sufficient to identify the insert when it is installed in the tapped hole.

3.3.2 Dry Film Lubricant Coating. When specified, dry film lubricant coating can be applied to helical coil inserts. It shall meet the requirements of para. 3.3.2.1 and para. 3.3.2.2. Color of dry film lubricated insert is dark gray to black.

3.3.2.1 Dry Film Material. The lubricant shall meet the requirements of SAE AS5272, Type I.

3.3.2.2 Thickness. The coating shall be uniformly deposited on the insert with minimum thickness being complete coverage. The maximum thickness shall be the avoidance of "bridging" between coils. Slight fill-in between closely wound coils that immediately separate as the coils are axially pulled apart by hand, shall not be considered "bridging."

3.4 Configuration and Dimensions

Insert configurations shall be in accordance with Fig. 1, and dimensions shall be in accordance with Tables 3 and 4.

3.4.1 Nominal Length. Each nominal insert size is standardized in five lengths which are multiples of the insert's nominal diameter. These are 1, 1½, 2, 2½, and 3 times nominal diameter.

Each nominal length is the minimum through-hole length (material thickness), without countersink, into which that insert can be installed. The nominal insert length is a reference value and cannot be measured.

3.4.2 Assembled Length. Actual assembled length of the insert equals nominal length minus ½ pitch to minus ¾ pitch, with insert installed in a basic STI threaded hole. It cannot be measured in the insert's free state.

4 INSPECTION AND QUALITY ASSURANCE

Unless otherwise specified by the purchaser, the inspection of inserts shall be in accordance with ASME B18.18.2 with inspection level 3 for a 15-cycle torque test as described in para. 4.2.3.

4.1 Inspection (Nondestructive)

4.1.1 Examination of the Product. Inserts shall be visually examined for conformance with drawings and workmanship requirements in accordance with ASME B18.18.2.

4.1.2 Threads. The inserts, when assembled in STI threaded holes conforming to Table 1, shall form threads conforming to ASME B1.1, tolerance Class 3B or Class 2B except for the locking feature of screw-locking inserts. The assembled insert, both types, shall accept and function with parts having external UNJ threads per SAE AS8879.

NOTE: Accuracy of the finished thread, when the insert is installed, is dependent upon the accuracy of the tapped hole. If the finished tapped hole gages satisfactorily, the installed insert will be within the thread tolerance when the insert meets the requirements of the Standard. It is, therefore, not necessary to gage the installed insert. After the insert is installed, the GO thread plug gage may not enter freely because the insert may not have been fully seated in the tapped hole. However, the insert should become seated after a bolt or screw is installed and tightened.

4.1.3 Tang Removal Notch. The tang removal notch shall be located as shown in Fig. 1 and shall be of such depth that the part may be installed without failure of the tang, and that the tang may be removed, after assembly, without affecting the function of the installed insert.

4.2 Screw-Locking Insert Self-Locking Torque (Destructive) Testing

The screw-locking insert, when assembled in threaded holes conforming to Table 1 and tested in accordance with the following paragraphs, shall provide a frictional lock to retain the bolt threads within the torque limits specified in Table 5.

4.2.1 Torque Test Bolts. Assembled screw-locking inserts shall be torque-tested with bolts in accordance with ASME B1.1, cadmium plated, or have other coating with a similar coefficient of friction and a hardness of 36 HRC to 44 HRC. The bolts selected for this test shall be of sufficient length so the thread run out does not enter the insert and that a minimum of one full thread extends past the end of the insert when the bolt is fully seated. Acceptability of bolt threads shall be determined based on System 22 of ASME B1.3 (see Note below).

NOTE: Until a replacement for cadmium plating on the torque test bolts (as specified in para. 4.2.1) is found, and test data completed, an alternate coating, lubricant, or both, can be used to perform the torque test (values may be different from those obtained using cad plated screws) based on agreement between the customer and the insert supplier.

4.2.2 Torque Test Block. The insert to be tested shall be installed in a Class 3B threaded hole conforming to Table 1 in a test block made from 2024-T4 (SAE AMS4120, ASTM B 209-02) aluminum alloy. After installation, the tang shall be removed. The surface of the test block from which the insert is assembled shall be marked to indicate the radial location where the assembled insert begins.

4.2.3 Torque Test Method. The torque test shall consist of a 15-cycle, room temperature test. A new bolt or screw and a new tapped hole shall be used for each complete 15-cycle test. Bolts must assemble freely, with the fingers, up to the locking coil or coils. The bolt shall be engaged and disengaged from the assembled insert for 15 full installation and removal cycles. The test shall be run at less than 40 rpm to yield a dependable measure of torque and avoid heating of the bolt. A bolt shall be considered fully installed when three threads extend past the end of the locking coils of the insert. The removal cycle shall be considered complete when the locking coils are disengaged.

4.2.3.1 Maximum Locking Torque. Maximum locking torque shall be the highest torque value encountered on any installation or removal cycle and shall not exceed the values specified in Table 5. Maximum locking torque readings shall be taken on the first and seventh installation cycles and on the fifteenth removal cycle.

4.2.3.2 Minimum Breakaway Torque. Minimum breakaway torque shall be the torque required to overcome static friction when 100% of the locking feature is engaged and the bolt or screw is not seated (no axial load). It shall be recorded at the start of the fifteenth removal cycle. The torque value for any cycle shall be not less than the applicable value shown in Table 5.

4.3 Acceptance

The inserts shall be considered to have failed if, at the completion of any of the tests and inspection, any of the following conditions exist:

(a) a break or crack in the insert

(b) installation or removal torque exceeds the maximum locking torque value in Table 5

(c) breakaway torque less than the values in Table 5

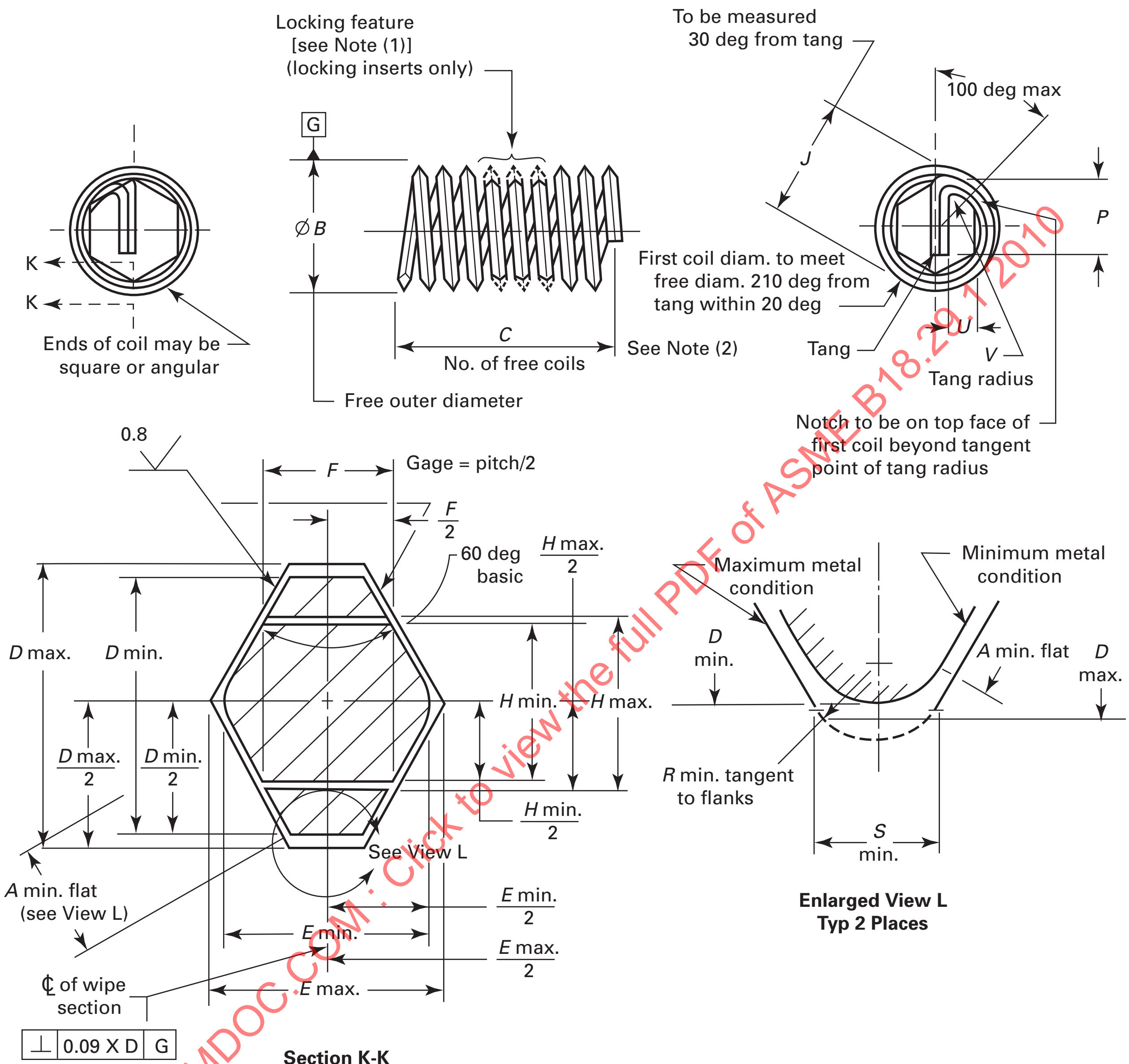
(d) movement of the insert beyond ±90 deg relative to the TOP surface when installing or removing the test bolt

