IFI
502
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METRIC TAPPING SCREWS

TAPPING SCREWS

IFI Note:

The requirements given in this Standard for flat, oval, pan and hex head tapping screws are in excellent agreement with ISO Standards. Hex flange tapping screws have not yet been addressed by ISO technical committees nor have their dimensions been finalized by IFI or ASME technical committees. ASME Standards Committee B18 is currently preparing a standard for metric tapping screws and when issued it will be designated ANSI B18.6.5M. The contents of IFI-502 will be incorporated into ANSI B18.6.5M.

1. Scope.

1.1 This Standard covers the complete general, dimensional and performance requirements for metric flat countersunk, oval countersunk and pan slotted and recessed head tapping screws and metric hex and hex flange head tapping screws recognized as standard. Also included are appendixes which provide means for determining effective grip lengths on screws, specifications and instructions for protrusion gaging of flat countersunk head screws, penetration gaging and wobble gaging of recessed head screws, and across corners gaging of hex head screws.

1.2 The inclusion of dimensional data in this Standard is not intended to imply that all of the products described are stock production sizes. Consumers should consult with manufacturers concerning the availability of products. (For recommended diameter-length combinations of tapping screws see Table 15.)

1.3 Comparison with ISO Standards. Flat countersunk, oval countersunk, pan and hex head tapping screws with thread types AB and B as presented in this Standard have been coordinated to the extent possible with ISO Standards. The comparable ISO Standard(s) is listed in the footnotes of each product standard. The dimensional differences between these tapping screws as covered in this Standard and those in ISO Standards are very few and relatively minor. None will affect the functional interchangeability of screws manufactured to the requirements of either.

1.3.1 Hex flange head screws, screws with Type III recess, and screws with thread Types D, F, T, BF and BT are not covered in ISO Standards.

1.3.2 Types 1 and 1A cross recesses of this Standard are designated Types H and Z respectively in ISO Standards.

2. Introductory Notes.

2.1 Head Types. The head types covered by this Standard include those commonly recognized as being applicable to tapping screws and are as follows:

2.1.1 Flat Countersunk Head. The flat countersunk head shall have a flat top surface and a conical bearing surface with a head angle of 90 to 92 deg.

2.1.2 Oval Countersunk Head. The oval countersunk head shall have a rounded top surface and a conical bearing surface with a head angle of 90 to 92 deg.

2.1.3 Pan Head. The slotted pan head shall have a flat top surface rounded into cylindrical sides and a flat bearing surface. The recessed pan head shall have a rounded top surface blending into cylindrical sides and a flat bearing surface.

2.1.4 Hex Head. The hex head shall have a flat or indented top surface, six flat sides and a flat bearing surface.

2.1.5 Hex Flange Head. The hex flange head shall have an indented top surface and six flat sides formed integrally with a frustroconical or slightly rounded (convex) flange which projects beyond the sides and provides a flat bearing surface.

2.2 Screw Types and Application. Screws covered by this Standard include tapping screws of both the thread forming and thread

cutting varieties. The type designations, descriptions and applications are as follows:

2.2.1 Thread Forming Tapping Screws. Thread forming tapping screws are generally for application in materials where large internal stresses are permissible or desirable to increase resistance to loosening. They shall be of the following types:

2.2.1.1 *Type AB* — Type AB tapping screws shall have spaced threads and gimlet points. They are primarily intended for use in thin metal, resin impregnated plywood, and asbestos compositions.

2.2.1.2 *Type B* — Type B tapping screws shall have spaced threads, with the same thread pitches as Type AB, and blunt points with tapered entering threads having unfinished crests. They are intended for use in materials such as thin metal, non-ferrous castings, plastics, resin impregnated plywood, certain resilient plastics and asbestos compositions.

2.2.2 Thread Cutting Tapping Screws. Thread cutting tapping screws are generally for application in materials where disruptive internal stresses are undesirable or where excessive driving torques are encountered with thread forming screws. They shall be of the following types:

2.2.2.1 *Types D, F and T* — Types D, F and T tapping screws shall have threads of machine screw diameter-pitch combinations (metric coarse thread series) approximating a 60° basic thread form (not necessarily conforming to any standard thread profile) with a blunt point and tapered entering threads having unfinished crests and having one or more cutting edges and chip cavities. Types D, F and T tapping screws are not subject to thread gaging but shall meet dimensions specified in this Standard. These screws are intended for use in materials such as aluminum, zinc and lead die castings, steel sheets and shapes, cast iron, brass, plastics, etc.

2.2.2.2 *Types BF and BT* — Types BF and BT tapping screws shall have spaced threads with a blunt point and tapered entering threads having unfinished crests, as on Type B, with one or more cutting edges and chip cavities. These screws are intended for use in plastics, asbestos and other similar compositions.

2.3 Assembly Considerations. The finish (plating or coating) on tapping screws and the material composition and hardness of the mating component are factors which affect assembly torques in individual applications. It should be noted that, due to various finishes providing different degrees of lubricity, some adjustment of installation torques may be necessary to suit individual applications. Also, where exceptionally heavy finishes are involved or screws are to be assembled into materials of higher hardness, some deviation in hole sizes may be required to provide optimum assembly. The necessity and extent of such deviations can best be determined by experiment in the particular assembly environment.

2.4 Dimensions. All dimensions in this Standard are given in millimeters unless otherwise stated.

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

2.6 Terminology. For definitions of terms relating to fasteners or component features used in this Standard, refer to the American National Standard, Glossary of Terms for Mechanical Fasteners, ANSI B18.12, an abstract of which is presented on page J—5.

2.7 Clearance Holes. Recommended nominal diameters of clearance holes in material to be assembled using tapping screws are given in IFI-527, page J—21.

3. General Data.

3.1 Heads.

3.1.1 Height of Head. The height of head indicated in the dimensional tables represents a metal to metal measurement. In other words, on heads having rounded top surfaces, the truncation of the rounded surface due to recess or slot is not considered part of the head height.

On countersunk type heads, the height of head is a reference dimension measured parallel to the axis of the screw from the

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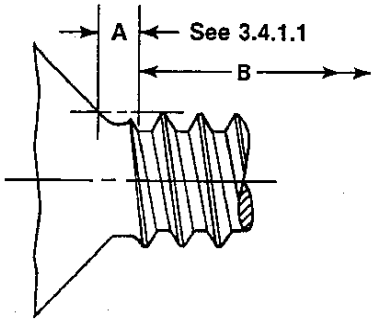
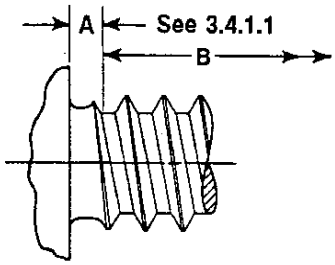


Flat and Oval Countersunk Head Screws



Pan, Hex and Hex Flange Head Screws

FIG. 1

Table 1 Thread Lengths for Types AB, B, BF and BT Screws

Nom Screw Size	L	B	A
	Nom Screw Length	Full Form Thread Length	Unthreaded Length Under Head
		Min[1]	Max[2]
2.2	16	13.0	0.8
2.9	20	17.0	1.1
3.5	25	21.0	1.3
4.2	30	25.0	1.4
4.8	35	29.0	1.6
5.5	40	33.0	1.8
6.3	45	38.0	1.8
8	45	38.0	2.1
9.5	50	38.0	2.1

NOTES:

1. Tabulated values through 6.3 mm size are equal to 6 times the basic screw diameter rounded to nearest millimeter.
2. Tabulated values are equal to 1 times the basic thread pitch, rounded to nearest 0.1 mm.

largest diameter of the bearing surface of the head to the point of intersection of the bearing surface of the head and basic major diameter of the screw. This point of intersection may not necessarily be the same as the actual junction of head and shank.

3.1.2 Bearing Surface. The bearing surface of perpendicular bearing surface type tapping screw heads shall be at right angles to the axis of the screw shanks within 2 deg.

3.1.3 Depth of Recess. The depth of recess in recessed head screws shall be measured parallel to the axis of the screw from the intersection of the maximum diameter of Types 1 and 1A recesses and the square sides of Type III recess with the head surface to the bottom of the recess.

Recess penetration gaging depth values are included in the dimensional tables and the method of gaging and specifications for gages are covered in Appendix C, page F—22.

Recess wobble gaging procedures and operating limits are given in Appendix D, page F—25.

3.1.4 Depth of Slot. The depth of slot in slotted head screws shall be measured parallel to the axis of the screw from the top of the head

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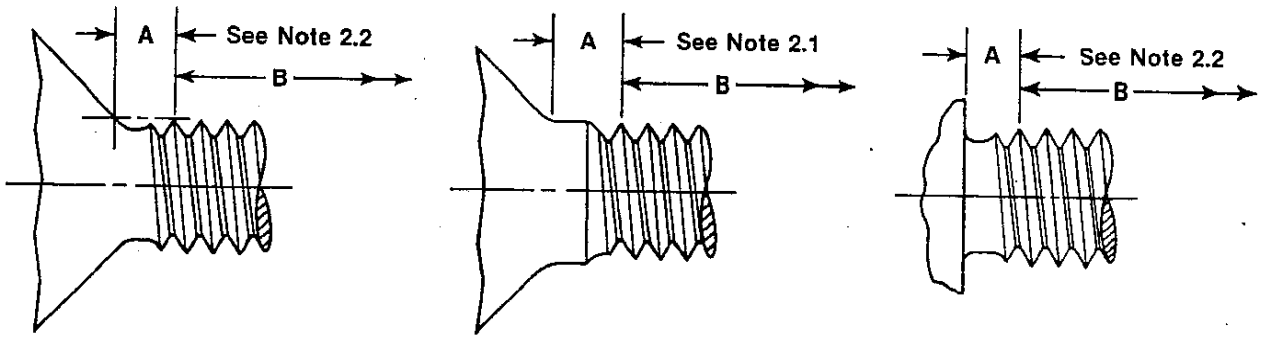

Oval Countersunk and Slotted Flat Countersunk Screws

Recessed Head Flat Countersunk Screws

Pan, Hex and Hex Flange Head Screws

FIG. 2

Table 2 Thread Lengths for Types D, F and T Screws

Nom Screw Size	L	A		L		A		L	B
	Nom Screw Length	Incomplete Thread		Nom Screw Length		Incomplete Thread		Nom Screw Length	Full Form Thread Length
		See Note 2.1	See Note 2.2			See Note 2.1	See Note 2.2		
	≤ than	Max	Max	> than	≤ than	Max	Max	> than	Min
2	6	1.0	0.4	6	16	1.0	0.8	16	12.0
2.5	8	1.1	0.5	8	20	1.1	0.9	20	15.0
3	9	1.2	0.5	9	25	1.2	1.0	25	18.0
3.5	10	1.6	0.6	10	30	1.5	1.2	30	21.0
4	12	1.8	0.7	12	35	1.8	1.4	35	24.0
5	15	2.0	0.8	15	40	2.0	1.6	40	30.0
6	18	2.5	1.0	18	45	2.5	2.0	45	38.0
8	24	3.1	1.2	24	45	3.1	2.5	45	38.0
10	30	3.8	1.5	30	45	3.8	3.0	45	38.0
12	36	4.4	1.8	36	50	4.4	3.5	50	38.0

NOTES:

1. Refer to Note 3.4.1.2 of the General Data.
2. 'A' is the distance from the underside of head to the first major diameter of thread within its specified limits.
   2.1 'A' values apply only to recessed head flat countersunk screws.
   2.2 'A' values apply to all screws except those excluded by 2.1.

to the intersection of the bottom of the slot with the head surface or bearing surface.

3.1.5 Positional Tolerances. The positional relationship between the heads and driving provisions of screws and the shanks of screws (formerly defined as Eccentricity) shall be as follows:

3.1.5.1 Position of Head. The axis of the head shall be located at true position relative to the axis of the screw shank within a tolerance zone having a diameter equivalent to 6 percent of the specified maximum head diameter, or the specified maximum width across flats of hex and hex flange heads, regardless of feature size.

3.1.5.2 Position of Recess. The recess in cross or square recessed head tapping screws shall be located at true position relative to the axis of the screw shank within a tolerance zone having a diameter equivalent to 12 percent of the basic screw diameter or 0.75 mm, whichever is greater, regardless of feature size.

