The American Society of Mechanical Engineers

AN AMERICAN NATIONAL STANDARD

METRIC MACHINE SCREWS

ASME B18.6.7M-1999

[Revision of ASME B18.6.7M-1985 (1993)]

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The 2000 edition of this Standard is being issued with an automatic addenda subscription service. The use of an addenda allows revisions made in response to public review comments or committee actions to be published as necessary. The next edition of this Standard is scheduled for publication in 2005.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. The interpretations will be included with the above addenda service. Interpretations are not part of the addenda to the Standard.

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

FOREWORD

ASME Standards Committee B18 for the standardization of bolts, screws, nuts, rivets and similar fasteners was organized in March 1922, as Sectional Committee B18 under the aegis of the American Engineering Standards Committee (later the American Standards Association, then the United States of America Standards Institute, and as of October 6, 1969, the American National Standards Institute, Inc.). The Society of Automotive Engineers and the American Society of Mechanical Engineers served as joint sponsors.

Subcommittee 3 was subsequently established and charged with the responsibility for technical content of standards covering slotted and recessed head screws. In accordance with a general realignment of the subcommittee structure on April 1, 1966, Subcommittee 3 was redesignated Subcommittee 6.

At its meeting on December 4, 1974, Standards Committee B18 authorized preparation of a series of standards for metric fasteners. Subcommittee 6 was responsible for developing product standards covering metric machine screws and tapping screws.

In subsequent meetings of Subcommittee 6, held over the ensuing two years, the content of the proposed metric standards was discussed and organized. It was decided that the coverage should be limited to the flat countersunk, oval countersunk, and pan head styles having slotted and Types I and IA cross recessed drive provisions and the hex and hex washer head designs. The machine screws would cover sizes M2 through M12 and, in steel, be available in two strength grades conforming to property classes 4.8 and 9.8. Also, it was the consensus that the respective head envelopes for both machine screws and tapping screws of comparable sizes should remain consistent with established inch practices. In 1976, the Industrial Fasteners Institute published IFI-513, documenting dimensions and specifications as then agreed upon and coordinated to the extent possible with the International Organization for Standardization (ISO) proposals, which Subcommittee 6 authorized as a first draft proposal for the metric machine screw document.

Because the common head for machine and tapping screw approach differed considerably from existing metric practices and ISO drafts, particularly in regard to countersunk heads, a task group was established at the September 1977 meeting of the Subcommittee to develop proportions for a common 90 deg flat countersunk recessed head having adequate head to shank strength combined with satisfactory driveability. Also at this meeting, it was recommended that consideration be given to developing a hex flange head having a smaller hex width across flats, similar to the metric hex flange screws evolving under Subcommittee 2 for larger product sizes. This head would be applicable to both machine and tapping screws and intended to replace the hex washer head, which in some sizes, was difficult to manufacture and had less than desirable driving capabilities. Over the ensuing years, the recommendations resulting from the task group studies along with other actions taken by Subcommittee 6 were coordinated through Subcommittee 4 with the appropriate ISO/TC2 working groups toward resolution of dimensional differences. At the March 1980 meeting of ISO/TC2, a tentative agreement was reached on the envelopes for the flat, oval, pan, and hex heads. These actions were confirmed by Subcommittee 6 at the October 22, 1980 meeting and a review of the cross recess dimensions was initiated. At the December 9, 1981 meeting the Subcommittee, following approval of the proposed format, authorized preparation of a formal draft standard that would include substituting the hex flange head for the hex washer head.

In May 26, 1982 it was agreed to add a short shoulder under the head of heat treated flat countersunk head screws and approval was granted for numerous other refinements.

A proposed draft of the standard was prepared and approved by letter ballot to Subcommittee 6 and ASME Standards of Committee B18 in December 17, 1984. Following acceptance by these respective groups, this proposal was approved by the sponsors and submitted by the ASME Board of Standardization to the American National Standards Institute. It was approved and formally designated an American National Standard in July 23, 1985.