(e) seizure or galling of the insert or test bolt

(f) tang not broken off which interferes with the test bolt at installation

(g) tang breaks off during insert installation

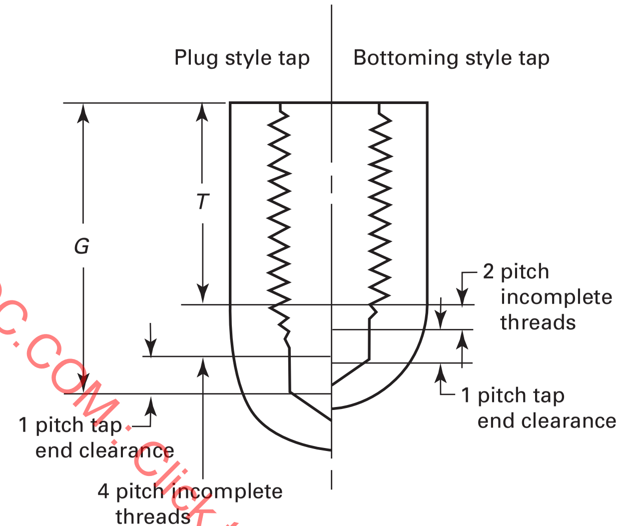
Fig. 1 Insert Configuration



GENERAL NOTES:
(a) Assembled length of insert to be measured from notch.
(b) Dimensions apply before supplementary coating (see Tables 4 and 5).
(c) Surface texture; symbols per ASME Y14.36, requirements per ASME B46.1.
(d) Dimensions and tolerancing; ASME Y14.5.

NOTES:
(1) Number of locking coils, spacing of locking coils, number of locking deformations, shape and orientation optional. Locking feature for 1, 1.5, and 2 diameter length inserts symmetrically positioned about the center of insert, and for 2.5 and 3 diameter length inserts at 1 diameter from tang end of insert.
(2) Number of free coils to be counted from notch.

Table 1 STI Threaded Hole Data



Nominal Thread Size	G Minimum Drilling Depth for Each Insert Length [Note (1)]										Countersink M Diameter (120 deg ± 5 deg Including Angle)		Minor Diameter		Pitch Diameter			Min. Major Dia.	T Minimum Tapping Depth [Note (2)]				
	Plug Taps					Bottoming Taps										3B	2B		Insert Length				
	1D	1.5D	2D	2.5D	3D	1D	1.5D	2D	2.5D	3D	Min.	Max.	Min.	Max.	Min.	Max.	Max.	2B, 3B	1D	1.5D	2D	2.5D	3D
Unified Coarse (UNC)																							
1 (0.073)-64	0.203	0.240	0.276	0.313	0.349	0.136	0.172	0.209	0.245	0.282	0.08	0.10	0.0764	0.0823	0.0832	0.0843	0.0850	0.0933	0.090	0.125	0.160	0.200	0.235
2 (0.086)-56	0.236	0.279	0.322	0.365	0.408	0.157	0.200	0.243	0.286	0.329	0.09	0.11	0.0899	0.0961	0.0976	0.0989	0.0995	0.1092	0.100	0.150	0.190	0.230	0.280
3 (0.099)-48	0.273	0.323	0.372	0.422	0.471	0.182	0.232	0.281	0.331	0.380	0.11	0.14	0.1036	0.1104	0.1126	0.1140	0.1148	0.1261	0.120	0.170	0.220	0.270	0.320
4 (0.112)-40	0.318	0.374	0.430	0.486	0.542	0.212	0.268	0.324	0.380	0.436	0.14	0.17	0.1175	0.1252	0.1283	0.1299	0.1308	0.1445	0.140	0.190	0.250	0.310	0.360
5 (0.125)-40	0.338	0.400	0.462	0.525	0.588	0.225	0.288	0.350	0.412	0.475	0.16	0.19	0.1305	0.1373	0.1413	0.1430	0.1438	0.1575	0.150	0.210	0.280	0.340	0.400
6 (0.138)-32	0.394	0.464	0.532	0.602	0.670	0.263	0.332	0.401	0.470	0.539	0.18	0.21	0.1448	0.1527	0.1583	0.1601	0.1611	0.1783	0.170	0.240	0.310	0.380	0.450
8 (0.164)-32	0.434	0.516	0.598	0.680	0.762	0.289	0.371	0.453	0.535	0.617	0.20	0.23	0.1708	0.1781	0.1843	0.1862	0.1872	0.2046	0.200	0.280	0.360	0.440	0.520
10 (0.190)-24	0.535	0.630	0.725	0.820	0.915	0.357	0.452	0.547	0.642	0.737	0.24	0.27	0.1990	0.2080	0.2170	0.2192	0.2203	0.2441	0.230	0.330	0.420	0.520	0.610
12 (0.216)-24	0.574	0.682	0.790	0.898	1.006	0.383	0.491	0.599	0.707	0.815	0.26	0.29	0.2250	0.2340	0.2430	0.2453	0.2464	0.2701	0.260	0.370	0.470	0.580	0.690
1/4 (0.250)-20	0.675	0.800	0.925	1.050	1.175	0.450	0.575	0.700	0.825	0.950	0.31	0.34	0.2608	0.2704	0.2825	0.2851	0.2864	0.3150	0.300	0.430	0.550	0.680	0.800
5/16 (0.3125)-18	0.801	0.957	1.113	1.269	1.425	0.534	0.690	0.846	1.002	1.158	0.38	0.41	0.3245	0.3342	0.3486	0.3515	0.3529	0.3847	0.370	0.530	0.680	0.840	0.990
3/8 (0.375)-16	0.750	0.938	1.125	1.312	1.500	0.625	0.812	1.000	1.188	1.375	0.45	0.48	0.3885	0.3987	0.4156	0.4189	0.4203	0.4562	0.440	0.630	0.810	1.000	1.190
7/16 (0.4375)-14	0.867	1.086	1.305	1.524	1.743	0.724	0.943	1.162	1.381	1.600	0.52	0.55	0.4530	0.4639	0.4839	0.4875	0.4890	0.5303	0.510	0.730	0.950	1.170	1.380
1/2 (0.500)-13	0.962	1.212	1.462	1.712	1.962	0.808	1.058	1.308	1.558	1.808	0.59	0.62	0.5166	0.5273	0.5499	0.5537	0.5554	0.5999	0.580	0.830	1.080	1.330	1.580
9/16 (0.5625)-12	1.062	1.343	1.624	1.905	2.186	0.895	1.176	1.457	1.738	2.019	0.66	0.69	0.5806	0.5918	0.6167	0.6208	0.6225	0.6708	0.650	0.930	1.210	1.490	1.770
5/8 (0.625)-11	1.170	1.483	1.795	2.108	2.420	0.989	1.301	1.614	1.926	2.239	0.73	0.76	0.6447	0.6564	0.6841	0.6885	0.6903	0.7431	0.720	1.030	1.340	1.650	1.970
3/4 (0.750)-10	1.350	1.725	2.100	2.475	2.850	1.150	1.525	1.900	2.275	2.650	0.87	0.90	0.7716	0.7838	0.8149	0.8196	0.8216	0.8799	0.850	1.230	1.600	1.980	2.350
7/8 (0.875)-9	1.542	1.979	2.417	2.854	3.292	1.319	1.757	2.194	2.632	3.069	1.00	1.03	0.8990	0.9119	0.9471	0.9522	0.9543	1.0193	0.990	1.420	1.860	2.300	2.740
1 (1.000)-8	1.750	2.250	2.750	3.250	3.750	1.500	2.000	2.500	3.000	3.500	1.14	1.17	1.0270	1.0421	1.0812	1.0868	1.0890	1.1624	1.130	1.630	2.130	2.630	3.130
1 1/8 (1.125)-7	1.982	2.545	3.107	3.670	4.232	1.696	2.259	2.821	3.384	3.946	1.29	1.32	1.1559	1.1730	1.2178	1.2239	1.2262	1.3106	1.270	1.830	2.390	2.960	3.520