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3.1.5.3 Position of Slot. The slot in slotted head tapping screws shall be located at true position relative to the axis of the screw shank within a tolerance zone having a diameter equivalent to 12 percent of the basic screw diameter or 0.50 mm, whichever is greater, regardless of feature size.

3.1.6 Underhead Fillets. All screws shall have a fillet radius at the junction of the head to shank within the limits as specified in the dimensional tables. For flat and oval countersunk head screws, the maximum fillet radius equals 0.4D and minimum radius equals 0.2D, rounded to one decimal place. For pan, hex and hex flange screws, the fillet shall be a smooth and continuous curve fairing smoothly into the under head bearing surface with a diameter of tangency not to exceed the tabulated D_A maximum and with no radius in the fillet contour being less than R minimum. For computation purposes, D equals the nominal screw size for thread Types D, F and T.

3.2 Length.

3.2.1 Measurement. The length of screw shall be measured parallel to the axis of the screw from the extreme point to the largest diameter of the bearing surface of the head. Recommended lengths of screws are given in Table 15.

3.2.2 Tolerance on Length. The tolerance on length of tapping screws shall conform to the following:

3.2.2.1 Tapping Screws, Type AB. The tolerance on length shall be as tabulated below:

Nom Screw Length, mm	Tolerance on Length, mm
Up to 25 Incl.	±0.8
Over 25	±1.3

3.2.2.2 Tapping Screws, Types B, BF, BT, D, F and T. The tolerance on length shall be as tabulated below:

Nom Screw Length, mm	Tolerance on Length, mm
Up to 20 Incl.	−0.8
Over 20 to 40	−1.3
Over 40	−1.5

3.3 Threads and Points. The threads and points applicable to screws covered by this Standard are generally described under paragraph 2.2 of the Introductory Notes. For details and dimensions, refer to Tables 5 and 6.

3.4 Length of Thread.

3.4.1 Tapping Screws. Tapping screws shall have thread lengths conforming to the following:

3.4.1.1 *Types AB, B, BF and BT* — Screws with nominal lengths equal to or shorter than those shown as 'L' in Table 1, shall have full form threads extending to the head such that the specified thread minor diameter limits are maintained to within a distance 'A' from the underside of the head, or closer if practicable. See Fig. 1. Screws of longer nominal lengths, unless otherwise specified by the purchaser, shall have a length of full form thread equal to or greater than 'B' as specified in Table 1.

3.4.1.2 *Types D, F and T* — Screws of nominal lengths within the ranges listed in Table 2 shall have full form threads extending close to the head such that the specified thread major diameter limits are maintained to within the respective 'A' limit from the underside of the head, or closer if practicable. See Fig. 2. Screws of longer nominal lengths, unless otherwise specified by the purchaser, shall have a length of full form thread equal to or greater than 'B' as specified in Table 2.

3.5 Diameter of Body.

3.5.1 Types AB, B, BF and BT. The diameter of the unthreaded portion shall not be less than the minimum minor diameter nor greater than the maximum major diameter of the thread.

3.5.2 Types D, F and T. The diameter of the unthreaded portion shall not be less than the minimum diameter specified in Table 6, nor greater than the maximum major diameter of the thread.

4. Materials.

4.1 Steel. Tapping screws are normally fabricated from carbon steel and suitably processed to meet the performance and test requirements specified in para. 7 of this Standard.

Table 3 Standard Test Plate Thicknesses and Hole Sizes for Drive Test Inspection of Tapping Screws

Nom Screw Size		Test Plate Thickness, mm				Test Hole			
		Thread Types AB and B		Thread Types D, F and T		Thread Types AB and B		Thread Types D, F and T	
Thread Types AB and B	Thread Types D, F and T	Max	Min	Max	Min	Metric Drill Size	Hole Dia, mm	Metric Drill Size	Hole Dia, mm
2.2	2	1.27	1.17	2.03	1.93	1.9	1.90	1.7	1.70
—	2.5	—	—	2.44	2.33	—	—	2.1	2.10
2.9	3	1.27	1.17	2.82	2.71	2.2	2.20	2.6	2.60
3.5	3.5	1.96	1.85	3.62	3.51	2.9	2.90	3.1	3.10
4.2	4	1.96	1.85	3.62	3.51	3.5	3.50	3.5	3.50
4.8	5	3.22	3.12	4.84	4.68	4.0	4.00	4.5	4.50
5.5	—	3.22	3.12	—	—	4.8	4.80	—	—
6.3	6	4.84	4.69	6.43	6.27	5.5	5.50	5.4	5.40
8	8	4.84	4.69	8.02	7.86	6.9	6.90	7.4	7.40
9.5	10	4.84	4.69	9.60	9.44	8.3	8.30	9.3	9.30

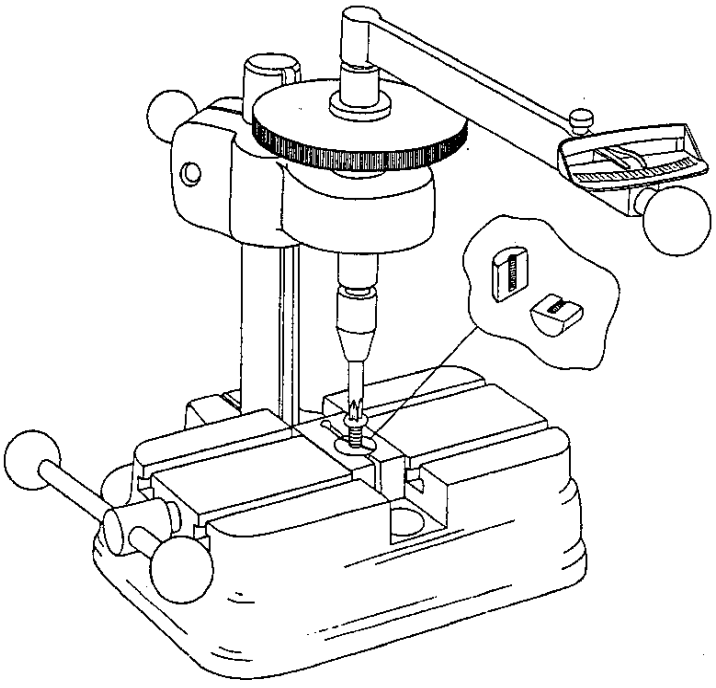

FIG. 3

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Table 4 Torsional Strength Requirements for Tapping Screws

Nom Screw Size		Torsional Strength Min N·m	
Thread Types AB, B, BF, BT	Thread Types D, F and T	Thread Types AB, B, BF, BT	Thread Types D, F and T
2.2	2	0.4	0.5
—	2.5	—	1.1
2.9	3	1.5	2.0
3.5	3.5	2.7	3.1
4.2	4	4.4	4.6
4.8	5	6.3	9.4
5.5	—	9.9	—
6.3	6	16	16
8	8	33	40
9.5	10	67	78

4.2 Other Materials. Tapping screws may also be made from corrosion resistant (stainless) steel, monel, brass and aluminum alloys. The materials and properties of such screws shall be as mutually agreed upon between the manufacturer and the purchaser.

5. Finishes.

Unless otherwise specified, tapping screws shall be supplied with a natural (as processed) finish, unplated or uncoated. Where corrosion preventative treatment is required, screws shall be plated or coated as agreed upon between the manufacturer and the purchaser. However, where carbon steel screws are plated or coated and subject to hydrogen embrittlement, they shall be suitably treated subsequent to the plating or coating operation to obviate such embrittlement.

6. Designation.

Tapping screws shall be designated by the following data in the sequence shown: Nominal size; thread pitch; nominal length; thread and point type; product name, including head type and driving provision; material; and protective finish, if required. See examples below:

6.3 × 1.4 × 30 Type AB, Slotted Pan Head Tapping Screw, Steel.

3.5 × 0.6 × 20 Type B, Type 1A Cross Recessed Oval Countersunk Head Tapping Screw, Corrosion Resistant Steel.

7. Performance Requirements and Tests for Steel Tapping Screws.

7.1 Purpose. The primary objective of these performance requirements is to insure that steel tapping screws will form or cut mating threads in materials of construction into which they are normally driven, without deforming their own thread and without breaking during assembly or service.

7.2 Applicability. The following performance requirements and tests, pertaining to respective screw types as designated, shall apply to carbon steel tapping screws only. Performance requirements applicable to tapping screws made from corrosion resistant (stainless) steel or other materials shall be subject to agreement between the manufacturer and purchaser.

7.2.1 Material and Processing Considerations. It should be noted that certain limitations on basic material and manufacturing processes have been incorporated because the size and configuration of the parts under consideration make them vulnerable to relatively small variations in chemistry, heat treatment, etc., and because experience has shown consistent "in balance." Until improved performance tests are developed, the limitations specified in Para. 7.5 will supplement the "performance" features of the Standard.

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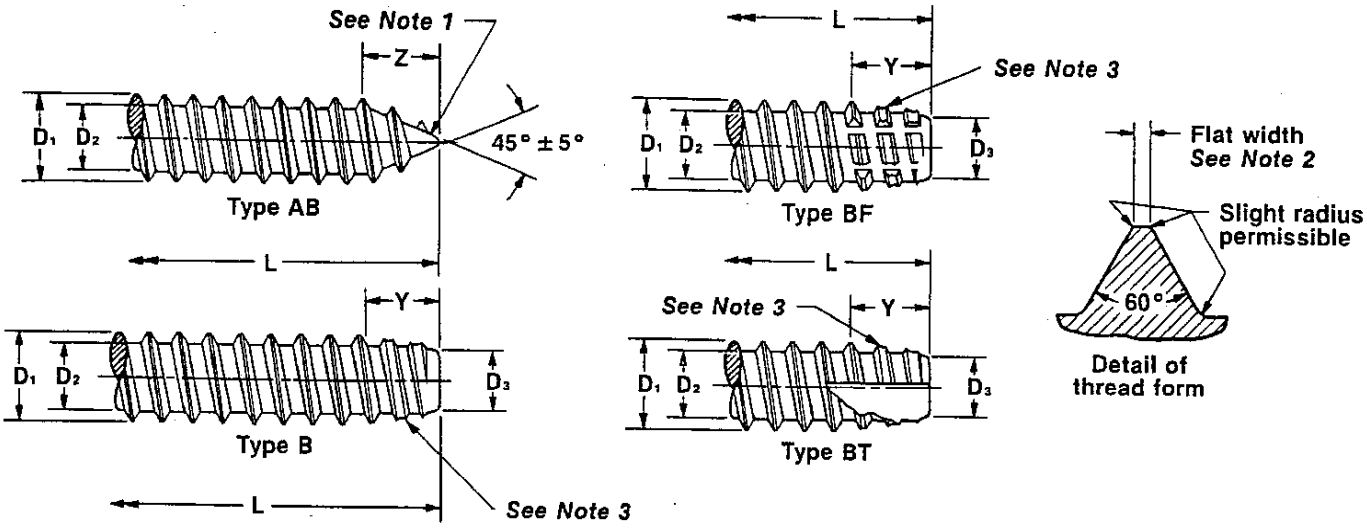

Table 5 Threads and Points for Types AB and B Thread Forming and Types BF and BT Thread Cutting Tapping Screws

Nom Screw Size and Thread Pitch	Basic Screw Dia	Basic Thread Pitch	D_1 Major Dia		D_2 Minor Dia		D_3 Point Dia		Y Point Taper Length For Types B, BF, BT		Z Point Length For Type AB	L Minimum Practical Nom Screw Lengths			
												Type AB		Types B, BF, BT	
	Ref	Ref	Max	Min	Max	Min	Max	Min	Max	Min	Ref	Pan, Hex and Hex Flange Heads	Flat and Oval CTSK Heads	Pan, Hex and Hex Flange Heads	Flat and Oval CTSK Heads
2.2 × 0.8	2.184	0.79	2.24	2.10	1.63	1.52	1.47	1.37	1.6	1.2	2.0	4	6	4	5
2.9 × 1	2.845	1.06	2.90	2.76	*2.18	2.08	2.01	1.88	2.1	1.6	2.6	6	7	5	7
3.5 × 1.3	3.505	1.27	3.53	3.35	2.64	2.51	2.41	2.26	2.5	1.9	3.2	7	9	6	8
4.2 × 1.4	4.166	1.41	4.22	4.04	3.10	2.95	2.84	2.69	2.8	2.1	3.7	8	10	7	10
4.8 × 1.6	4.826	1.59	4.80	4.62	3.58	3.43	3.30	3.12	3.2	2.4	4.3	9	12	8	11
5.5 × 1.8	5.486	1.81	5.46	5.28	4.17	3.99	3.86	3.68	3.6	2.7	5.0	11	14	9	12
6.3 × 1.8	6.350	1.81	6.25	6.03	4.88	4.70	4.55	4.34	3.6	2.7	6.0	12	16	10	13
8 × 2.1	7.938	2.12	8.00	7.78	6.20	5.99	5.84	5.64	4.2	3.2	7.5	16	20	12	17
9.5 × 2.1	9.525	2.12	9.65	9.43	7.85	7.59	7.44	7.24	4.2	3.2	8.0	19	24	14	19
See Notes	4	4					5		6			8			