In 1997, Subcommittee 6 initiated work to revise the head diameters for flat head screws, length measurement method for oval head screws, height inspection for oval head screws, and quality assurance. Protrusion height inspection for oval head screws was also added. These changes were balloted and approved by the ASME B18 Committee. The proposal was submitted to the American National Standards Institute and designated an American National Standard in August 19, 1999.

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

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

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CORRESPONDENCE WITH THE B18 COMMITTEE

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

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

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

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

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

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

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings which are necessary to explain the question; however, they should not contain proprietary names or information.

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

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

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

CONTENTS

Mandatory Appendices

METRIC MACHINE SCREWS

1 INTRODUCTORY NOTES

1.1 Scope

1.1.1 This Standard covers the complete general and dimensional data for metric flat countersunk, oval countersunk and pan slotted and recessed head machine screws, and metric hex and hex flange head machine screws recognized as standard. Also included are appendices that provide specifications and instructions for protrusion gaging of flat countersunk head screws, across-corners gaging of hex head screws, and penetration gaging and wobble gaging of recessed head screws, and clearance hole recommendations.

1.1.2 The inclusion of dimensional data in this Standard is not intended to imply that all of the products described are stock production sizes. Consumers should consult with manufacturers concerning the availability of products. The recommended diameter–length combinations applicable to metric machine screws are shown in Table 17.

1.2 Comparison With ISO Standards

1.2.1 The dimensions for flat countersunk, oval countersunk, pan, and hex head machine screws as presented in this Standard have been coordinated to the extent possible with ISO standards. Where applicable, the comparable ISO standard is referenced in the footnotes to the dimensional tables for the respective screw products. Except for the recessed flat countersunk heads, the dimensional differences between machine screws 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. For recessed flat countersunk head screws, the head envelopes are identical in both standards. One ISO standard incorporates shallower recesses without a shoulder and another ISO standard, identical to this ASME Standard, is being drafted. However, heat-treated products covered by this document feature a short shoulder under the head (with an attendant increase in the minimum grip length) and recess depths consistent with other head styles.

1.2.2 Hex flange head screws and screws implementing the Type III recess are not, as of this writing, covered by ISO standards.

1.2.3 The Types I and IA cross-recesses documented in this Standard are designated Types H and Z, respectively, in corresponding ISO standards.

1.2.4 Nominal screw lengths of 12-mm and 14-mm are recognized as ISO standard lengths. The 13-mm length shown in Table 17 is not.

1.3 Head Types

The head types covered by this Standard include those commonly recognized as being applicable to metric machine screws and are listed and described as follows:

1.3.1 Flat Countersunk Head. The flat countersunk head shall have a flat top surface and a conical bearing surface with a head angle of 90 deg to 92 deg. Dimensions are given in Tables 2 through 5.

1.3.2 Oval Countersunk Head. The oval countersunk head shall have a rounded top surface and a conical bearing surface with a head angle of 90 deg to 92 deg. Dimensions are given in Tables 6 through 9.

1.3.3 Pan Head. The slotted pan head shall have a flat top surface rounding 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. Dimensions are given in Tables 10 through 13.

1.3.4 Hex Head. The hex head shall have a flat or indented top surface, six flat sides, and a flat bearing surface. Dimensions are given in Table 14.

1.3.5 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 that projects beyond the sides and provides a flat bearing surface. Dimensions are given in Table 15.

1.4 Dimensions

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

1.5 Options

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

1.6 Terminology

Refer to ASME B18.12 for definitions of terms relating to fasteners or to component features thereof used in this Standard.

1.7 Designation

1.7.1 To promote uniformity and understanding in communications relating to products conforming to this Standard, it is recommended that metric machine screws be designated in accordance with the following data, preferably in the sequence shown:

(a) product name, including head style and driving provision
(b) designation of the Standard
(c) nominal size
(d) thread pitch
(e) nominal length
(f) header point, if desired
(g) material (including property class, if steel)
(h) protective finish, if required

EXAMPLES:

(1) Slotted Pan Head Machine Screw, ASME B18.6.7M, M8 x 1.25 x 30, Class 4.8 Steel, Zinc Plated.