Table 1 STI Threaded Hole Data (Cont'd)

Nominal Thread Size	G Minimum Drilling Depth for Each Insert Length [Note (1)]										Countersink M Diameter (120 deg ± 5 deg Including Angle)		Minor Diameter		Pitch Diameter			Min. Major Dia.	T Minimum Tapping Depth [Note (2)]				
	Plug Taps					Bottoming Taps										3B	2B		Insert Length				
	1D	1.5D	2D	2.5D	3D	1D	1.5D	2D	2.5D	3D	Min.	Max.	Min.	Max.	Min.	Max.	Max.	2B, 3B	1D	1.5D	2D	2.5D	3D
Unified Coarse (UNC) (Cont'd)																							
1 1/4 (1.250)-7	2.107	2.732	3.357	3.982	4.607	1.821	2.446	3.071	3.696	4.321	1.41	1.44	1.2809	1.2980	1.3428	1.3490	1.3515	1.4356	1.390	2.020	2.640	3.270	3.890
1 3/8 (1.375)-6	2.375	3.062	3.750	4.437	5.125	2.042	2.726	3.417	4.104	4.792	1.56	1.59	1.4110	1.4310	1.4832	1.4900	1.4926	1.5915	1.540	2.230	2.920	3.600	4.290
1 1/2 (1.500)-6	2.500	3.250	4.000	4.750	5.500	2.167	2.917	3.667	4.417	5.167	1.69	1.72	1.5360	1.5560	1.6082	1.6151	1.6177	1.7165	1.670	2.420	3.170	3.920	4.670
Unified Fine (UNF)																							
2 (0.086)-64	0.223	0.266	0.309	0.352	0.395	0.149	0.192	0.235	0.278	0.321	0.09	0.11	0.0894	0.0947	0.0962	0.0974	0.0981	0.1063	0.100	0.145	0.190	0.230	0.275
3 (0.099)-56	0.256	0.305	0.355	0.404	0.454	0.170	0.220	0.269	0.319	0.368	0.11	0.14	0.1029	0.1086	0.1106	0.1119	0.1126	0.1222	0.120	0.170	0.220	0.270	0.310
4 (0.112)-48	0.293	0.349	0.405	0.461	0.517	0.195	0.251	0.307	0.363	0.419	0.14	0.17	0.1166	0.1229	0.1256	0.1271	0.1279	0.1391	0.130	0.190	0.240	0.300	0.360
6 (0.138)-40	0.357	0.426	0.495	0.564	0.633	0.238	0.307	0.376	0.445	0.514	0.17	0.20	0.1435	0.1503	0.1543	0.1560	0.1569	0.1705	0.160	0.230	0.300	0.370	0.440
8 (0.164)-36	0.413	0.495	0.577	0.659	0.741	0.275	0.357	0.439	0.521	0.603	0.20	0.23	0.1701	0.1771	0.1821	0.1840	0.1849	0.2001	0.190	0.270	0.360	0.440	0.520
10 (0.190)-32	0.472	0.568	0.662	0.758	0.852	0.315	0.410	0.505	0.600	0.695	0.23	0.26	0.1968	0.2041	0.2103	0.2123	0.2133	0.2306	0.220	0.320	0.410	0.510	0.600
1/4 (0.250)-28	0.589	0.714	0.839	0.964	1.089	0.393	0.518	0.648	0.768	0.893	0.29	0.32	0.2577	0.2646	0.2732	0.2754	0.2765	0.2964	0.290	0.410	0.540	0.660	0.790
5/16 (0.3125)-24	0.718	0.874	1.030	1.186	1.342	0.479	0.635	0.791	0.947	1.103	0.36	0.39	0.3215	0.3288	0.3395	0.3421	0.3433	0.3666	0.350	0.510	0.670	0.820	0.980
3/8 (0.375)-24	0.625	0.812	1.000	1.187	1.375	0.542	0.729	0.917	1.104	1.292	0.42	0.45	0.3840	0.3910	0.4020	0.4047	0.4059	0.4291	0.420	0.600	0.790	0.980	1.170
7/16 (0.4375)-20	0.738	0.957	1.176	1.395	1.614	0.638	0.857	1.076	1.295	1.514	0.50	0.53	0.4483	0.4561	0.4700	0.4731	0.4744	0.5025	0.490	0.710	0.930	1.140	1.360
1/2 (0.500)-20	0.800	1.050	1.300	1.550	1.800	0.700	0.950	1.200	1.450	1.700	0.56	0.59	0.5108	0.5186	0.5325	0.5357	0.5371	0.5650	0.550	0.800	1.050	1.300	1.550
9/16 (0.5625)-18	0.895	1.176	1.457	1.738	2.019	0.784	1.065	1.346	1.627	1.908	0.63	0.66	0.5745	0.5826	0.5986	0.6020	0.6035	0.6347	0.620	0.900	1.180	1.460	1.740
5/8 (0.625)-18	0.958	1.271	1.583	1.895	2.208	0.847	1.160	1.472	1.785	2.097	0.69	0.72	0.6370	0.6451	0.6611	0.6646	0.6661	0.6972	0.680	0.990	1.310	1.620	1.930
3/4 (0.750)-16	1.125	1.500	1.875	2.250	2.625	1.000	1.375	1.750	2.125	2.500	0.82	0.85	0.7635	0.7720	0.7906	0.7945	0.7961	0.8312	0.810	1.190	1.560	1.940	2.310
7/8 (0.875)-14	1.304	1.741	2.179	2.616	3.054	1.161	1.598	2.036	2.473	2.911	0.96	0.99	0.8905	0.8994	0.9214	0.9257	0.9274	0.9678	0.950	1.380	1.820	2.260	2.700
1 (1.000)-12	1.500	2.000	2.500	3.000	3.500	1.333	1.833	2.333	2.833	3.333	1.10	1.13	1.0181	1.0281	1.0542	1.0590	1.0608	1.1083	1.080	1.580	2.080	2.580	3.080
1 1/8 (1.125)-12	1.625	2.187	2.750	3.312	3.875	1.453	2.021	2.583	3.146	3.708	1.22	1.25	1.1431	1.1531	1.1792	1.1841	1.1860	0.1233	1.210	1.770	2.330	2.900	3.460
1 1/4 (1.250)-12	1.750	2.375	3.000	3.625	4.250	1.583	2.208	2.833	3.458	4.083	1.35	1.38	1.2681	1.2781	1.3042	1.3092	1.3112	1.3583	1.330	1.960	2.580	3.210	3.830
1 3/8 (1.375)-12	1.875	2.562	3.250	3.937	4.625	1.708	2.395	3.083	3.771	4.458	1.47	1.50	1.3931	1.4031	1.4292	1.4343	1.4364	1.4833	1.460	2.150	2.830	3.520	4.210
1 1/2 (1.500)-12	2.000	2.750	3.500	4.250	5.000	1.833	2.583	3.333	4.083	4.833	1.60	1.63	1.5181	1.5281	1.5542	1.5595	1.5615	1.6083	1.580	2.330	3.080	3.830	4.580
Undefined Special (UNS)																							
1 (1.000)-14	1.429	1.929	2.429	2.929	3.429	1.286	1.786	2.286	2.786	3.286	1.08	1.11	1.0155	1.0243	1.0464	1.0508	1.0527	1.0928	1.070	1.570	2.070	2.570	3.070

Table 1 STI Threaded Hole Data (Cont'd)

GENERAL NOTE: Thread diameters are calculated as follows:

(a) pitch diameter

pitch diameter, min. = pitch diameter, min., of nominal thread + 2 × *H* max.
pitch diameter, max. = pitch diameter, max., of nominal thread + 2 × *H* min.

where *H* min. and *H* max. are from Table 4 and Fig. 1

(b) major/minor diameter

major diameter, min. = pitch diameter, min. + 0.649519 pitch
minor diameter, min. = pitch diameter, min. − 0.433013 pitch
minor diameter, max. = minor diameter, min. + tolerance

where tolerance is selected from the appropriate table in ASME B1.1 with basic major diameter equal to the minimum major diameter of the STI thread

NOTES:

(1) The minimum drilling depths allow for

(a) countersinking the drilled hole to prevent a featheredge at the start of the tapped hole.

(b) 0.75 pitch to 1.5 pitch of insert "set-down" to allow for maximum production tolerance.