NOTES:

1. No extrusion of excess metal beyond apex of the Type AB point resulting from thread rolling shall be permissible; a slight rounding or truncation of the point is desirable.
2. The width of flat at crest of thread shall not exceed 0.10 mm for sizes up to and including 4.2 mm, and 0.15 mm for larger sizes.
3. Tapered threads on Type B shall have unfinished crests.
4. Basic screw diameter and basic thread pitch shall be used for calculation purposes wherever these factors appear in formulation.
5. The tabulated values of point diameter apply to screw blanks before thread rolling.
6. Tabulated max values equal approximately 2 times basic thread pitch.
7. Points of screws shall be tapered and fluted or slotted as illustrated. The flute on Type BT screws shall have an included angle of 90 to 95 deg and the thread cutting edge located above the axis of screw. Tapered threads shall have unfinished crests and the flutes of Type BF may extend through the first full thread, whereas the slot of Type BT shall extend through the first full thread beyond the taper. Other details of taper and flute design shall be optional with the manufacturer provided the screws meet the specified performance requirements.
8. Lengths shown are theoretical minimums. Refer to Table 15 for recommended diameter-length combinations. These values are to assist the user in the selection of proper screw lengths and shall not be subject to inspection.
9. See Introductory Notes and General Data on page F—1.
10. Thread and point dimensions are in agreement with those given in ISO 1478.

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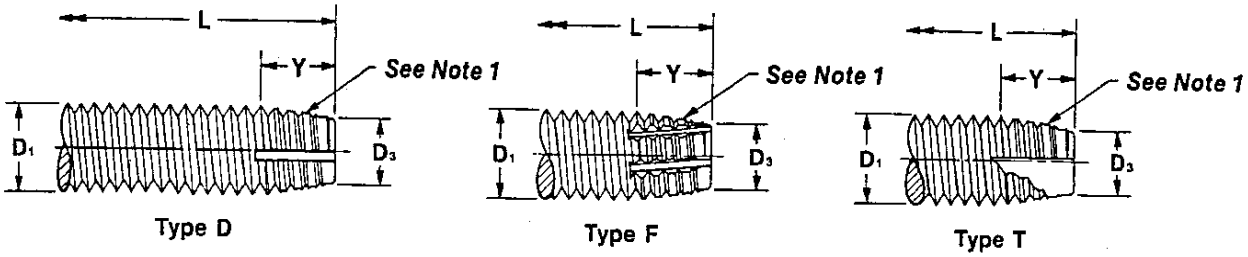

Table 6 Threads and Points for Thread Cutting Tapping Screws — Types D, F and T

Nom Screw Size and Thread Pitch	D_1		D_3		Y		L		
	Major Dia		Point Dia		Point Taper Length		Body Dia	Minimum Practical Nom Screw Lengths	
	Max	Min	Max	Min	Max	Min	Min	Pan, Hex and Hex Flange Heads	Flat and Oval CTSK Heads
2 × 0.4	2.00	1.88	1.45	1.39	1.8	1.4	1.65	4	5
2.5 × 0.45	2.50	2.37	1.88	1.82	2.0	1.6	2.12	4	6
3 × 0.5	3.00	2.87	2.32	2.26	2.3	1.8	2.58	5	6
3.5 × 0.6	3.50	3.35	2.68	2.60	2.7	2.1	3.00	5	8
4 × 0.7	4.00	3.83	3.07	2.97	3.2	2.5	3.43	6	9
5 × 0.8	5.00	4.82	3.94	3.84	3.6	2.8	4.36	7	10
6 × 1	6.00	5.79	4.69	4.55	4.5	3.5	5.21	9	12
8 × 1.25	8.00	7.76	6.40	6.24	5.6	4.4	7.04	11	16
10 × 1.5	10.00	9.73	8.08	7.86	6.8	5.3	8.86	13	18
See Notes			2, 3		4			6	

NOTES:

1. Points of screws shall be tapered and fluted or slotted as illustrated. The flute on Type T screws shall have an included angle of 90 to 95 deg and the thread cutting edge located above the axis of screw. Tapered threads shall have unfinished crests and the flutes or slots may extend through the first full thread beyond the taper. Other details of taper and flute design shall be optional with the manufacturer provided the screws meet the specified performance requirements.
2. The tabulated values apply to screw blanks before roll threading.
3. Point diameter values equal basic major diameter of thread minus the thread pitch diameter tolerance within a tolerance equal to 0.065 times the thread pitch or 0.1 mm whichever is greater.
4. Tabulated max values equal 4.5 times and min values equal 3.5 times the thread pitch rounded upward to nearest 0.1 mm.
5. Threads of tapping screws are not normally subjected to thread gaging requirements.
6. Lengths shown are theoretical minimums. Refer to Table 15 for recommended diameter-length combinations. Shorter length screws are available with point taper lengths shortened to limits equal to 3.5 to 2.5 times thread pitch.
7. See Introductory Notes and General Data, page F—1.

7.2.2 Finish Considerations. In cases where screws are plated subsequent to delivery to the purchaser (or where plating of screws is otherwise under the control of the purchaser), the screw producer is not responsible for failures due to plating. In such cases, additional screws from the same lot shall be stripped of plating, baked, lubricated with machine oil, and retested in the plain finish condition.

7.3 Drive Test for Types AB, B, D, F and T[1]. Sample screws (coated or uncoated, as received) shall, without deforming their own thread, form a mating thread in the test plate described below until a thread of full diameter is completely through the test plate. (Note 1: This test does not apply to Types BF and BT screws.)

The test plate shall be made of low carbon cold rolled steel, having hardness of

Rockwell B70-85 or equivalent, and thickness as specified in Table 3. Test holes shall be drilled or punched and redrilled, or reamed, to ±0.03 mm of nominal diameter specified in Table 3 for the type and size of screw being tested.

7.4 Torsional Strength Test. The shank of the sample screw (coated or uncoated, as received) shall be securely clamped in a mating, split, blind-hole die (Fig. 3) or other means, such that the clamped portion of the threads is not damaged and at least two full threads project above the clamping device and at least two full form threads exclusive of point, flute(s) or end slot are held within the clamping device. (A blind hole may be used in place of the clamping device, providing the hole depth is such as to insure that breakage will occur beyond the point, or the full length of the flute(s) or end slot.) By means of a suitably calibrated torque measuring device, torque shall be applied to the screw until failure occurs. The torque required to cause failure shall equal or exceed the minimum value in Table 4 for the type and size of screw being tested.

7.5 Material and Processing Requirements.

7.5.1 Material. Screws shall be made from cold heading quality, killed steel wire, conforming to the chemical composition limits shown below:

Nom Screw Size	Analysis (1)	Chemical Composition, Percent by Weight	
		Carbon	Manganese
2 thru 3	Ladle Check	0.13—0.25 0.11—0.27	0.60—1.65 0.57—1.71
3.5 thru 12	Ladle Check	0.15—0.25 0.13—0.27	0.70—1.65 0.64—1.71

NOTES:

1. Ladle analyses may be used for routine reporting. Check analyses refer to individual determinations on uncarburized or core portion of screws and shall be used for referee purposes or as required by the purchaser.
2. Boron is permitted in the range of 0.0005 to 0.003 percent.

7.5.2 Heat Treatment. Screws shall be heat treated in a carbonitriding or gas carburizing system. Screws shall be quenched in a liquid medium and then tempered by reheating to 340 °C min.

Cyaniding systems may be approved by a purchaser when the producer shows that a continuous flow (no batch) quenching process is employed which consistently produces uniform case and core.

7.5.3 Total Case Depth. Case depth shall conform to the following, as measured at thread flank midpoint between crest and root:

Nom Screw Size	Thickness, mm
2 thru 3.5	0.05—0.18
4 thru 5.5	0.10—0.23
6 thru 12	0.13—0.28

7.5.4 Surface Hardness After Tempering. Shall be equivalent to Rockwell C45 minimum. For routine quality control purposes (where case depth and geometry of screws permit), measurements may be made on end, shank, or head using Rockwell 15N. As an alternate, or where this method is not applicable, a microhardness instrument with a Knoop or diamond pyramid indenter and a 500 gram load may be used. In such cases, measurements shall be made on the thread profile of a properly prepared longitudinal metallographic specimen.

7.5.5 Core Hardness After Tempering. Shall be Rockwell C28-38[2], as determined at mid-radius of a transverse section through the screw taken at a distance sufficiently behind the point of the screw to be through the full minor diameter. (Note 2: Hardness shall not exceed maximum shown and preferably should be no higher than Rockwell C36 to insure against failure in assembly and service.)

7.5.6 Microstructure. Shall show no band of free ferrite between case and core, as determined by metallographic examination.

8. Inspection.

8.1 Inspection and Quality Assurance. Unless otherwise specified by the purchaser in the original inquiry and purchase order, acceptability shall be based on conformance with the requirements specified in ANSI B18.18.1M, page J—25.

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METRIC TAPPING SCREWS

TAPPING SCREWS

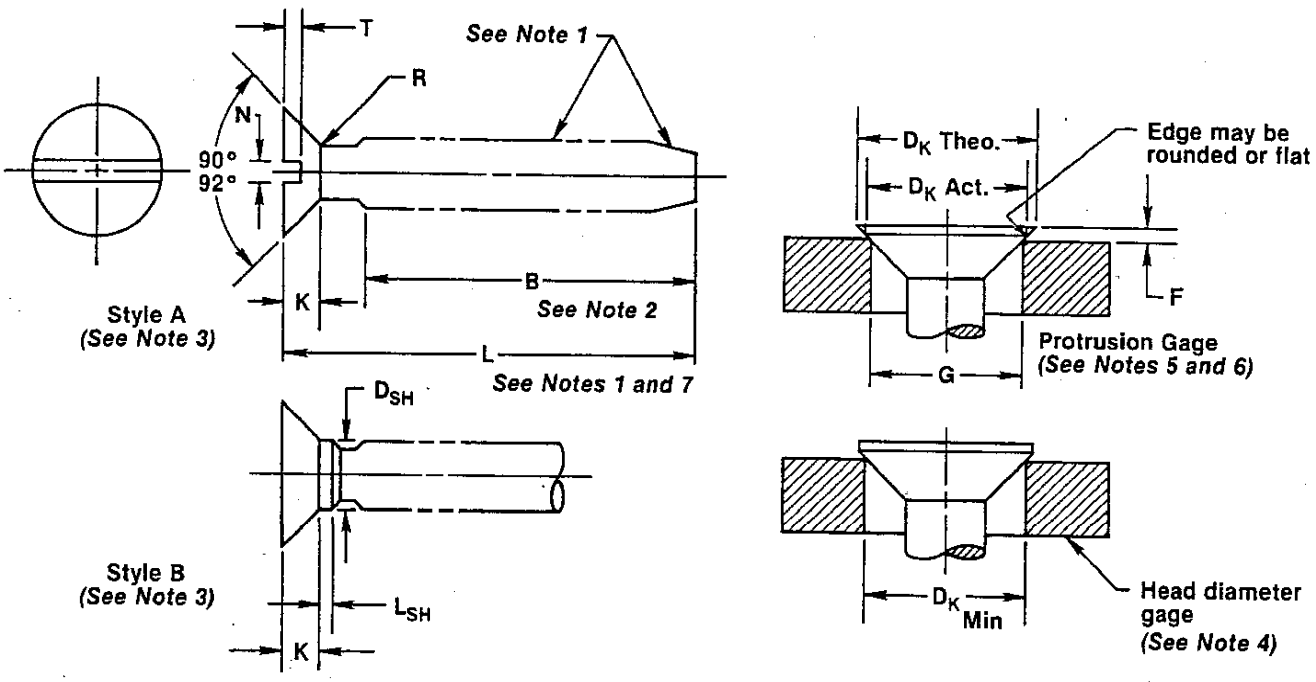
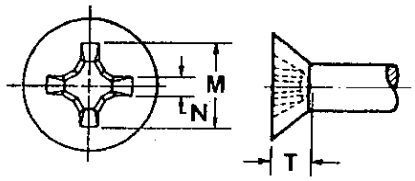