(2) Type IA Cross-Recessed Oval Countersunk Head Machine Screw, ASME B18.6.7M, M3.5 x 0.6 x 20, Header Point, Brass.

NOTE: It is common practice in ISO Standards to omit thread pitch from the product size designation when screw threads are the metric coarse thread series (e.g., M10 is M10 x 1.5).

1.7.2 For the recommended B18 part identifying numbering system (PIN), see ASME B18.24.1.

1.8 Clearance Holes

Recommendations pertaining to clearance holes for use in components to be assembled with machine screws are presented in Appendix V.

1.9 Reference Standards

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

ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)[1]
ASME B1.3M, Screw Thread Gaging Systems for Dimensional Acceptability–Inch and Metric Screw Threads (UN, UNR, UNJ, M and MJ)[1]
ASME B1.13M, Metric Screw Threads–M Profile[1]
ASME B18.12, Glossary of Terms for Mechanical Fasteners[1]
ASME B18.18.1M, Inspection and Quality Assurance for General Purpose Fasteners[1]
ASME B18.18.2M, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners[1]
ASME B18.24.1, Part Identifying Number (PIN) Code System Standard for B18 Externally Threaded Products[1]

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

ASTM F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

Publisher: The American Society for Testing and Materials, (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428

ISO 1580, Slotted Pan Head Screws–Product Grade A
ISO 2009, Slotted Countersunk Head Screws (common head style)–Product Grade A[1]
ISO 7045, Cross-Recessed Pan Head Screws–Product Grade A[1]
ISO 7046-1, Countersunk Flat Head Screws (common head style) With Type H or Type Z Cross-Recess–Product Grade A–Part 1: Property Class 4.8
ISO 7046-2, Countersunk Flat Head Screws (common head style)–Grade A, Part 2: Steel of Property Class 8.8, Stainless Steel and Non-ferrous Metals[1]
ISO 7047, Cross-Recessed Raised Countersunk head Screws (common head style)–Product Grade A[1]

Publisher: International Organization for Standardization (ISO), 1 rue de Varembé, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse

[1] May also be obtained from American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036.

1.10 Inspection and Quality Assurance

Unless otherwise specified, acceptability to this Standard shall be determined in accordance with ASME B18.18.1M.

When applicable, the following designated characteristics shall be inspected to the inspection levels shown according to ASME B18.18.2M.

Designated Characteristic	Inspection Level
Recess penetration depth	C
Slot depth	C
Width across-corners	C
Thread acceptance	C

For nondesignated dimensional characteristics, the provisions of ASME B18.18.1M shall apply. Should a nondesignated dimension be determined to be outside its specified limits, it shall be deemed conforming to this Standard if the user who is the installer accepts the dimension, based upon form, fit, and function considerations.

2 GENERAL DATA

2.1 Screw Heads

2.1.1 Head Height. All dimensions pertaining to head height specified in the dimensional tables shall be measured parallel to the axis of screw, and those relating to the top of head shall represent a metal to metal measurement. Any truncation of rounded head contours due to the slot or recess shall not be considered part of the head height.

Total or overall head heights shall be measured from the top of the head to the bearing surface for perpendicular bearing surface type heads and to the junction of the conical bearing surface with the basic screw diameter for flat countersunk heads.

Head side heights shall be measured from the theoretical intersection of the top surface of head with the head diameter to the plane of the bearing surface for flat bearing surface type heads, and to the junction of conical bearing surface with the basic screw diameter for countersunk heads. The raised head height shall be measured from the theoretical intersection of the head top surface with the head diameter to the top of the head.

On countersunk heads, the junction of the conical bearing surface with the basic screw diameter may not necessarily be the same as the actual junction of head with shank, and the head height delineating the conical bearing surface is a reference dimension.

2.1.2 Bearing Surface. The bearing surface of perpendicular bearing surface-type screw heads shall be at right angles to the axis of screw shank within 2 deg.