(c) dimensions are shown for both plug and bottoming taps. Plug taps $^5/_{16}$ in. and smaller have a male center and the drilled hole depth dimensions allow for this length (one-half of the diameter of the bolt). Calculation of dimension *G* is as follows:

(1) for plug taps $^5/_{16}$ in. and smaller,

G = insert nominal length + 0.5 × bolt nominal diameter + 4 pitch (tap chamfer) + 1 pitch (tap end clearance) + 1 pitch (allowance for countersink and maximum insert set-down)

(2) for plug taps $^3/_8$ in. and larger,

G = insert nominal length + 4 pitch (tap chamfer) + 1 pitch (tap end clearance) + 1 pitch (allowance for countersink and maximum insert set-down)

(3) for bottoming taps,

G = insert nominal length + 2 pitch (tap chamfer) + 1 pitch (tap end clearance) + 1 pitch (allowance for countersink and maximum insert set-down)

(2) The minimum tapping depth (dimension *T*) is the minimum for countersink holes with insert set-down of 1.5 pitch maximum (see figure in Table 1). The calculation for dimension *T* is

T = insert nominal length + 1 pitch

Table 2 Chemical Composition

Element	Analysis, %	Check Analysis Under, Min.	Check Analysis Over, Max.
Carbon	0.15 max.	. . .	0.01
Manganese	2.00 max.	. . .	0.04
Silicon	1.00 max.	. . .	0.05
Phosphorous	0.045 max.	. . .	0.01
Sulphur	0.035 max.	. . .	0.005
Chromium	17.00 to 20.00	0.20	0.20
Nickel	8.00 to 10.50	0.15	0.15
Molybdenum	0.75 max.	. . .	0.05
Copper	0.75 max.	. . .	0.05
Iron	Remainder		

GENERAL NOTE: Suitable grades of material are within the UNS S30000 series.

Table 3 Insert Length Data

Nominal Thread Size	1 × Diameter Nominal	1 × Diameter Assembled Max.	1 × Diameter Assembled Min.	1 × Diameter C, Ref.	1 1/2 × Diameter Nominal	1 1/2 × Diameter Assembled Max.	1 1/2 × Diameter Assembled Min.	1 1/2 × Diameter C, Ref.	2 × Diameter Nominal	2 × Diameter Assembled Max.	2 × Diameter Assembled Min.	2 × Diameter C, Ref.	2 1/2 × Diameter Nominal	2 1/2 × Diameter Assembled Max.	2 1/2 × Diameter Assembled Min.	2 1/2 × Diameter C, Ref.	3 × Diameter Nominal	3 × Diameter Assembled Max.	3 × Diameter Assembled Min.	3 × Diameter C, Ref.
Unified Coarse (UNC)																				
1 (0.073)-64	0.073	0.065	0.061	2 3/4	0.110	0.102	0.098	4 7/8	0.146	0.138	0.134	6 7/8	0.182	0.174	0.170	8 7/8	0.219	0.211	0.207	10 7/8
2 (0.086)-56	0.086	0.077	0.073	3	0.129	0.120	0.116	5 1/4	0.172	0.163	0.159	7 3/8	0.215	0.206	0.202	9 5/8	0.258	0.249	0.245	11 7/8
3 (0.099)-48	0.099	0.089	0.083	2 7/8	0.148	0.138	0.133	5	0.198	0.188	0.182	7 1/4	0.248	0.238	0.232	9 3/8	0.297	0.287	0.281	11 1/2
4 (0.112)-40	0.112	0.100	0.093	2 3/4	0.168	0.156	0.149	4 3/4	0.224	0.212	0.205	6 3/4	0.280	0.268	0.261	8 7/8	0.336	0.324	0.317	10 7/8
5 (0.125)-40	0.125	0.113	0.106	3 1/4	0.188	0.175	0.169	5 1/2	0.250	0.238	0.231	7 3/4	0.312	0.300	0.293	10	0.375	0.363	0.356	12 1/4
6 (0.138)-32	0.138	0.122	0.115	2 3/4	0.207	0.191	0.184	4 3/4	0.276	0.260	0.253	6 7/8	0.345	0.329	0.322	8 7/8	0.414	0.398	0.391	10 7/8
8 (0.164)-32	0.164	0.148	0.141	3 1/2	0.246	0.230	0.223	6	0.328	0.312	0.305	8 3/8	0.410	0.394	0.387	10 3/4	0.492	0.476	0.469	13 1/4
10 (0.190)-24	0.190	0.169	0.159	2 7/8	0.285	0.264	0.254	5	0.380	0.359	0.349	7 1/8	0.475	0.454	0.444	9 1/4	0.570	0.549	0.539	11 3/8
12 (0.216)-24	0.216	0.195	0.185	3 1/2	0.324	0.303	0.293	6	0.432	0.411	0.401	8 3/8	0.540	0.519	0.509	10 5/8	0.648	0.627	0.617	13 1/8
1/4 (0.250)-20	0.250	0.225	0.212	3 3/8	0.375	0.350	0.338	5 3/4	0.500	0.475	0.462	8	0.625	0.600	0.588	10 3/8	0.750	0.725	0.712	12 3/4
5/16 (0.3125)-18	0.312	0.284	0.271	4	0.469	0.440	0.427	6 5/8	0.625	0.597	0.583	9 1/4	0.781	0.753	0.740	11 7/8	0.938	0.909	0.896	14 5/8
3/8 (0.375)-16	0.375	0.344	0.328	4 3/8	0.562	0.531	0.516	7 1/4	0.750	0.718	0.703	10	0.928	0.906	0.891	12 7/8	1.125	1.093	1.078	15 3/4
7/16 (0.4375)-14	0.438	0.402	0.384	4 1/2	0.656	0.621	0.603	7 3/8	0.875	0.839	0.821	10 1/4	1.094	1.058	1.040	13 1/8	1.312	1.277	1.259	16 1/8
1/2 (0.500)-13	0.500	0.462	0.442	4 7/8	0.750	0.712	0.693	7 7/8	1.000	0.962	0.942	11	1.250	1.212	1.192	14 1/8	1.500	1.462	1.442	17 1/8
9/16 (0.5625)-12	0.562	0.521	0.500	5 1/8	0.844	0.802	0.781	8 1/4	1.125	1.083	1.062	11 1/2	1.406	1.364	1.344	14 3/4	1.688	1.646	1.625	17 7/8
5/8 (0.625)-11	0.625	0.580	0.557	5 1/4	0.938	0.892	0.869	8 1/2	1.250	1.205	1.182	11 3/4	1.562	1.517	1.494	15	1.875	1.830	1.807	18 3/8
3/4 (0.750)-10	0.750	0.700	0.675	5 7/8	1.125	1.075	1.050	9 3/8	1.500	1.450	1.425	13	1.875	1.825	1.800	16 1/2	2.250	2.000	2.175	20 1/8
7/8 (0.875)-9	0.875	0.819	0.792	6 1/4	1.312	1.257	1.229	10	1.750	1.694	1.667	13 3/4	2.188	2.132	2.104	17 1/2	2.625	2.569	2.542	21 1/4
1 (1.000)-8	1.000	0.938	0.906	6 3/8	1.500	1.438	1.406	10 1/8	2.000	1.938	1.906	14	2.500	2.438	2.406	17 3/4	3.000	2.938	2.906	21 5/8
1 1/8 (1.125)-7	1.125	1.054	1.018	6 1/8	1.688	1.616	1.580	9 7/8	2.250	2.179	2.143	13 5/8	2.812	2.741	2.705	17 1/2	3.375	3.304	3.268	21 1/4
1 1/4 (1.250)-7	1.250	1.179	1.143	7	1.875	1.804	1.768	11 1/4	2.500	2.249	2.393	15 3/8	3.125	3.054	3.018	19 1/2	3.750	3.697	3.643	23 3/4
1 3/8 (1.375)-6	1.375	1.292	1.250	6 1/2	2.062	1.979	1.938	10 1/2	2.750	2.667	2.625	14 3/8	3.438	3.354	3.312	18 3/8	4.125	4.402	4.000	22 1/4
1 1/2 (1.500)-6	1.500	1.417	1.375	7 1/4	2.250	2.167	2.125	11 1/2	3.000	2.917	2.875	15 7/8	3.750	3.667	3.625	20 1/8	4.500	4.417	4.375	24 1/2
Unified Fine (UNF)																				
2 (0.086)-64	0.086	0.078	0.074	3 1/2	0.129	0.121	0.117	5 7/8	0.172	0.164	0.160	8 3/8	0.215	0.207	0.203	10 3/4	0.258	0.250	0.246	13 1/8
3 (0.099)-56	0.099	0.090	0.086	3 3/8	0.143	0.139	0.135	5 5/8	0.198	0.189	0.185	8	0.248	0.239	0.234	10 3/8	0.297	0.288	0.284	12 5/8
4 (0.112)-48	0.112	0.102	0.096	3 3/8	0.168	0.158	0.152	5 5/8	0.224	0.214	0.208	7 7/8	0.280	0.270	0.264	10 1/4	0.336	0.326	0.320	12 1/2
6 (0.138)-40	0.138	0.126	0.119	3 1/2	0.207	0.195	0.188	6	0.276	0.264	0.257	8 3/8	0.345	0.333	0.326	10 3/4	0.414	0.402	0.393	13 1/4
8 (0.164)-36	0.164	0.150	0.143	3 7/8	0.246	0.232	0.225	6 1/2	0.328	0.314	0.307	9 1/8	0.410	0.396	0.389	11 5/8	0.492	0.554	0.171	14 1/4
10 (0.190)-32	0.190	0.174	0.167	4 1/8	0.285	0.269	0.262	6 7/8	0.380	0.364	0.357	9 1/2	0.475	0.459	0.452	12 1/4	0.570	0.402	0.547	14 7/8
1/4 (0.250)-28	0.250	0.232	0.223	5	0.375	0.357	0.348	8 1/4	0.500	0.482	0.473	11 3/8	0.625	0.607	0.598	14 1/2	0.750	0.732	0.723	17 5/8
5/16 (0.3125)-24	0.312	0.291	0.281	5 1/2	0.469	0.447	0.438	8 7/8	0.625	0.604	0.594	12 1/4	0.781	0.760	0.750	15 5/8	0.938	0.916	0.906	19
3/8 (0.375)-24	0.375	0.354	0.344	6 7/8	0.562	0.541	0.531	11	0.750	0.729	0.719	15	0.938	0.917	0.906	19 1/8	1.125	1.104	1.094	23 1/8
7/16 (0.4375)-20	0.438	0.412	0.400	6 5/8	0.656	0.631	0.619	10 5/8	0.875	0.850	0.838	14 5/8	1.094	1.068	1.056	18 1/2	1.312	1.287	1.275	22 1/2