Table 7 Slotted Flat Countersunk Head Tapping Screws

Nom Screw Size		D_K			D_{SH}		K		L_{SH}		R		N		T		F		G
		Head Diameter					Head Height												
Thread Types AB, B, BF, BT	Thread Types D, F, T	Theoretical Sharp		Actual	Shoulder Dia		Types AB, B BF, BT	Types D, F T	Shoulder Length		Fillet Radius		Slot Width		Slot Depth		Protrusion Above Gaging Dia		Gaging Dia
		Max	Min	Min	Max	Min	Max Ref	Max Ref	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
2.2	2	4.4	4.1	3.5	2.00	1.86	1.1	1.2	0.50	0.30	0.8	0.4	0.7	0.5	0.6	0.4	0.79	0.62	2.82
—	2.5	5.5	5.1	4.4	2.50	2.36	—	1.5	0.55	0.35	1.0	0.5	0.8	0.6	0.7	0.5	0.88	0.66	3.74
2.9	3	6.3	5.9	5.2	3.00	2.86	1.7	1.7	0.60	0.40	1.2	0.6	1.0	0.8	0.9	0.6	0.83	0.60	4.65
3.5	3.5	8.2	7.7	6.9	3.50	3.32	2.3	2.3	0.70	0.50	1.4	0.7	1.2	1.0	1.2	0.9	1.32	1.03	5.57
4.2	4	9.4	8.9	8.0	4.00	3.82	2.6	2.7	0.80	0.60	1.6	0.8	1.5	1.2	1.3	1.0	1.46	1.17	6.48
4.8	5	10.4	9.8	8.9	5.00	4.82	2.8	2.7	0.90	0.70	2.0	1.0	1.5	1.2	1.4	1.1	1.05	0.72	8.31
5.5	—	11.5	10.9	9.9	—	—	3.0	—	—	—	2.2	1.1	1.9	1.6	1.5	1.1	1.14	0.81	9.23
6.3	6	12.6	11.9	10.9	6.00	5.82	3.1	3.3	1.10	0.90	2.4	1.2	1.9	1.6	1.6	1.2	1.23	0.85	10.14
8	8	17.3	16.5	15.4	8.00	7.78	4.6	4.6	1.40	1.10	3.2	1.6	2.3	2.0	2.3	1.8	1.75	1.30	13.60
9.5	10	20.0	19.2	17.8	10.00	9.78	5.2	5.0	1.70	1.30	4.0	2.0	2.8	2.5	2.6	2.0	2.23	1.77	15.54
See Notes				4	3				3								5.6		

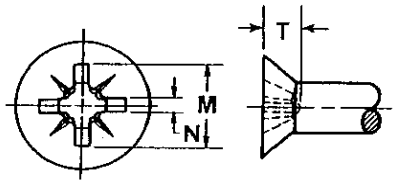
NOTES:

1. See Tables 5 and 6 for thread and point dimensions and minimum practical screw lengths.
2. See Tables 1 and 2 for thread lengths.
3. Recessed head (Table 8) tapping screws with Types D, F or T threads and recessed head thread rolling screws (see SAE J1237, page F—27) shall have Style B head form. All slotted head screws and recessed head screws with Types AB, B, BF or BT threads shall have Style A head form. The underhead shoulder on Style B screws is mandatory, other head dimensions are the same for Styles A and B.
4. Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified actual D_K minimum within a tolerance of plus 0.00 mm and minus 0.01 mm. The head shall not enter the gage.
5. For protrusion gaging see Appendix A, page F—20.
6. No tolerance for gaging diameter is given. If the gaging diameter of the gage used differs from the tabulated value, the protrusion will be affected accordingly and the proper protrusion values must be recalculated using the formulas given in Appendix A.
7. See Table 15 for recommended screw lengths.
8. See Introductory Notes and General Data, page F—1.
9. Comparable ISO Standards —
   ISO 1482 — Slotted countersunk (flat) head tapping screws.
   ISO 7050 — Recessed countersunk head tapping screws.



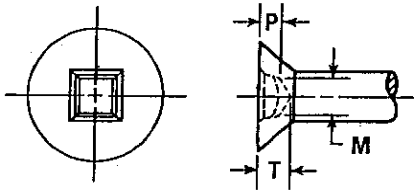
Type I

This type of recess has a large center opening, tapered wings, and blunt bottom, with all edges relieved or rounded.



Type 1A

This type of recess has a large center opening, wide straight wings, and blunt bottom, with all edges relieved or rounded.



Type III

This type of recess has a square center opening, slightly tapered side walls and a conical bottom.

Table 8 Recess Dimensions of Flat Countersunk Head Tapping Screws

Nom Screw Size		Type I								Type 1A								Type III							
		M		T		N				M		T		N				M		T			P		
Thread Types AB, B, BF, BT	Thread Types D, F, T	Recess Dia		Recess Depth		Recess Width	Driver Size	Recess Penetration Gaging Depth		Recess Dia		Recess Depth		Recess Width	Driver Size	Recess Penetration Gaging Depth		Recess Square		Recess Depth		Driver Size	Penetration Gaging Depth		
		Max	Min	Max	Min	Min		Max	Min	Max	Min	Max	Min	Min		Max	Min	Max	Min	Max	Min		Max	Min	
2.2	2	2.31	1.98	1.69	1.39	0.53	0	1.55	1.25	2.37	2.04	1.74	1.39	0.47	0	1.55	1.20	—	—	—	—	—	—	—	—
—	2.5	2.97	2.64	1.98	1.58	0.74	1	1.80	1.40	2.94	2.61	2.03	1.63	0.73	1	1.75	1.35	1.80	1.77	1.86	1.59	0	0.96	0.81
2.9	3	3.27	2.94	2.28	1.88	0.79	1	2.10	1.70	3.24	2.91	2.28	1.88	0.73	1	2.00	1.60	1.80	1.77	1.86	1.59	0	0.96	0.81
3.5	3.5	4.22	3.89	2.50	2.00	0.91	2	2.20	1.70	4.31	3.98	2.61	2.16	1.03	2	2.20	1.75	2.32	2.29	2.98	2.56	1	1.65	1.45
4.2	4	4.62	4.29	2.90	2.40	0.96	2	2.60	2.10	4.60	4.27	2.90	2.45	1.03	2	2.50	2.05	2.86	2.82	3.55	3.03	2	1.91	1.65
4.8	5	5.22	4.89	3.50	3.00	1.04	2	3.20	2.70	5.15	4.82	3.46	3.01	1.04	2	3.05	2.60	2.86	2.82	3.65	3.13	2	2.01	1.75
5.5	—	6.49	6.16	3.66	3.16	1.08	3	3.20	2.70	6.57	6.24	3.76	3.31	1.43	3	3.20	2.75	3.38	3.34	3.98	3.61	3	2.03	1.98
6.3	6	6.79	6.46	3.96	3.46	1.12	3	3.50	3.00	6.82	6.49	4.01	3.56	1.44	3	3.45	3.00	3.38	3.34	4.36	3.73	3	2.41	2.11
8	8	8.95	8.62	5.18	4.58	1.80	4	4.60	4.00	8.98	8.65	5.29	4.84	2.18	4	4.60	4.15	4.86	4.81	5.39	4.62	4	2.59	2.29
9.5	10	10.05	9.72	6.28	5.68	1.98	4	5.70	5.10	10.01	9.68	6.34	5.89	2.19	4	5.65	5.20	4.86	4.81	5.79	5.03	4	3.00	2.69

NOTES:

1. Head dimensions not shown are the same as those of slotted heads given in Table 7.
2. For penetration gaging, see Appendix C, page F—22.
3. For wobble gaging, see Appendix D, page F—25.
4. See Introductory Notes and General Data, page F—1.

METRIC TAPPING SCREWS

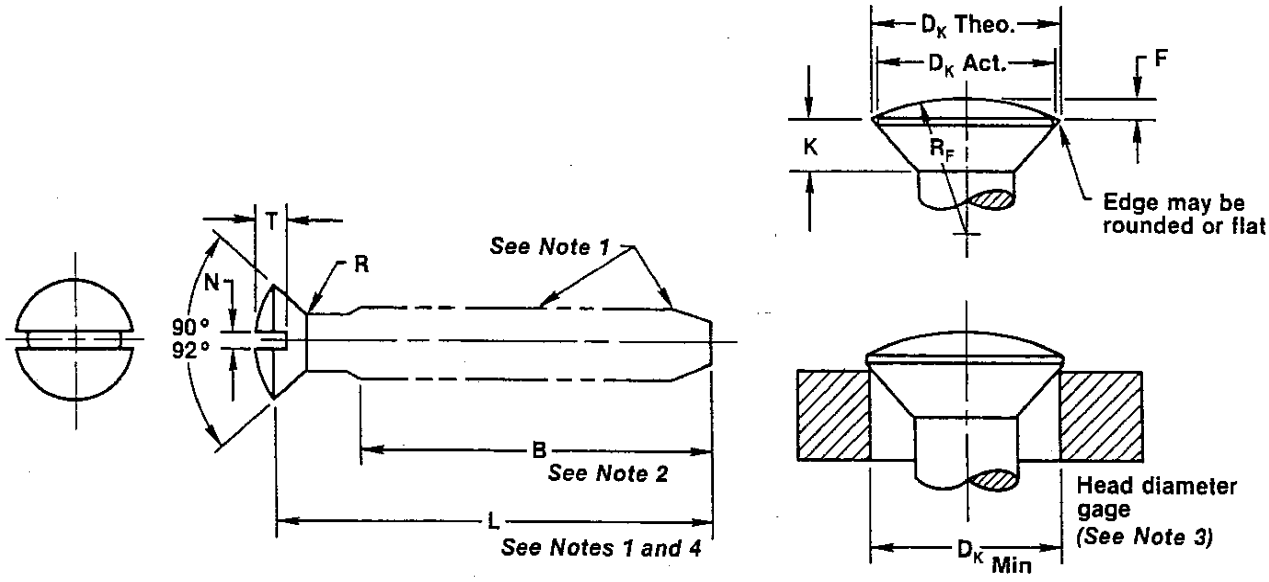
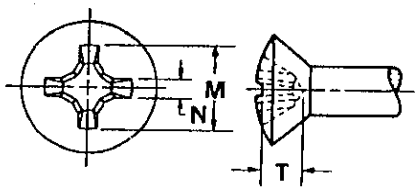


Table 9 Slotted Oval Countersunk Head Tapping Screws

Nom Screw Size		D_K			K		F	R_F	R		N		T	
Thread Types AB, B, BF, BT	Thread Types D, F, T	Head Diameter			Head Side Height		Raised Head Height	Head Radius	Fillet Radius		Slot Width		Slot Depth	
		Theoretical Sharp		Actual	Types AB, B BF, BT	Types D, F T								
		Max	Min	Min	Max Ref	Max Ref	Max	Approx	Max	Min	Max	Min	Max	Min
2.2	2	4.4	4.1	3.5	1.1	1.2	0.5	5.0	0.8	0.4	0.7	0.5	1.0	0.8
—	2.5	5.5	5.1	4.4	—	1.5	0.6	6.6	1.0	0.5	0.8	0.6	1.2	1.0
2.9	3	6.3	5.9	5.2	1.7	1.7	0.7	7.4	1.2	0.6	1.0	0.8	1.5	1.2
3.5	3.5	8.2	7.7	6.9	2.3	2.3	0.8	10.9	1.4	0.7	1.2	1.0	1.7	1.4
4.2	4	9.4	8.9	8.0	2.6	2.7	1.0	11.6	1.6	0.8	1.5	1.2	1.9	1.6
4.8	5	10.4	9.8	8.9	2.8	2.7	1.2	11.9	2.0	1.0	1.5	1.2	2.4	2.0
5.5	—	11.5	10.9	9.9	3.0	—	1.3	13.4	2.2	1.1	1.9	1.6	2.6	2.2
6.3	6	12.6	11.9	10.9	3.1	3.3	1.4	14.9	2.4	1.2	1.9	1.6	2.8	2.4
8	8	17.3	16.5	15.4	4.6	4.6	2.0	19.7	3.2	1.6	2.3	2.0	3.7	3.2
9.5	10	20.0	19.2	17.8	5.2	5.0	2.3	22.9	4.0	2.0	2.8	2.5	4.4	3.8
See Notes				3										

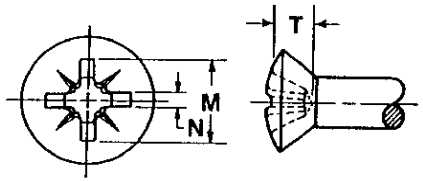
NOTES:

1. See Tables 5 and 6 for thread and point dimensions and minimum practical screw lengths.
2. See Tables 1 and 2 for thread lengths.
3. Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified actual D_K minimum within a tolerance of plus 0.00 mm and minus 0.01 mm. The head shall not enter the gage.
4. See Table 15 for recommended screw lengths.
5. See Introductory Notes and General Data, page F—1.
6. Comparable ISO Standards —
   ISO 1483 — Slotted raised countersunk head tapping screw.
   ISO 7051 — Recessed raised countersunk head tapping screw.