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

Recess penetration gaging depth values are included in the respective dimensional tables and the method of gaging and specifications for gages are covered in Appendix III.

Recess wobble gaging procedures and acceptable limits are contained in Appendix IV.

2.1.4 Slot Depth. The slot depth in slotted head screws shall be measured, parallel to the axis of screw, from the top of the head to the intersection of the bottom of the slot with the head surface or bearing surface. On slotted pan heads, the unslotted thickness shall be measured, parallel to the axis of screw, from the bearing surface to the intersection of the bottom of the slot with the head diameter.

2.1.5 Feature Positional Tolerances. The positional relationship of the heads and driving provisions of screws with respect to the shanks of screws (formerly defined as eccentricity) shall be as follows.

2.1.5.1 Head True Position. 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% of the specified maximum head diameter or maximum width across flats of hex and hex flange heads, regardless of feature size.

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

2.1.5.3 Slot True Position. The slot in slotted head screws shall be located at a true position relative to the axis of the screw shank within a tolerance zone having a width equivalent to 12% of the basic screw diameter or 0.5-mm, whichever is greater, regardless of feature size.

2.1.6 Underhead Fillets. All screws shall have a fillet radius at the junction of the head and shank within the limits specified in the dimensional tables. For flat and oval countersunk head screws, the maximum and minimum fillet radii are equal to 0.4 and 0.2 times the basic screw diameter rounded to one decimal place, respectively. For pan, hex, and hex flange head screws, the fillet shall be a smooth and continuous concave curve fairing smoothly into the underhead 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 the specified R minimum.

2.2 Length

2.2.1 Measurement. The nominal length of screw, L, shall be measured, parallel to the axis of screw, from the extreme point to the plane of the bearing surface for screws having perpendicular bearing surface type heads, and to the theoretical intersection of the top surface of head with the head diameter for screws having countersunk type heads. For all oval heads, the overall length, L_o, shall be measured, parallel to the axis of the screw, from the extreme point to the top of the head, where $L_o = L + O$.

2.2.2 Tolerance on Length. The length tolerance shall apply to L_o for all oval heads, and to L for all other head styles. The tolerance on the length of machine screws shall conform to the following:

Nominal Screw Length	Tolerance on Length, mm
Up to 3 mm, inclusive	±0.2
Over 3 to 10 mm, inclusive	±0.3
Over 10 to 16 mm, inclusive	±0.4
Over 16 to 50 mm, inclusive	±0.5
Over 50 mm	±1.0

2.2.3 Standard Lengths. The recommended standard diameter–length combinations applicable to the respective machine screw head styles are shown in Table 17.

2.3 Threads

Unless otherwise specified by the purchaser, threads shall be metric coarse series conforming to the dimensions of general purpose external threads in ASME B1.13M. Thread size limits prior to plating or coating shall be class 6g (GO and NOT GO). After plating or coating, class 6g threads shall be accepted using the size limits of 6h GO (high limit) and 6g NOT GO (low limit).

2.3.1 Thread Gaging. Unless otherwise specified by the purchaser, gaging for screw thread dimensional acceptability shall be in accordance with gaging System 21 as specified in ASME B1.3M.

2.4 Thread Length

The thread length on machine screws shall be as specified in Table 1 for the applicable screw type, size, and length. For screws that are threaded full length the maximum unthreaded length under the head shall be controlled as designated therein. For longer screws, the minimum thread length, B, shall be the distance, measured parallel to the axis of screw, from the extreme end to the last complete (full-form) thread as depicted in the illustrations above the dimensional tables.

2.5 Body Diameter

The body diameter on machine screws shall be within the limits specified in the dimensional tables.

2.6 Points

Unless otherwise specified, machine screws shall have plain sheared ends. When so designated, header points shall be obtainable on screws as shown in Table 16. Other points or the pointing of longer lengths to the header point dimensions may require machining.