Table 3 Insert Length Data (Cont'd)

Nominal Thread Size	1 x Diameter				1 1/2 × Diameter				2 × Diameter				2 1/2 × Diameter				3 × Diameter			
	Nom-inal	Assembled		C, Ref.	Nom-inal	Assembled		C, Ref.	Nom-inal	Assembled		C, Ref.	Nom-inal	Assembled		C, Ref.	Nom-inal	Assembled		C, Ref.
		Max.	Min.			Max.	Min.			Max.	Min.			Max.	Min.			Max.	Min.	
Unified Fine (UNF) (Cont'd)																				
1/2 (0.500)-20	0.500	0.475	0.462	7 7/8	0.750	0.725	0.712	12 3/8	1.000	0.975	0.962	16 7/8	1.250	1.225	1.212	21 3/8	1.500	1.475	1.462	25 7/8
9/16 (0.5625)-18	0.562	0.534	0.521	8	0.844	0.815	0.802	12 1/2	1.125	1.097	1.083	17 1/8	1.406	1.378	1.365	21 3/4	1.688	1.659	1.646	26 1/4
5/8 (0.625)-18	0.625	0.597	0.583	9	0.938	0.909	0.896	14 1/8	1.250	1.222	1.208	19 1/4	1.562	1.534	1.521	24 1/4	1.875	1.847	1.833	29 3/8
3/4 (0.750)-16	0.750	0.719	0.703	9 3/4	1.125	1.094	1.078	15 1/8	1.500	1.469	1.453	20 5/8	1.875	1.844	1.828	26	2.250	2.218	2.203	31 1/2
7/8 (0.875)-14	0.875	0.839	0.821	9 7/8	1.312	1.276	1.259	15 1/2	1.750	1.714	1.696	21 1/8	2.188	2.151	2.134	26 5/8	2.625	2.589	2.571	32 1/5
1 (1.000)-12	1.000	0.958	0.938	9 5/8	1.500	1.458	1.438	15	2.000	1.958	1.938	20 1/2	2.500	2.458	2.438	26	3.000	2.958	2.938	31 1/2
1 1/8 (1.125)-12	1.125	1.083	1.062	11 1/8	1.688	1.645	1.625	17 1/4	2.250	2.208	2.188	23 3/8	2.812	2.770	2.750	29 1/2	3.375	3.333	3.312	35 3/4
1 1/4 (1.250)-12	1.250	1.208	1.188	12 1/2	1.875	1.833	1.812	19 3/8	2.500	2.458	2.438	26 1/4	3.125	3.083	3.062	33	3.750	3.708	3.688	39 7/8
1 3/8 (1.375)-12	1.375	1.333	1.312	13 3/4	2.062	2.020	2.000	21 3/8	2.750	2.708	2.688	28 7/8	3.438	3.395	3.375	36 1/2	4.125	4.083	4.062	44
1 1/2 (1.500)-12	1.500	1.458	1.438	15 1/4	2.250	2.208	2.188	23 1/2	3.000	2.958	2.938	31 5/8	3.750	3.708	3.688	39 7/8	4.500	4.458	4.438	48 1/2
Unified Special (UNS)																				
1 (1.000)-14	1.000	0.964	0.946	11 1/2	1.500	1.464	1.446	17 7/8	2.000	1.964	1.946	24 1/4	2.500	2.464	2.446	30 5/8	3.000	2.964	4.946	37