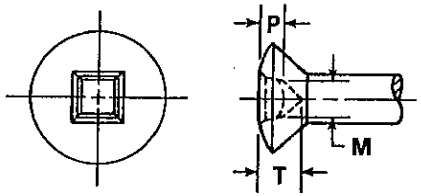
Type I

This type of recess has a large center opening, tapered wings, and blunt bottom, with all edges relieved or rounded.



Type 1A

This type of recess has a large center opening, wide straight wings, and blunt bottom, with all edges relieved or rounded.



Type III

This type of recess has a square center opening, slightly tapered side walls and a conical bottom.

Table 10 Recess Dimensions of Oval Countersunk Head Tapping Screws

Nom Screw Size		Type I								Type 1A								Type III							
		M		T		N				M		T		N				M		T			P		
Thread Types AB, B, BF, BT	Thread Types D, F, T	Recess Dia		Recess Depth		Recess Width	Driver Size	Recess Penetration Gaging Depth		Recess Dia		Recess Depth		Recess Width	Driver Size	Recess Penetration Gaging Depth		Recess Square		Recess Depth		Driver Size	Penetration Gaging Depth		
		Max	Min	Max	Min	Min		Max	Min	Max	Min	Max	Min	Min		Max	Min	Max	Min	Max	Min		Max	Min	
2.2	2	2.52	2.19	1.84	1.54	0.56	0	1.70	1.40	2.56	2.23	1.90	1.55	0.48	0	1.72	1.37	—	—	—	—	—	—	—	—
—	2.5	3.22	2.89	2.15	1.75	0.77	1	1.96	1.56	2.78	2.45	2.14	1.74	0.73	1	1.98	1.58	1.80	1.77	1.86	1.59	0	0.96	0.81	
2.9	3	3.61	3.28	2.53	2.13	0.83	1	2.43	2.03	3.15	2.82	2.51	2.11	0.74	1	2.32	1.92	1.80	1.77	1.86	1.59	0	0.96	0.81	
3.5	3.5	4.54	4.21	2.73	2.23	0.94	2	2.43	1.93	4.62	4.29	2.88	2.43	1.03	2	2.48	2.03	2.32	2.29	2.98	2.56	1	1.65	1.45	
4.2	4	5.09	4.76	3.24	2.74	1.01	2	2.98	2.48	5.07	4.74	3.33	2.88	1.04	2	2.93	2.48	2.86	2.82	3.55	3.03	2	1.91	1.65	
4.8	5	5.82	5.49	3.99	3.49	1.10	2	3.69	3.19	5.74	5.41	4.00	3.55	1.05	2	3.60	3.15	2.86	2.82	3.65	3.13	2	2.01	1.75	
5.5	—	7.08	6.75	4.09	3.59	1.14	3	3.63	3.13	7.15	6.82	4.28	3.83	1.44	3	3.72	3.27	3.38	3.34	4.16	3.53	3	2.21	1.91	
6.3	6	7.47	7.14	4.51	4.01	1.19	3	4.05	3.55	7.48	7.15	4.61	4.16	1.45	3	4.05	3.60	3.38	3.34	4.36	3.73	3	2.41	2.11	
8	8	10.02	9.69	6.11	5.51	1.95	4	5.53	4.93	10.06	9.73	6.31	5.86	2.19	4	5.62	5.17	4.86	4.81	5.39	4.62	4	2.59	2.29	
9.5	10	11.41	11.08	7.45	6.85	2.17	4	6.87	6.27	11.34	11.01	7.61	7.16	2.20	4	6.92	6.47	4.86	4.81	5.79	5.03	4	3.00	2.69	

NOTES:

1. Head dimensions not shown are the same as those of slotted heads given in Table 9.
2. For penetration gaging, see Appendix C, page F—22.
3. For wobble gaging, see Appendix D, page F—25.
4. See Introductory Notes and General Data, page F—1.

METRIC TAPPING SCREWS

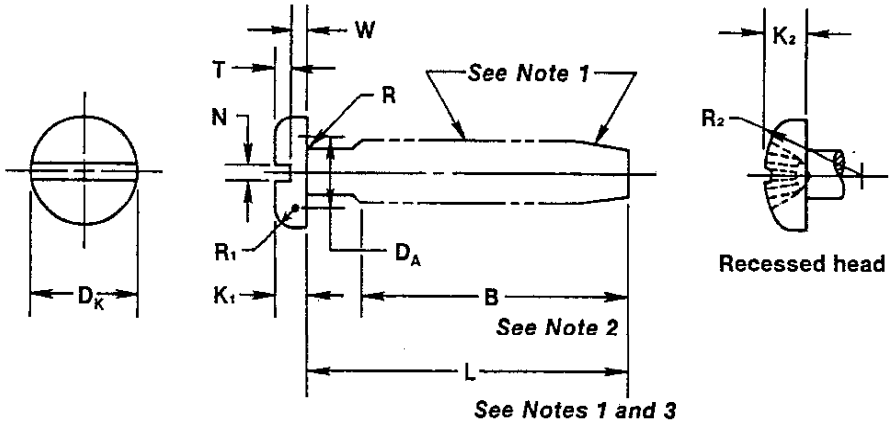
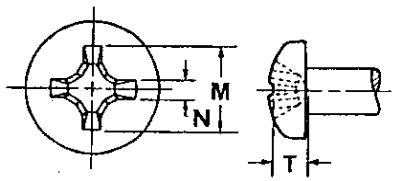


Table 11 Slotted and Recessed Pan Head Tapping Screws

Nom Screw Size		D_K		K_1		K_2		R_1	R_2	D_A		R	N		T	W
Thread Types AB, B, BF, BT	Thread Types D, F, T	Head Dia		Head Height				Head Radius	Head Radius	Fillet Transition Dia		Fillet Radius	Slot Width		Slot Depth	Unslotted Thickness
				Slotted Head		Recessed Head				AB, B BF, BT	D, F T					
		Max	Min	Max	Min	Max	Min	Max	Ref	Max	Max	Min	Max	Min	Min	Min
2.2	2	4.0	3.7	1.3	1.1	1.6	1.4	0.8	3.2	2.8	2.6	0.1	0.7	0.5	0.5	0.5
—	2.5	5.0	4.7	1.5	1.3	2.1	1.9	1.0	4.0	—	3.1	0.1	0.8	0.6	0.6	0.6
2.9	3	5.6	5.3	1.8	1.6	2.4	2.2	1.2	5.0	3.5	3.6	0.1	1.0	0.8	0.7	0.7
3.5	3.5	7.0	6.6	2.1	1.9	2.6	2.3	1.4	6.0	4.1	4.1	0.1	1.2	1.0	0.8	0.8
4.2	4	8.0	7.6	2.4	2.2	3.1	2.8	1.6	6.5	4.9	4.7	0.2	1.5	1.2	1.0	0.9
4.8	5	9.5	9.1	3.0	2.7	3.7	3.4	2.0	8.0	5.5	5.7	0.2	1.5	1.2	1.2	1.2
5.5	—	11.0	10.5	3.2	2.9	4.0	3.7	2.2	9.0	6.3	—	0.2	1.9	1.6	1.3	1.3
6.3	6	12.0	11.5	3.6	3.3	4.6	4.3	2.5	10.0	7.1	6.8	0.3	1.9	1.6	1.4	1.4
8	8	16.0	15.5	4.8	4.5	6.0	5.6	3.2	13.0	9.2	9.2	0.4	2.3	2.0	1.9	1.9
9.5	10	20.0	19.4	6.0	5.7	7.5	7.1	4.0	16.0	10.7	11.2	0.4	2.8	2.5	2.4	2.4
—	12	24.0	23.4	—	—	8.4	7.9	—	24.0	—	13.2	0.4	—	—	—	—
See Note 5																

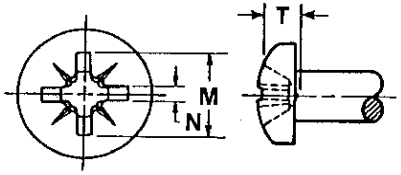
NOTES:

1. See Tables 5 and 6 for thread and point dimensions and minimum practical screw lengths.
2. See Tables 1 and 2 for thread lengths.
3. See Table 15 for recommended screw lengths.
4. See Introductory Notes and General Data, page F—1.
5. Dimensions for 12 × 1.75 recessed head screws apply only to thread rolling screws, see SAE J1237, page F—27.
6. Comparable ISO Standards —
   ISO 1481 — Slotted pan head tapping screws.
   ISO 7049 — Recessed pan head tapping screws.



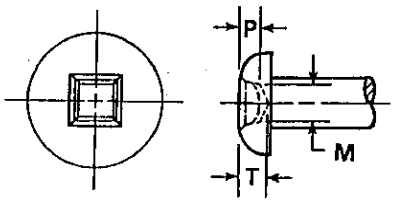
Type I

This type of recess has a large center opening, tapered wings, and blunt bottom, with all edges relieved or rounded.



Type 1A

This type of recess has a large center opening, wide straight wings, and blunt bottom, with all edges relieved or rounded.



Type III

This type of recess has a square center opening, slightly tapered side walls and a conical bottom.