2.7 Straightness

At maximum material condition, the derived median line of the screw body diameter and thread major diameter shall lie within a straightness tolerance diameter equal to $0.006L$ for nominal lenghts, L, 300 mm for shorter, and $0.008L$ for screws having nominal lengths, L, over 300 mm through 600 mm. For screws with conical bearing surface type heads, reduce the nominal length, L, by the specified maximum head or raised head height, K, prior to calulating the straightness tolerance diameter. A gage and gaging procedure for checking straightness is given in Appendix II of ASME B18.2.3.1M

2.8 Materials

2.8.1 Steel. As specified by the purchaser, steel machine screws shall be low carbon steel conforming to the requirements of property class 4.8 or heat treated carbon steel conforming to the requirements of property class 9.8, as covered in ASTM F568M.

2.8.1.1 Marking. Hex and hex flange head screws, M5 and larger, shall be permanently and legibly

marked with the property class numerals. Other head styles need not be marked.

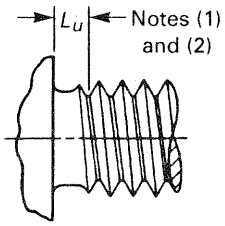
2.8.2 Other Materials. Machine screws may also be made from higher strength steels, corrosion resistant steel, brass, monel, aluminum alloys, or other materials, as agreed upon between the manufacturer and the purchaser.

2.9 Finish

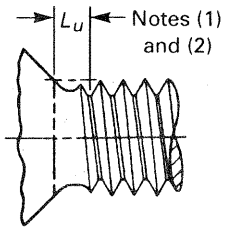
Unless otherwise specified, machine screws shall be supplied with a naturally bright unplated or uncoated finish. When corrosion preventative treatment is required, screws shall be plated or coated as agreed upon between the manufacturer and the purchaser. Where heat-treated carbon steel screws, however, are plated or coated and subject to hydrogen embrittlement, they shall be suitably treated after the plating or coating operation to obviate such embrittlement.

2.10 Workmanship

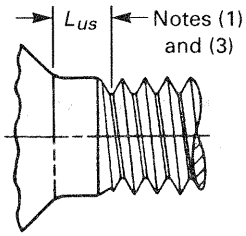
Machine screws shall be free from surface irregularities affecting their serviceability, such as excessive burrs, seams, laps, loose scale, and other irregularities.



Pan, Hex, and Hex Flange Head Screws



Flat and Oval Countersunk Head Screws



Heat Treated Recessed Flat Countersunk Head Screws

TABLE 1 THREAD LENGTHS FOR MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Nominal Screw Length Equal to or Shorter Than, *L*	Max. Unthreaded Length [Note (1)]		Nominal Screw Length, *L*		Max. Unthreaded Length [Note (1)]		Nominal Screw Length Longer Than, *L*	Min. Full Form Thread Length, *B* [Note (4)]
		L_{us} [Note (3)]	L_u [Note (2)]	Over	To and Including	L_{us} [Note (3)]	L_u Note (2)]		
M2 × 0.4	6	1.0	0.4	6	30	1.0	0.8	30	25.0
M2.5 × 0.45	8	1.1	0.5	8	30	1.1	0.9	30	25.0
M3 × 0.5	9	1.2	0.5	9	30	1.2	1.0	30	25.0
M3.5 × 0.6	10	1.5	0.6	10	50	1.5	1.2	50	38.0
M4 × 0.7	12	1.8	0.7	12	50	1.8	1.4	50	38.0
M5 × 0.8	15	2.0	0.8	15	50	2.0	1.6	50	38.0
M6 × 1	18	2.5	1.0	18	50	2.5	2.0	50	38.0
M8 × 1.25	24	3.1	1.2	24	50	3.1	2.5	50	38.0
M10 × 1.5	30	3.8	1.5	30	50	3.8	3.0	50	38.0
M12 × 1.75	36	4.4	1.8	36	50	4.4	3.5	50	38.0

GENERAL NOTES:
(a) For additional requirements, refer to para. 2.4.
(b) Dimensions are in millimeters.