Table 4 Insert Dimensions

Nominal Thread Size	A Min.	B Min.	B Max.	D Min.	D Max.	E Min.	E Max.	Gage, F	H Min.	H Max.	J Min.	J Max.	P Min.	P Max.	Q, deg	R Min.	S Min.	U Max.	U Min.	V Max.
Unified Coarse (UNC)																				
1 (0.073)-64	0.0028	0.095	0.103	0.0139	0.0169	0.0107	0.0137	0.00781	0.00975	0.01015	0.092	0.103	0.055	0.075	75–150	0.0028	0.0049	0.060	0.017	0.010
2 (0.086)-56	0.0033	0.110	0.119	0.0163	0.0193	0.0126	0.0156	0.00893	0.01120	0.01160	0.103	0.111	0.062	0.085	75–150	0.0032	0.0056	0.071	0.025	0.011
3 (0.099)-48	0.0043	0.128	0.139	0.0196	0.0226	0.0152	0.0182	0.01042	0.01313	0.01353	0.120	0.139	0.070	0.090	75–150	0.0038	0.0065	0.085	0.026	0.013
4 (0.112)-40	0.0068	0.144	0.159	0.0241	0.0271	0.0189	0.0219	0.01250	0.01584	0.01624	0.144	0.159	0.070	1.105	25–100	0.0045	0.0078	0.043	0.027	0.013
5 (0.125)-40	0.0068	0.158	0.173	0.0241	0.0271	0.0189	0.0219	0.01250	0.01584	0.01624	0.158	0.173	0.078	0.108	25–100	0.0045	0.0078	0.049	0.029	0.013
6 (0.138)-32	0.0076	0.178	0.193	0.0295	0.0338	0.0233	0.0273	0.01563	0.01985	0.02030	0.178	0.193	0.091	0.135	25–100	0.0056	0.0098	0.055	0.031	0.017
8 (0.164)-32	0.0076	0.205	0.220	0.0295	0.0338	0.0233	0.0273	0.01563	0.01985	0.02030	0.205	0.220	0.117	0.153	20–100	0.0056	0.0098	0.068	0.040	0.019
10 (0.190)-24	0.0120	0.244	0.259	0.0410	0.0449	0.0305	0.0365	0.02083	0.02656	0.02706	0.244	0.259	0.138	0.183	15–90	0.0075	0.0130	0.071	0.040	0.022
12 (0.216)-24	0.0120	0.270	0.285	0.0410	0.0449	0.0305	0.0365	0.02033	0.02656	0.02706	0.270	0.285	0.154	0.189	20–80	0.0075	0.0130	0.084	0.051	0.026
1/4 (0.250)-20	0.0164	0.310	0.330	0.0500	0.0540	0.0378	0.0438	0.02500	0.03198	0.03248	0.310	0.330	0.182	0.238	20–80	0.0090	0.0156	0.094	0.057	0.031
5/16 (0.3125)-18	0.0176	0.380	0.400	0.0560	0.0600	0.0416	0.0486	0.02778	0.03558	0.03608	0.375	0.400	0.214	0.291	20–80	0.0100	0.0174	0.122	0.080	0.032
3/8 (0.375)-16	0.0215	0.452	0.472	0.0636	0.0677	0.0477	0.0547	0.03125	0.04009	0.04059	0.445	0.472	0.269	0.354	20–80	0.0113	0.0195	0.149	0.100	0.032
7/16 (0.4375)-14	0.0267	0.526	0.551	0.0730	0.0770	0.0545	0.0625	0.03571	0.04589	0.04639	0.518	0.551	0.313	0.416	20–80	0.0129	0.0223	0.179	0.115	0.012
1/2 (0.500)-13	0.0273	0.597	0.622	0.0758	0.0829	0.0593	0.0673	0.03846	0.04946	0.04996	0.586	0.622	0.348	0.463	20–80	0.0139	0.0240	0.212	0.140	0.056
9/16 (0.5625)-12	0.0334	0.669	0.694	0.0861	0.0900	0.0649	0.0729	0.04167	0.05363	0.05413	0.656	0.676	0.390	0.521	20–80	0.0150	0.0260	0.234	0.160	0.056
5/8 (0.625)-11	0.0351	0.742	0.767	0.0909	0.0980	0.0715	0.0795	0.04545	0.05855	0.05905	0.727	0.747	0.421	0.572	20–80	0.0164	0.0284	0.267	0.179	0.072
3/4 (0.750)-10	0.0402	0.881	0.906	0.1007	0.1079	0.0795	0.0875	0.05000	0.06445	0.06495	0.840	0.885	0.453	0.640	60–120	0.0180	0.0312	0.331	0.219	0.072
7/8 (0.875)-9	0.0465	1.022	1.052	0.1124	0.1199	0.0892	0.0972	0.05556	0.07167	0.07217	0.991	1.026	0.500	0.734	60–120	0.0200	0.0347	0.385	0.267	0.102
1 (1.000)-8	0.0544	1.166	1.196	0.1264	0.1350	0.1004	0.1094	0.06250	0.08069	0.08119	1.135	1.170	0.526	0.781	60–120	0.0226	0.0391	0.438	0.310	0.106
1 1/8 (1.125)-7	0.0645	1.315	1.355	0.1451	0.1546	0.1160	0.1250	0.07143	0.09229	0.09279	1.260	1.315	0.557	0.843	60–120	0.0258	0.0446	0.480	0.355	0.103
1 1/4 (1.250)-7	0.0645	1.443	1.483	0.1451	0.1546	0.1160	0.1250	0.07143	0.09229	0.09279	1.366	1.416	0.679	0.937	60–120	0.0258	0.0446	0.536	0.424	0.110
1 3/8 (1.375)-6	0.0775	1.598	1.643	0.1695	0.1799	0.1368	0.1458	0.08333	0.10775	0.10825	1.545	1.598	0.689	1.093	60–120	0.0301	0.0521	0.573	0.423	0.112
1 1/2 (1.500)-6	0.0775	1.727	1.772	0.1695	0.1799	0.1368	0.1458	0.08333	0.10775	0.10825	1.676	1.727	0.811	1.187	60–120	0.0301	0.0521	0.661	0.500	0.114
Unified Fine (UNF)																				
2 (0.086)-64	0.0028	0.110	0.119	0.0139	0.0169	0.0107	0.0137	0.00781	0.00975	0.01015	0.103	0.111	0.062	0.080	75–150	0.0028	0.0049	0.069	0.024	0.011
3 (0.099)-56	0.0033	0.131	0.146	0.0163	0.0193	0.0126	0.0156	0.00893	0.01120	0.01160	0.124	0.146	0.072	0.090	75–150	0.0032	0.0056	0.083	0.031	0.012
4 (0.112)-48	0.0043	0.174	0.162	0.0196	0.0226	0.0152	0.0182	0.01042	0.01313	0.01353	0.134	0.162	0.060	0.095	75–150	0.0038	0.0065	0.093	0.034	0.013
6 (0.138)-40	0.0068	0.173	0.193	0.0241	0.0271	0.0189	0.0219	0.01250	0.01584	0.01624	0.173	0.193	0.100	0.130	25–100	0.0045	0.0078	0.057	0.033	0.018
8 (0.164)-36	0.0059	0.204	0.224	0.0261	0.0301	0.0203	0.0243	0.01389	0.01764	0.01804	0.204	0.224	0.117	0.147	20–100	0.0050	0.0087	0.069	0.043	0.019
10 (0.190)-32	0.0076	0.236	0.256	0.0295	0.0338	0.0233	0.0273	0.01563	0.01985	0.02030	0.236	0.256	0.130	0.182	15–90	0.0056	0.0093	0.084	0.058	0.025
1/4 (0.250)-28	0.0085	0.306	0.326	0.0347	0.0387	0.0253	0.0313	0.01786	0.02270	0.02320	0.306	0.326	0.173	0.244	15–70	0.0064	0.0112	0.111	0.071	0.032
5/16 (0.3125)-24	0.0120	0.380	0.400	0.0410	0.0449	0.0305	0.0365	0.02083	0.02656	0.02706	0.359	0.400	0.203	0.291	15–55	0.0075	0.0130	0.138	0.094	0.036
3/8 (0.375)-24	0.0120	0.448	0.468	0.0410	0.0449	0.0305	0.0365	0.02083	0.02656	0.02706	0.422	0.468	0.235	0.353	15–75	0.0075	0.0130	0.169	0.125	0.032
7/16 (0.4375)-20	0.0164	0.524	0.549	0.0500	0.0540	0.0378	0.0438	0.02500	0.03198	0.03248	0.494	0.549	0.281	0.416	15–75	0.0090	0.0156	0.198	0.141	0.042

Table 4 Insert Dimensions (Cont'd)

Nominal Thread Size	A	B		D		E		Gage,	H		J		P		Q,	R	S	U		V
	Min.	Min.	Max.	Min.	Max.	Min.	Max.	F	Min.	Max.	Min.	Max.	Min.	Max.	deg	Min.	Min.	Max.	Min.	Max.
Unified Fine (UNF) (Cont'd)																				
1/2 (0.500)-20	0.0164	0.592	0.617	0.0500	0.0540	0.0378	0.0438	0.02500	0.03198	0.03248	0.556	0.617	0.313	0.479	15–75	0.0090	0.0156	0.229	0.172	0.042
9/16 (0.5625)-18	0.0176	0.666	0.691	0.0560	0.0600	0.0416	0.0486	0.02778	0.03558	0.03608	0.625	0.691	0.344	0.541	15–75	0.0100	0.0174	0.256	0.196	0.056
5/8 (0.625)-18	0.0176	0.733	0.758	0.0560	0.0600	0.0416	0.0486	0.02778	0.03558	0.03608	0.688	0.758	0.375	0.588	15–75	0.0100	0.0174	0.287	0.227	0.072
3/4 (0.750)-16	0.0215	0.876	0.901	0.0636	0.0677	0.0477	0.0547	0.03125	0.04009	0.04059	0.820	0.901	0.453	0.562	15–75	0.0113	0.0195	0.345	0.280	0.072
7/8 (0.875)-14	0.0267	1.021	1.051	0.0730	0.0770	0.0545	0.0625	0.03571	0.04589	0.04639	0.955	1.051	0.495	0.640	15–75	0.0129	0.0223	0.402	0.330	0.104
1 (1.000)-12	0.0334	1.169	1.199	0.0861	0.0990	0.0649	0.0729	0.04167	0.05363	0.05413	1.094	1.119	0.526	0.728	15–75	0.0150	0.0260	0.450	0.380	0.106
1 1/8 (1.125)-12	0.0334	1.304	1.334	0.0861	0.0990	0.0649	0.0729	0.04167	0.05363	0.05413	1.219	1.334	0.557	0.819	10–70	0.0150	0.0260	0.523	0.432	0.108
1 1/4 (1.250)-12	0.0334	1.439	1.469	0.0861	0.0990	0.0649	0.0729	0.04167	0.05363	0.05413	1.344	1.374	0.679	0.941	10–70	0.0150	0.0260	0.589	0.491	0.110
1 3/8 (1.375)-12	0.0334	1.575	1.610	0.0861	0.0990	0.0649	0.0729	0.04167	0.05363	0.05413	1.469	1.504	0.689	1.001	10–70	0.0150	0.0260	0.652	0.553	0.112
1 1/2 (1.500)-12	0.0334	1.710	1.745	0.0861	0.0990	0.0649	0.0729	0.04167	0.05363	0.05413	1.594	1.629	0.811	1.123	10–70	0.0150	0.0260	0.718	0.612	0.114
Unified Special (UNS)																				
1 (1.000)-14	0.0267	1.156	1.186	0.0730	0.0770	0.0545	0.0625	0.03571	0.04589	0.04639	1.080	1.186	0.525	0.750	15–75	0.0129	0.0223	0.464	0.382	0.166