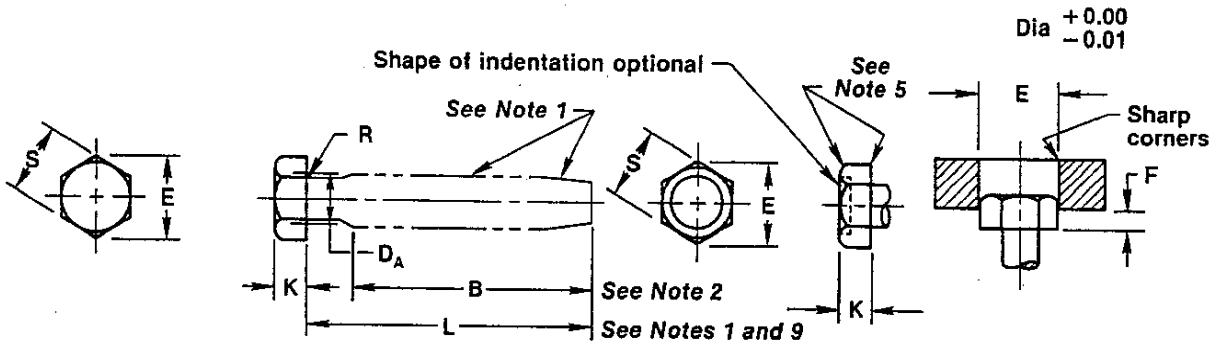
Table 12 Recess Dimensions of Pan Head Tapping Screws

Nom Screw Size		Type I								Type 1A								Type III							
		M		T		N				M		T		N				M		T			P		
Thread Types AB, B, BF, BT	Thread Types D, F, T	Recess Dia		Recess Depth		Recess Width	Driver Size	Recess Penetration Gaging Depth		Recess Dia		Recess Depth		Recess Width	Driver Size	Recess Penetration Gaging Depth		Recess Square		Recess Depth		Driver Size	Penetration Gaging Depth		
		Max	Min	Max	Min	Min		Max	Min	Max	Min	Max	Min	Min		Max	Min	Max	Min	Max	Min		Max	Min	
2.2	2	1.99	1.66	1.34	1.04	0.48	0	1.20	0.95	2.08	1.75	1.40	1.05	0.47	0	1.20	0.85	—	—	—	—	—	—	—	
—	2.5	2.85	2.52	1.73	1.33	0.70	1	1.55	1.15	2.79	2.46	1.78	1.38	0.73	1	1.50	1.10	1.80	1.77	1.86	1.59	0	0.96	0.81	
2.9	3	3.06	2.73	1.96	1.56	0.74	1	1.80	1.40	3.03	2.70	2.03	1.63	0.73	1	1.75	1.35	1.80	1.77	1.86	1.59	0	0.96	0.81	
3.5	3.5	4.08	3.75	2.20	1.70	0.87	2	1.90	1.40	4.06	3.73	2.36	1.91	1.03	2	1.90	1.45	2.32	2.29	2.98	2.56	1	1.65	1.45	
4.2	4	4.57	4.24	2.70	2.20	0.93	2	2.40	1.90	4.53	4.20	2.76	2.31	1.03	2	2.35	1.90	2.86	2.82	3.55	3.03	2	1.91	1.65	
4.8	5	5.07	4.74	3.20	2.70	1.00	2	2.90	2.40	4.92	4.59	3.16	2.71	1.04	2	2.75	2.30	2.86	2.82	3.65	3.13	2	2.01	1.75	
5.5	—	6.60	6.27	3.56	3.06	1.07	3	3.10	2.60	6.46	6.13	3.56	3.11	1.43	3	3.00	2.55	3.38	3.34	4.16	3.53	3	2.21	1.91	
6.3	6	7.09	6.76	4.06	3.56	1.14	3	3.60	3.10	6.97	6.64	4.07	3.62	1.44	3	3.50	3.05	3.38	3.34	4.36	3.73	3	2.41	2.11	
8	8	9.18	8.85	5.18	4.58	1.69	4	4.60	4.00	8.98	8.65	5.19	4.74	2.18	4	4.50	4.05	4.86	4.81	5.39	4.62	4	2.59	2.29	
9.5	10	10.35	10.02	6.39	5.79	1.84	4	5.80	5.20	10.20	9.87	6.39	5.94	2.19	4	5.70	5.25	4.86	4.81	5.79	5.03	4	3.00	2.69	
—	12	11.16	10.83	7.25	6.65	1.96	4	6.67	6.07	11.05	10.72	7.32	6.87	2.20	4	6.62	6.17	—	—	—	—	—	—	—	

NOTES:

1. Head dimensions not shown are the same as those of slotted heads given in Table 11.
2. For penetration gaging, see Appendix C, page F—22.
3. For wobble gaging, see Appendix D, page F—25.
4. See Introductory Notes and General Data, page F—1.

METRIC TAPPING SCREWS



Trimmed head or fully upset head *(See Note 8)*

Indented Head *(See Note 8)*

Table 13 Hex Head Tapping Screws

Nom Screw Size		S		E	K		D_A		R	F
Thread Types AB, B, BF, BT	Thread Types D, F, T	Width Across Flats		Width Across Corners	Head Height		Fillet Transition Dia		Fillet Radius	Protrusion Beyond Gaging Ring
							AB, B BF, BT	D, F, T		
		Max	Min	Min	Max	Min	Max	Max	Min	Min
2.2	2	3.20	3.02	3.38	1.6	1.3	2.8	2.6	0.1	0.78
—	2.5	4.00	3.82	4.28	2.1	1.8	—	3.1	0.1	1.08
2.9	3	5.00	4.82	5.40	2.3	2.0	3.5	3.6	0.1	1.20
3.5	3.5	5.50	5.32	5.96	2.6	2.3	4.1	4.1	0.1	1.38
4.2	4	7.00	6.78	7.59	3.0	2.6	4.9	4.7	0.2	1.56
4.8	5	8.00	7.78	8.71	3.8	3.3	5.5	5.7	0.2	1.98
5.5	—	8.00	7.78	8.71	4.1	3.6	6.3	—	0.2	2.16
6.3	6	10.00	9.78	10.95	4.7	4.1	7.1	6.8	0.3	2.46
8	8	13.00	12.73	14.26	6.0	5.2	9.2	9.2	0.4	3.12
9.5	10	16.00	15.73	17.62	7.5	6.5	10.7	11.2	0.4	3.90
—	12	18.00	17.73	19.86	9.0	7.8	—	13.2	0.4	4.68
See Notes	3.4		6	6.7						7
9.5	10	15.00	14.73	16.50	7.5	6.5	10.7	11.2	0.4	3.90

NOTES:

1. See Tables 5 and 6 for thread and point dimensions and minimum practical screw lengths.
2. See Tables 1 and 2 for thread lengths.
3. 9.5 and 10 mm screws with 15 mm width across flats are not ISO Standard. Unless 9.5 and 10 mm screws with 15 mm width across flats are specifically ordered, 9.5 and 10 mm screws with 16 mm width across flats shall be furnished.
4. Dimensions for 12 mm screws apply only to thread rolling screws, see SAE J1237, page F—27.
5. A slight rounding of all edges of the hex surfaces of indented hex heads is permissible provided the diameter of the bearing circle is not less than 90 percent of the minimum width across flats dimension.
6. Dimensions across flats and across corners of the head shall be measured at the point of maximum metal. Taper of sides of hex (angle between one side and the axis) shall not exceed 2 deg or 0.10 mm whichever is greater, the specified width across flats being the large dimension.
7. The rounding due to lack of fill on all six corners of the head shall be reasonably uniform, and the width across corners of the head shall be such that when a sharp ring having an inside diameter equal to the specified minimum width across corners is placed on the top and bottom of the head, the head shall protrude by an amount equal to, or greater than, the F value tabulated. For across corners gaging see Appendix B, page F—21.
8. Heads may be indented, trimmed or fully upset at the option of the manufacturer.
9. See Table 15 for recommended screw lengths.
10. See Introductory Notes and General Data, page F—1.
11. Comparable ISO Standard —
    ISO 1479 — Hexagon head tapping screws.

METRIC TAPPING SCREWS

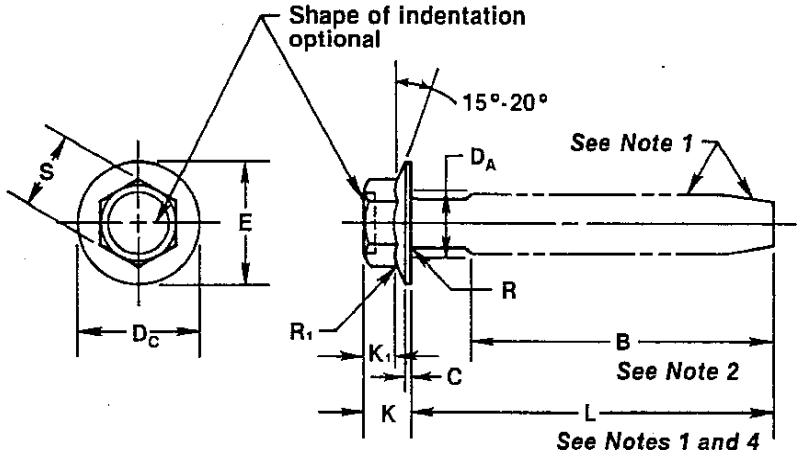


Table 14 Hex Flange Head Tapping Screws

Nom Screw Size		S		E	D_C		C	R_1	K	K_1	D_A		R	F
Thread Types AB, B, BF, BT	Thread Types D, F, T	Width Across Flats		Width Across Corners	Flange Dia		Flange Edge Thickness	Flange Top Fillet Radius	Head Height	Hex Height	Fillet Transition Dia		Fillet Radius	Protrusion Beyond Gaging Dia
											Thread Types AB, B, BF, BT	Thread Types D, F, T		
		Max	Min	Min	Max	Min	Min	Max	Max	Min	Max	Max	Min	Min
2.2	2	3.00	2.84	3.16							2.8	2.6	0.1	
—	2.5	3.20	3.04	3.39							—	3.1	0.1	
2.9	3	4.00	3.84	4.27							3.5	3.6	0.1	
3.5	3.5	5.00	4.82	5.36							4.1	4.1	0.1	
4.2	4	5.50	5.32	5.92							4.9	4.7	0.2	
4.8	—	7.00	6.78	7.55			These dimensions are under development.				5.5	—	0.2	Under development
—	5	7.00	6.78	7.55							—	5.7	0.2	
5.5	—	7.00	6.78	7.55							6.3	—	0.2	
6.3	6	8.00	7.78	8.66							7.1	6.8	0.3	
8	8	10.00	9.78	10.89							9.2	9.2	0.4	
9.5	10	13.00	12.72	14.16							10.7	11.2	0.4	
—	12	15.00	14.72	16.38							—	13.2	0.4	
See Note 3														

NOTES:

1. See Tables 5 and 6 for thread and point dimensions and minimum practical screw lengths.
2. See Tables 1 and 2 for thread lengths.
3. Dimensions for 12 mm screws apply only to thread rolling screws, see SAE J1237, page F—27.
4. See Table 15 for recommended screw lengths.
5. See Introductory Notes and General Data, page F—1.
6. There are no ISO standards for hex flange head tapping screws.

METRIC TAPPING SCREWS

Table 15 Recommended Tapping Screw Lengths

Nom Screw Length	Nom Screw Size — Thread Types AB, B, BF, BT									
	2.2	—	2.9	3.5	4.2	4.8	5.5	6.3	8	9.5
	Nom Screw Size — Thread Types D, F, T									
	2	2.5	3	3.5	4	5	—	6	8	10
3										
4	PH	PH								
5	PH	PH								
6	A	A	PH							
8	A	A	A	PH	PH					
10	A	A	A	A	A	PH				
13	A	A	A	A	A	A	PH	PH		
16		A	A	A	A	A	A	A	PH	
20				A	A	A	A	A	A	PH
25				A	A	A	A	A	A	A
30						A	A	A	A	A
35						A	A	A	A	A
40							A	A	A	A
45									A	A
50									A	A
55										A
60										A

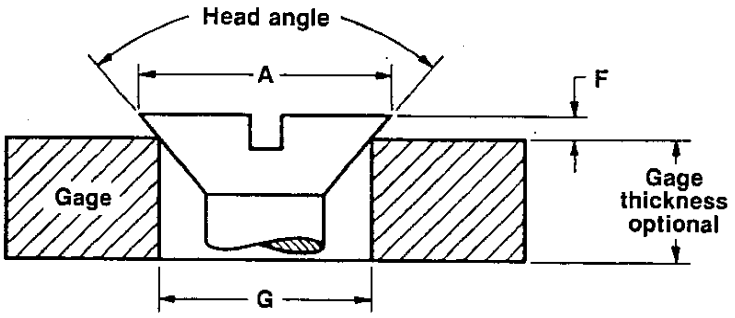
NOTE:
Lengths included between the heavy lines are recommended. "PH" means the length is recommended only for pan, hex and hex flange screws. "A" means the length is recommended for all head styles. When shorter length screws are required, refer to Tables 5 and 6 for guidance on minimum practical lengths.

APPENDIX A

PROTRUSION GAGING OF FLAT COUNTERSUNK HEADS

Suitability of flat countersunk head screws, for application in countersinks designed to the principal dimensions of the screws may be determined by the use of a protrusion gage as illustrated below.

The gaging dimensions and the gage diameters are specified in the dimensional tables for flat countersunk head screws. The protrusion limits shown in the tables shall apply only when the gaging diameter is exactly as indicated with the gaging edge of a sharpness obtained by lapping the hole and the top surface of the gage. Any variation in the gaging diameter will require recalculation of protrusion values by the original formulas given below:



Gage Hole Dia = 1.83 D − 0.838 for screw sizes 8 mm and smaller.
1.79 D − 2.360 for screw size 10 mm.