Table 5 Self-Locking Torque

Nominal Thread Size	Maximum Locking Torque Installation or Removal	Minimum Breakaway Torque
Unified Coarse (UNC)		
1 (0.073)-64	15.0 ozf-in.	2.0 ozf-in.
2 (0.086)-56	20.0 ozf-in.	3.0 ozf-in.
3 (0.099)-48	32.0 ozf-in.	7.0 ozf-in.
4 (0.112)-40	48.0 ozf-in.	10.0 ozf-in.
5 (0.125)-40	75.2 ozf-in.	13.0 ozf-in.
6 (0.138)-32	6.0 lbf-in.	1.0 lbf-in.
8 (0.164)-32	9.0 lbf-in.	1.5 lbf-in.
10 (0.190)-24	13.0 lbf-in.	2.0 lbf-in.
12 (0.216)-24	24.0 lbf-in.	3.0 lbf-in.
1/4 (0.250)-20	30.0 lbf-in.	4.5 lbf-in.
5/16 (0.3125)-18	60.0 lbf-in.	7.5 lbf-in.
3/8 (0.375)-16	80.0 lbf-in.	12.0 lbf-in.
7/16 (0.4375)-14	100.0 lbf-in.	16.5 lbf-in.
1/2 (0.500)-13	150.0 lbf-in.	24.0 lbf-in.
9/16 (0.5625)-12	200.0 lbf-in.	30.0 lbf-in.
5/8 (0.625)-11	300.0 lbf-in.	40.0 lbf-in.
3/4 (0.750)-10	400.0 lbf-in.	60.0 lbf-in.
7/8 (0.875)-9	600.0 lbf-in.	82.0 lbf-in.
1 (1.000)-8	800.0 lbf-in.	110.0 lbf-in.
1 1/8 (1.125)-7	900.0 lbf-in.	137.0 lbf-in.
1 1/4 (1.250)-7	1,000.0 lbf-in.	165.0 lbf-in.
1 3/8 (1.375)-6	1,150.0 lbf-in.	185.0 lbf-in.
1 1/2 (1.500)-6	1,350.0 lbf-in.	210.0 lbf-in.
Unified Fine (UNF)		
2 (0.086)-64	20.0 ozf-in.	3.0 ozf-in.
3 (0.099)-56	32.0 ozf-in.	7.0 ozf-in.
4 (0.112)-48	48.0 ozf-in.	10.0 ozf-in.
6 (0.138)-40	6.0 lbf-in.	1.0 lbf-in.
8 (0.164)-36	9.0 lbf-in.	1.5 lbf-in.
10 (0.190)-32	13.0 lbf-in.	2.0 lbf-in.
1/4 (0.250)-28	30.0 lbf-in.	3.0 lbf-in.
5/16 (0.3125)-24	60.0 lbf-in.	6.5 lbf-in.
3/8 (0.375)-24	80.0 lbf-in.	9.5 lbf-in.
7/16 (0.4375)-20	100.0 lbf-in.	14.0 lbf-in.
1/2 (0.500)-20	150.0 lbf-in.	18.0 lbf-in.
9/16 (0.5625)-18	200.0 lbf-in.	24.0 lbf-in.
5/8 (0.625)-18	300.0 lbf-in.	32.0 lbf-in.
3/4 (0.750)-16	400.0 lbf-in.	50.0 lbf-in.
7/8 (0.875)-14	600.0 lbf-in.	70.0 lbf-in.
1 (1.000)-12	800.0 lbf-in.	90.0 lbf-in.
1 1/8 (1.125)-12	900.0 lbf-in.	117.0 lbf-in.
1 1/4 (1.250)-12	1,000.0 lbf-in.	143.0 lbf-in.
1 3/8 (1.375)-12	1,150.0 lbf-in.	165.0 lbf-in.
1 1/2 (1.500)-12	1,350.0 lbf-in.	190.0 lbf-in.
Unified Special (UNS)		
1 (1.000)-14	800.0 lbf-in.	90.0 lbf-in.

NONMANDATORY APPENDIX A
INSERT LENGTH SELECTION

A-1 ENGAGED LENGTH OF BOLT

Normally, the engaged length of bolt in an insert is determined by strength considerations.

A-2 MATERIAL STRENGTHS

The standard engineering practice of balancing the tensile strength of the bolt material against the shear strength of the parent or boss material also applies to helical coil inserts. Tables A-1 and A-2 will aid in developing the full load value of the bolt rather than stripping the parent or tapped material.

In using these tables, the following factors must be considered:

(a) The parent material shear strengths are for room temperature. Elevated temperatures call for significant shear value reductions; compensation should be made when required. Shear values are appropriate because the parent material is subject to shearing stress at the major diameter of the tapped threads.

(b) When parent material shear strength falls between two tabulated values, use the lower of the two.

(c) Bolt thread length, overall length, insert length, and full tapped thread depth must be adequate to insure full thread engagement when assembled in order to comply with its design function.

Table A-1 Insert Length Selection

Parent Material Shear Strength, psi	Bolt Designation				
	SAE J429, Grade 2	SAE J429, Grade 5 1 in. and Less	SAE J429, Grade 5 Over 1 in.	SAE J429, Grade 8	ASTM A 574, Socket Head Cap Screw
	Insert Length in Terms of Diameters				
15,000	$2\frac{1}{2}$	3	3	. . .	. . .
20,000	2	$2\frac{1}{2}$	$2\frac{1}{2}$	3	. . .
25,000	$1\frac{1}{2}$	2	2	$2\frac{1}{2}$	3
30,000	$1\frac{1}{2}$	2	$1\frac{1}{2}$	2	$2\frac{1}{2}$
40,000	1	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	2
50,000	1	1	1	$1\frac{1}{2}$	$1\frac{1}{2}$

Table A-2 Hardness Number Conversion

Bolt Property Class	Maximum Rockwell Hardness	Maximum Tensile Strength, psi
SAE Grade 2	B100	117,000
SAE Grade 5, 1 in. and smaller	34 HRC	153,000
SAE Grade 5, over 1 in.	30 HRB	138,000
SAE Grade 8	39 HRC	176,000
Socket head cap screw	45 HRC	215,000

GENERAL NOTE: Bolt strength upon which insert length recommendations are based are developed by taking the maximum hardness allowed and the equivalent tensile strength from SAE J417, Hardness Tests and Hardnesss Number Conversions. These are shown in Table A-2.

NONMANDATORY APPENDIX B
SCREW THREAD INSERT TAPS

B-1 SCOPE

This Appendix covers design and dimensions for taps for producing inch series STI threaded holes required for the installation of helical coil screw thread inserts. Threaded hole dimensions are shown in Table 1.

B-2 NOMENCLATURE

Helical coil screw thread insert taps are identified by the designation STI.

B-3 DESIGNS AND DIMENSIONS

B-3.1 Types of Taps

Various types and styles of STI taps are available. General dimensions and tolerances are in accordance with ASME B94.9.

B-3.2 Tap Thread Limits

Ground thread taps are recommended for screw thread inserts. Tap thread limits are in accordance with ASME B94.9. The basic pitch diameter used in determining values is the "Pitch Diameter, Min." in Table 1.

B-4 MARKING

Taps are marked in accordance with ASME B94.9.

EXAMPLE: 1/4-28 STI NF HS G H2

Other information may be added at the discretion of the manufacturer.

NONMANDATORY APPENDIX C
STI THREAD PLUG GAGES

C-1 U.S. PRACTICE

U.S. gage manufacturers produce metric series gages using inch dimensions converted from the basic dimensions

C-2 BLANKS

STI gage blanks are in accordance with ASME B47.1, Gage Blanks.

C-3 GAGE DESIGN

STI gages are designated in accordance with ASME B1.2, Gages and Gaging for Unified Inch Screw Threads.

C-4 GAGE TOLERANCES

X tolerances are applied to all metric STI gages in accordance with ASME B1.2, Gages and Gaging for Unified Inch Screw Threads.

NONMANDATORY APPENDIX D
INSTALLATION

D-1 INSERT INSTALLATION

Helical coil inserts are greater in diameter than the STI tapped holes into which they are installed. The installation process applies torque to the tang to reduce the diameter of the leading coil and permit it to enter the tapped hole. The remaining coils are reduced in diameter as they, in turn, are screwed into the tapped hole. When the torque or rotation is stopped, the insert coil expands with a spring-like action to anchor the insert permanently in place against the threads of the tapped hole.

Finer pitch inserts are proportionally larger (before installation) than coarse pitch inserts and, thus, have to be "prewound" to a smaller diameter for installation. Large, coarse pitch inserts (and inserts) need only a threaded mandrel tool for installation.

D-2 STRIP FEED

Helical coil inserts are normally furnished in bulk containers. However, they are also normally available in feeding belts known as strip feed.