►Maximum Protrusion $= \frac{\text{Max Sharp Dia} - \text{Gage Hole Dia}}{2} \times \tan\left(90° - \frac{\text{Min Head Angle}}{2}\right)$

►Minimum Protrusion $= \frac{\text{Min Sharp Dia} - \text{Gage Hole Dia}}{2} \times \tan\left(90° - \frac{\text{Max Head Angle}}{2}\right)$

or correction in accordance with the following formula:

$$F' = F\frac{A - G'}{A - G}$$

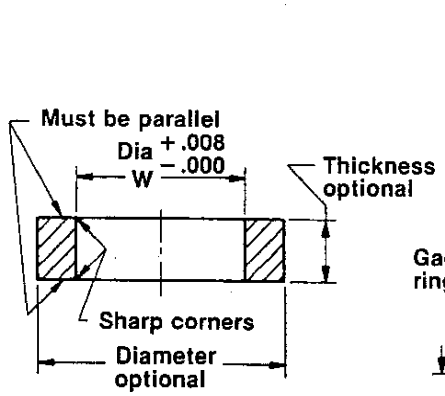
Where:
- F = tabulated protrusion value
- F' = corrected protrusion value
- A = Head diameter (Maximum or Minimum for Maximum or Minimum protrusion respectively)
- G = tabulated gage diameter
- G' = measured gage diameter

To insure adequate service life, the protrusion gage should be made of tool steel having hardness of not less than 60 Rockwell C.

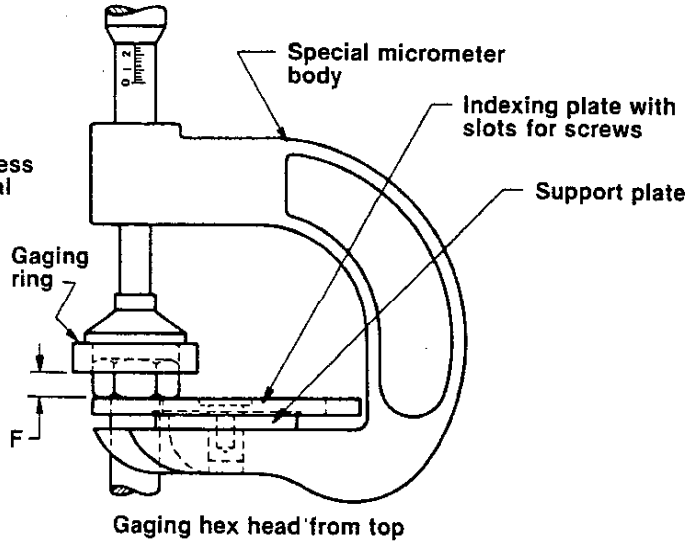
►Protrusion values shown in dimensional tables were calculated from these formulas and rounded to nearest 0.01 mm, upward for the maximum, and downward for the minimum.

APPENDIX B

ACROSS CORNERS GAGING OF HEX HEAD TAPPING SCREWS



Gaging ring



Typical gaging fixture

Suitability of across corners dimensions of hex head tapping screws may be determined by the use of gaging rings as described below.

When the gaging ring is placed on the top of a hex head screw, and also the bottom of a hex head screw, at right angles to the axis of the screw, the head must protrude beyond the ring by an amount equal to 60 percent of the minimum head height, H. For convenience, the minimum protrusion values are given in the dimensional tables for hex head screws.

The gaging ring shall have an inside diameter equal to the tabulated minimum width across corners, within a tolerance of plus 0.008 mm. The gaging edges of the ring shall be sharp and opposite faces shall be parallel. To insure adequate service life, the ring should be made of tool steel and have a hardness of not less than 60 Rockwell C.

A typical gaging fixture is shown below with an explanation of its application; however any equivalent means may be used.

To check hex head screws from the top, an initial reading shall be taken with the gaging ring placed on the indexing plate. Then, with the screw placed in the fixture, the gaging ring shall be placed on top of the screw head and a second reading taken. The difference between the two readings is equal to the protrusion, F, of the head beyond the gaging ring.

Gaging the bottom of the head on hex head screws may be accomplished in the same manner as gaging the top except the ring is placed below the head. The same protrusion values shall apply.

APPENDIX C
PENETRATION GAGING OF RECESSED HEADS

Penetration gaging is a test to determine the suitability of recesses in the heads of tapping screws and may be used to indicate deficiencies in the dimensions of the recesses specified in the dimensional tables. Penetrations which are too deep indicate the possibility of a thin section between head and shank of screw, a weakness which might result in twisting-off screw heads during tightening of the screws. Use of screws having shallow penetrations might result in production problems such as reaming of recesses or excessive wear on driver bits.

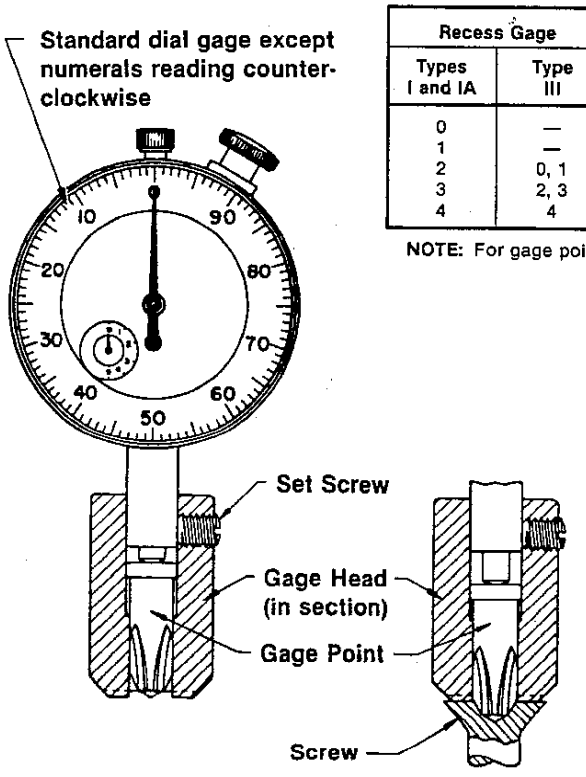
Penetration gaging depth values for the various styles of recessed heads are included in the dimensional tables for the respective heads. These values were predicated originally on the gaging of plain finish (unplated or uncoated) screws. However, subsequent experience has shown that the Type I recess penetration limits, as tabulated, and the Types IA and III recess penetration depths with tabulated minimum limit reduced by up to 0.12 mm, to be suitable for the gaging of screws having coating thickness of up to and including 0.008 mm on significant surfaces.

PENETRATION GAGING — TYPES I, IA AND III

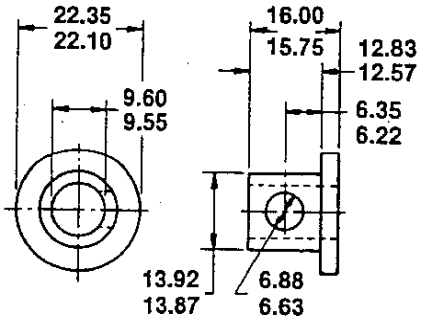
Table C1 Dimensions of Gage Heads

Recess Gage		A	B	C	D	E	F	G
Types I and IA	Type III	±0.05	±0.08	±0.005	±0.03	±0.13	±0.13	±0.13
0	—	0.20	0.38	1.168	9.58	14.27	42.88	25.5
1	—	0.30	0.51	2.235	9.58	14.27	42.88	25.5
2	0, 1	0.46	0.79	3.607	9.58	14.27	42.88	25.5
3	2, 3	0.56	0.94	5.334	9.58	14.27	42.88	25.5
4	4	0.79	1.57	7.950	9.58	14.27	42.88	25.5

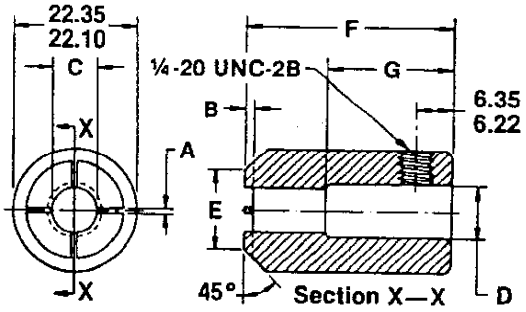
NOTE: For gage point dimensions see Tables C2, C3, C4.



Penetration Gage



Bushing for No. 5 Gage Head



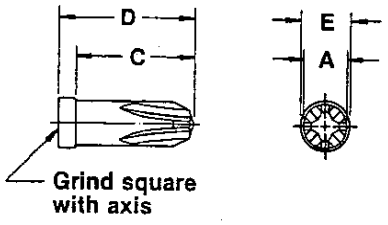
Gage Head

METRIC TAPPING SCREWS

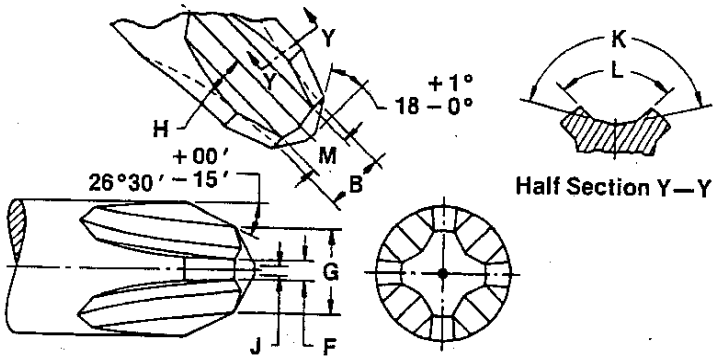
Screws having heavier coatings, which fail to meet the penetration gaging requirements, must be stripped of finish and gaged for acceptance or rejection in the plain condition.

Specified herein are dimensions of gage points to be used for penetration gaging the Types I, IA and III recesses. Gage points approach as nearly as possible the perfect driver form. Also specified are gage heads and bushings which adapt the gage points to standard dial gages. The same heads and bushings are used when gaging all types of recesses.

Penetration is gaged relative to a reference plane defined by the intersection of the edge of the recess wings of Types I and IA and the recess square of Type III with the top surface of the screw head. This plane is the same as the top surface of a flat head screw but is somewhat below the topmost portion of heads which have rounded top surfaces. Knife edges or tapered ridges on the gage head are used to establish the reference plane. A reverse reading dial gage is used to indicate the penetration of the gage point into the recess. The gage may be zeroed on any flat surface.



Gage Point



Enlarged Point Detail

Table C2 Dimensions of Gage Points for Type I Recess

Size of Recess Gage	A	B	C	D	E	F		G	H	J		K	L	M
	Point Dia	Point Width	Length	Length	Dia	Wing Thickness		Point Width	Milling Angle	Flat on End		Base Flute Angle	Side Flute Angle	Flute Width at Bottom
	±0.005	+0.000 −0.025	±0.13	±0.13	±0.13	Max	Min	+0.025 −0.000	+00′ −15′	Max	Min	+15′ −00′	+15′ −00′	+0.000 −0.025
0	1.143	0.610	16.66	19.84	2.39	0.30	0.25	0.813	7°00′	0.38	0.25	**	92°00′	*0.384
1	2.210	1.001	17.48	20.62	3.96	0.51	0.46	1.270	7°00′	0.51	0.38	138°00′	92°00′	0.513
2	3.581	1.539	19.05	22.22	5.56	0.64	0.58	2.286	5°45′	0.51	0.38	140°00′	92°00′	1.102
3	5.309	2.497	19.84	23.01	6.35	0.79	0.74	3.810	5°45′	0.51	0.38	146°00′	92°00′	2.098
4	7.925	3.574	21.44	24.61	9.12	1.12	1.07	5.080	7°00′	0.51	0.38	153°00′	92°00′	2.738

NOTES: *Tolerance on size 0 is plus 0.000 mm and minus 0.066 mm.
**Base of flute on size 0 is 0.229 mm to 0.277 mm radius.