Strip feed consists of a belt or strip of pliable plastic such as polyethylene through which holes have been punched, and into which the helical coil inserts are positioned, the ends of the inserts protruding from each side of the strip. The strip is coiled on a reel or spool.

The purpose for, and advantage of strip feed is to ease handling of the insert and to increase installation rates.

Inserting tools are available for handling strip feed, wherein the strip passes through a slot in the prewinder thus locating each insert for engagement with the mandrel. After each insert has been driven through the tool and installed into the work, the strip indexes the next insert into position. Helical coil inserts are normally available in strip feed in sizes up through 8 mm nominal diameter.

D-3 INSERTING TOOLS

D-3.1 Hand-Inserting Tools

Various types of hand inserting tools are available. Examples are shown in Table D-1.

These hand-inserting tools will install helical coil inserts up to 3 diameters long for thread sizes up through $\frac{7}{8}$ in. UNC and UNF. Inserts 1 in. and larger will install inserts up to 2 diameters long. Inserts 1 in. and larger in size that are more than 2 diameters in length require special tools for installation.

D-3.2 Power-Inserting Tools: Air Driven

For installing large quantities of helical coil inserts, power-inserting tools are available. A typical tool is comprised of the following three basic assemblies:

(a) a reversible air motor that provides the driving torque

(b) an adapter that couples the motor to the front end assembly

(c) front end assembly that holds the insert and, in operation, reduces the diameter of the insert (prewinds), then drives it into its tapped hole

A foot activated air valve may be used as an alternative to the hand activated lever.

Two sizes of adapters are available — one for the smaller range of thread sizes and one for the larger sizes. These tools will install 1, 1.5, and 2 diameter length inserts. Front end assemblies are also available for longer length inserts or larger sizes. Examples of air driven power-inserting tools are shown in Table D-2.

D-3.3 Power-Inserting Tools: Electric

Electric power tools are available for use where electric power is preferred over air. The slender configuration of the mandrels allows them to reach into constricted areas. Electric power meets the requirements of clean room operations. Some operators prefer electric power because it is quieter and the tool is lighter. Examples of electric power-inserting tools are shown in Table D-3.

D-4 TANG BREAK-OFF TOOLS

If the bolt is to engage the full length of the insert, the driving tang must be removed to eliminate interference with the end of the assembled bolt. Tang break-off tools are available in several types.

D-4.1 Spring Actuated Manual Tang Break-Off Tool

Spring actuated tang break-off tools are available for use with inserts through $\frac{1}{2}$ in. nominal diameter. Their operation is automatic, having a spring loaded, easily triggered punch that strikes a sharp, uniform blow against the tang of the installed insert.

Examples are shown in Table D-4.

D-4.2 Rod Type Tang Break-Off Tool

Rod type tools are available for use with inserts through $\frac{1}{2}$ in. nominal diameter. They are actuated by the tap of a hammer. Examples are shown in Table D-5.

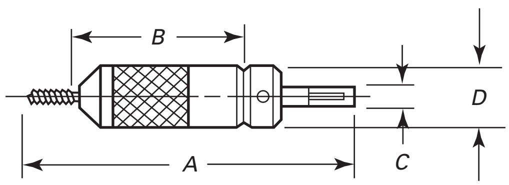
D-4.3 Long Nose Pliers

For insert nominal sizes larger than 1/2 in., use long nose pliers, bending the tang up and down to snap it off at the notch.

D-5 EXTRACTING TOOLS

Examples of tools to remove helical coil inserts are shown in Table D-6. These operate by applying the tool to the insert, striking the head of the tool a light blow and turning counterclockwise while maintaining steady downward pressure.

Table D-1-1 Hand Insert Tools: Type II UNF



Size	A	B	C	D
#1-64	2 5/8	3/4	3/16	7/16
#2-64	2 5/8	3/4	3/16	7/16

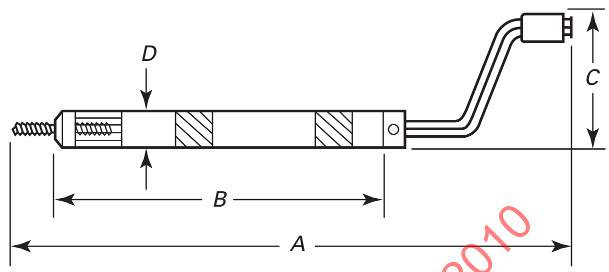
GENERAL NOTES:
(a) Reference Standard: A-A-59158
(b) All dimensions are in inches unless otherwise indicated.

Table D-1-2 Hand Insert Tools: Type II UNC

Size	A	B	C
#2-56	2 7/16	2	5/16
#3-48	2 7/16	2	5/16

GENERAL NOTES:
(a) Reference Standard: A-A-59158
(b) All dimensions are in inches unless otherwise indicated.

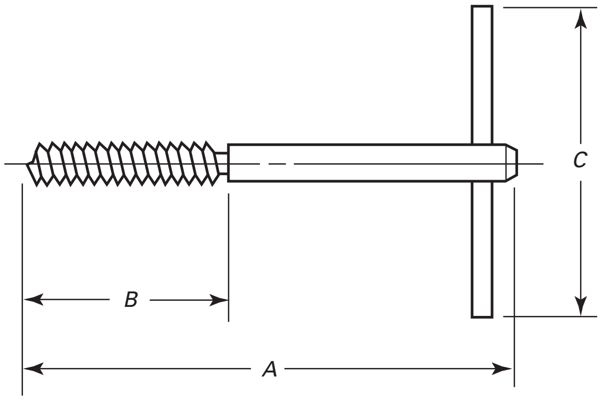
Table D-1-3 Hand Insert Tools: Type III UNC and UNF



Size	A	B	C	D
#2-56	2 3/4	1 1/2	2 1/8	5/16
#3-48	2 3/4	1 1/2	2 1/8	5/16
#3-56	7 15/32	4 5/8	2 9/32	3/8
#4	7 15/32	4 5/8	2 9/32	3/8
#5	7 15/32	4 5/8	2 9/32	3/8
#6	7 15/32	4 5/8	2 9/32	3/8
#8	7 15/32	4 5/8	2 9/32	3/8
#10	7 15/32	4 5/8	2 9/32	15/32
#12	7 31/32	4 5/8	2 17/32	33/64
1/4	7 31/32	4 5/8	2 17/32	33/64
5/16	7 31/32	4 5/8	3 23/32	5/8
3/8	7 31/32	5	3 23/32	45/64
7/16	8 15/32	5 1/4	3 23/32	25/32
1/2	8 15/32	5 1/2	3 23/32	7/8

GENERAL NOTES:
(a) Reference Standard: A-A-59158
(b) All dimensions are in inches unless otherwise indicated.

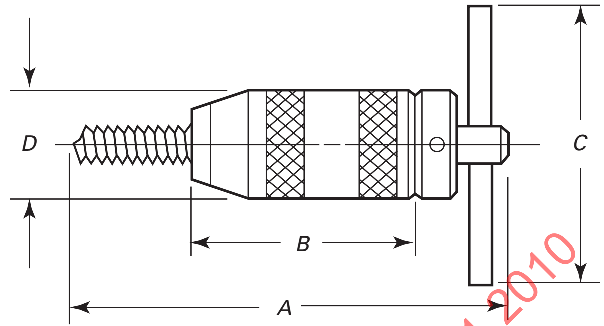
Table D-1-4 Hand Insert Tools: Type IV UNC



Size	A	B	C
9/16	4 7/8	1 13/16	4
5/8	4 7/8	2	4
3/4	4 7/8	2 3/8	4
7/8	4 7/8	2 3/4	4 1/2
1	4 7/8	2 1/8	4 1/2
1 1/8	6 3/4	2 1/2	6
1 1/4	6 3/4	2 3/4	6
1 3/8	6 3/4	3	6
1 1/2	6 3/4	3 1/4	6

GENERAL NOTES:
(a) Reference Standard: A-A-59158
(b) All dimensions are in inches unless otherwise indicated.

Table D-1-5 Hand Insert Tools: Type V



Size	A	B	C	D
9/16	5 3/8	2 7/8	4	1 1/8
5/8	5 3/8	2 7/8	4	1 1/8
3/4	6	2 7/8	4	1 1/2
7/8	6 3/8	2 7/8	4 1/2	1 1/2
1	5 7/8	2 7/8	4 1/2	1 5/8
1 1/8	6 5/16	3 1/16	4 1/2	2
1 1/4	6 13/16	3 5/16	6	2
1 3/8	7 5/16	3 9/16	6	2 1/4
1 1/2	7 13/16	3 13/16	6	2 1/4

GENERAL NOTES:
(a) Reference Standard: A-A-59158
(b) All dimensions are in inches unless otherwise indicated.