TAPPING SCREWS

METRIC TAPPING SCREWS

IFI 502 1982

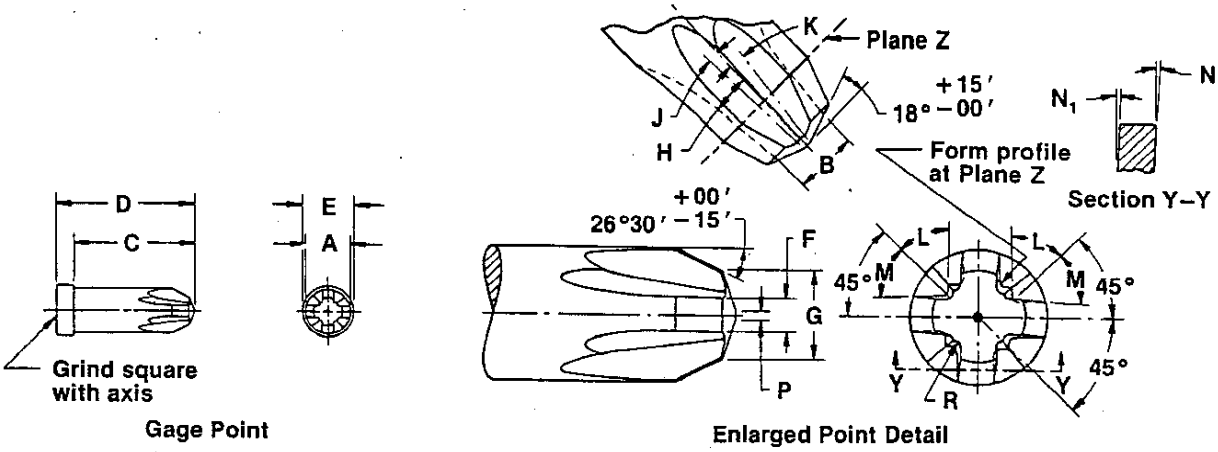


Table C3 Dimensions of Gage Points for Type IA Recess

Size of Recess Gage	A	B		C	D	E	F	G	H	J	K	L	M	N	N_1	P	R	
	Point Dia	Point Width (at Base of R Radius)		Length	Length	Dia	Wing Thickness	Point Width	Milling Angle	Milling Offset Angle	Milling Offset Angle	Rib Form Angle	Wing Form Angle	Wing Offset Angle	Wing Offset Angle	Flat on End	Radius	
	±0.005	Max	Min	±0.13	±0.13	±0.13	+0.025 −0.000	+0.025 −0.000	+00′ −06′	+06′ −00′	+06′ −00′	+07′ −00′	+07′ −00′			+0.13 +0.00	Max	Min
0	1.143	0.711	0.673	16.66	19.84	2.39	0.420	0.890	7°00′	4°23′	7°45′	46°00′	46°00′	22′	2°00′	0.25	0.101	0.076
1	2.210	1.112	1.074	17.48	20.62	3.96	0.673	1.372	7°00′	4°23′	7°45′	46°00′	46°00′	22′	2°00′	0.38	0.127	0.101
2	3.581	1.702	1.664	19.05	22.22	5.56	0.965	2.413	5°45′	3°00′	6°20′	46°00′	46°00′	17′	2°04′	0.38	0.203	0.152
3	5.309	2.591	2.553	19.84	23.01	6.35	1.347	3.937	5°45′	3°00′	6°20′	56°15′	46°00′	17′	2°04′	0.38	0.305	0.203
4	7.925	3.861	3.823	21.44	24.61	9.12	2.058	5.157	7°00′	4°23′	7°45′	56°15′	46°00′	22′	2°00′	0.38	0.508	0.356

NOTE:
1. Dimensions L and M are measured normal to the milling cut.

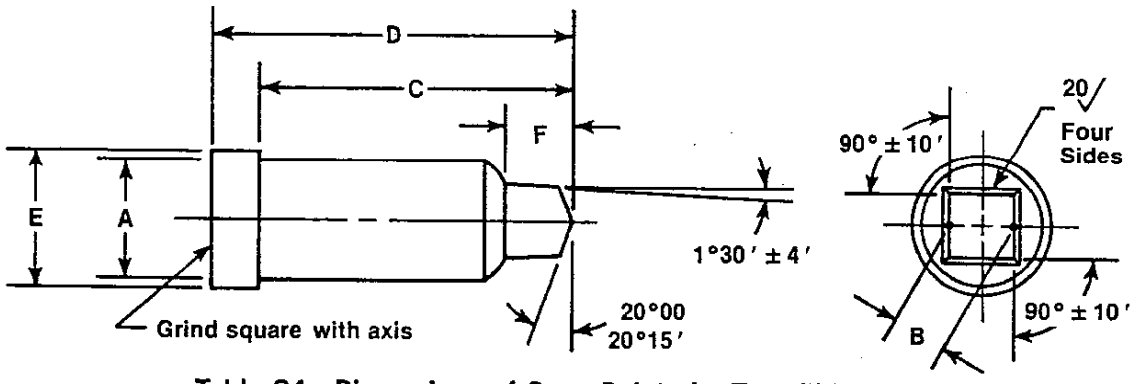


Table C4 Dimensions of Gage Points for Type III Recess

Size of Recess Gage	A	B		C	D	E	F
	Point Dia	Width of Square		Length	Length	Dia	Point Length
	±0.005	Max	Min	±0.2	±0.2	±0.13	+0.50 −0.00
0	3.581	1.748	1.743	19.0	22.0	5.56	2.5
1	3.581	2.268	2.263	19.0	22.0	5.56	2.5
2	5.309	2.802	2.797	20.0	23.0	6.35	3.5
3	5.309	3.315	3.310	20.0	23.0	6.35	3.5
4	7.925	4.772	4.767	21.5	24.5	9.12	4.5

APPENDIX D

WOBBLE GAGING OF RECESSED HEADS

Wobble gaging provides a means for determining the compatibility of cross recesses in the heads of tapping screws with companion screw drivers and will indicate the point where deviations in the recess contours affect satisfactory driver engagement. Recesses which exhibit excessive wobble characteristics will result in poor screw driveability because of driver camout prior to attaining normal torque level, damage to recesses; and/or accelerated driver wear.

The allowable total wobble gaging limits for Types I and IA cross recesses were predicated originally on the gaging of plain finish (unplated or uncoated) screws. However, subsequent experience has shown these limits to be suitable for the gaging of screws having coating thickness up to and including 7.5 μm on significant surfaces. Screws having heavier coatings, which fail to meet the wobble gaging requirements, must be stripped of finish and gaged for acceptance or rejection in the plain condition. Type III recesses are not subject to wobble gaging because the near parallel sides of the recess and driver are essentially wobble free.

Wobble gaging fixtures as illustrated on the following page and appropriate cross recess master plug gages with handles and position indicators for the respective recess types are available through the screw suppliers. Dimensions of the points on master plug gages are, except for the body diameters tabulated herein, the same as those specified for the respective gage points in Appendix C on Penetration Gaging.

The screw to be gaged shall be placed into the screw holding chuck and oriented such that one set of recess wings is parallel to the upright back plate. The screw shall be so positioned and the chuck shall be tightened sufficiently to prevent any tilting of the screw in the chuck when taking wobble readings.

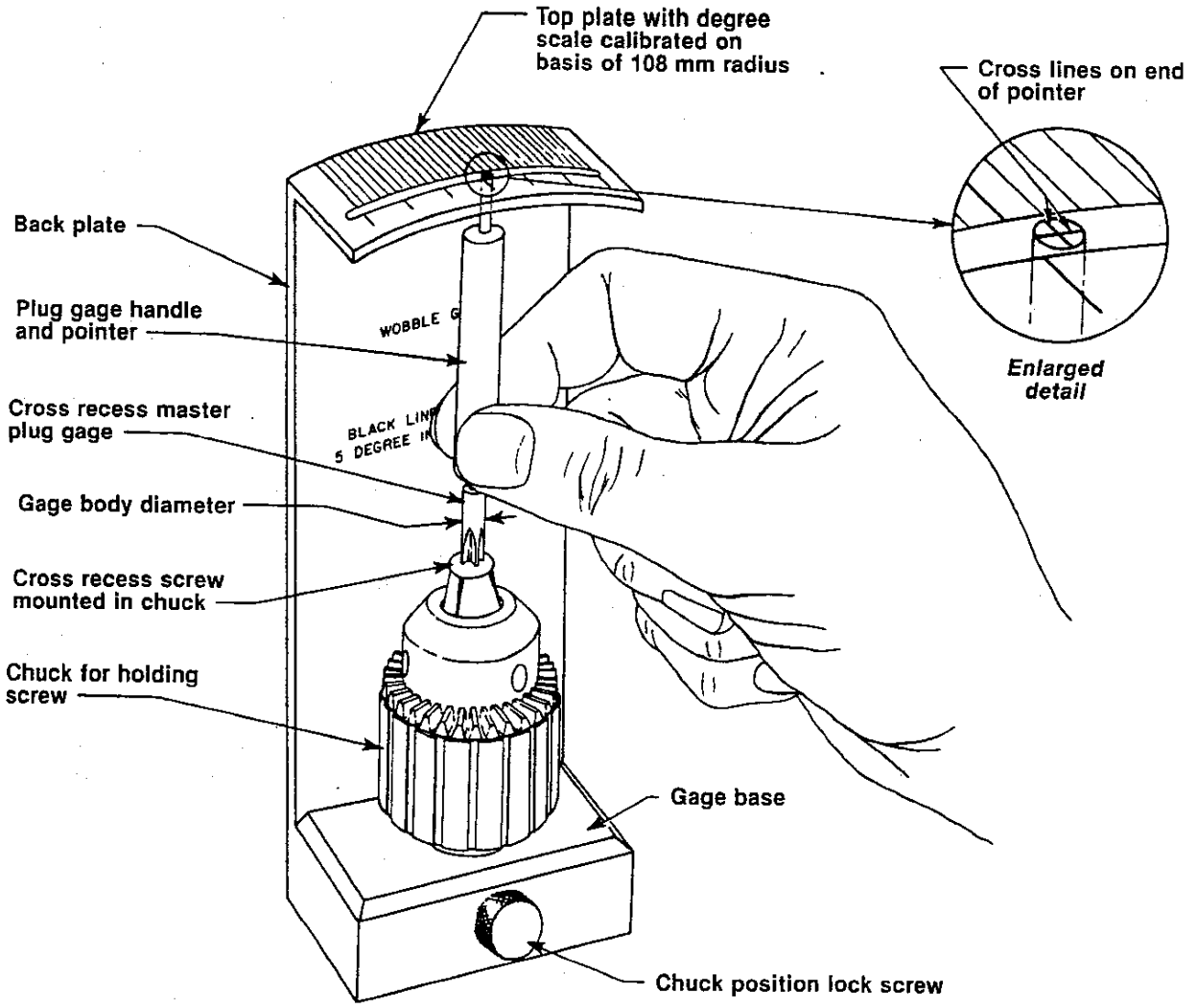
The position gage pointer and handle with the proper master plug gage for the recess size being checked shall be positioned in the slot of the degree scale on top plate and the point of the plug gage inserted into the screw recess. It is essential that registry between the cross lines of pointer and the recess wings be maintained. To correct any misalignment, the chuck position lock screw is loosened, the chuck is rotated until registry is obtained, and the chuck raised or lowered until the gage pointer is flush with the top of the degree scale. The chuck position lock screw is then tightened and the readings taken. The gage handle, with downward pressure applied, is moved from side to side until resistance is encountered and the total reading between points of travel of the gage pointer is recorded. The allowable angular wobble limits shall not exceed the values tabulated below. Cross lines on gage pointer should be rechecked with plug gage wings to make certain cross lines and gage wings are registered on identical radials.

Gaging Limits for Type I and Type IA Recesses

Size of Recess Gage	Max Allowable Total Wobble	
	Type I	Type IA
1	15°	12°
2	12°	10°
3	10°	8°
4	10°	8°

NOTE: Values for No. 0 recess are under development.

METRIC TAPPING SCREWS



GAGING FIXTURE

Gage Body Diameters

Size of Recess Gage	Types 1 & 1A Recesses	
	Max	Min
0	3.43	2.92
1	5.03	4.52
2	6.60	6.10
3	8.20	7.70
4	9.78	9.27