NOTES:
(1) Unthreaded lengths L_u and L_{us} represent the distance, measured parallel to the axis of the screw, from the underside of the head to the face of a non-chamfered or non-counterbored thread ring gage set to the maximum Class 6H limit, assembled by hand as far as the thread will permit.
(2) The L_u values shall apply to all screws except those cited in Note (3).
(3) The L_{us} values shall apply only to recessed flat countersunk head screws.
(4) Refer to the illustrations for respective screw head styles (Tables 2 through 15).

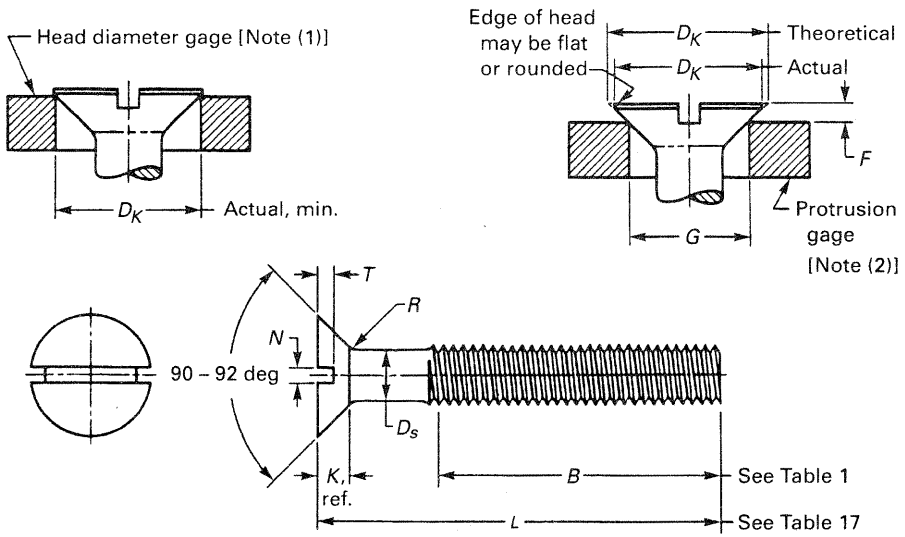


TABLE 2 DIMENSIONS OF SLOTTED FLAT COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Actual Head Diameter, D_K		Max. Head Height, K, Reference	Underhead Fillet Radius, R		Slot Width, N		Slot Depth, T		Head Protrusion Above Gage Diameter, F [Note (2)]		Protrusion Gage Diameter, G [Note (2)]
	Max.	Min.	Max.	Min. [Note (1)]		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
M2 × 0.4	2.00	1.65	3.8	3.5	1.2	0.8	0.4	0.7	0.5	0.6	0.4	0.79	0.62	2.82
M2.5 × 0.45	2.50	2.12	4.7	4.4	1.5	1.0	0.5	0.8	0.6	0.7	0.5	0.88	0.66	3.74
M3 × 0.5	3.00	2.58	5.5	5.2	1.7	1.2	0.6	1.0	0.8	0.9	0.6	0.83	0.60	4.65
M3.5 × 0.6	3.50	3.00	7.3	6.9	2.3	1.4	0.7	1.2	1.0	1.2	0.9	1.32	1.03	5.57
M4 × 0.7	4.00	3.43	8.4	8.0	2.7	1.6	0.8	1.5	1.2	1.3	1.0	1.46	1.17	6.48
M5 × 0.8	5.00	4.36	9.3	8.9	2.7	2.0	1.0	1.5	1.2	1.4	1.1	1.05	0.72	8.31
M6 × 1	6.00	5.21	11.3	10.9	3.3	2.4	1.2	1.9	1.6	1.6	1.2	1.23	0.85	10.14
M8 × 1.25	8.00	7.04	15.8	15.4	4.6	3.2	1.6	2.3	2.0	2.3	1.8	1.75	1.30	13.80
M10 × 1.5	10.00	8.86	18.3	17.8	5.0	4.0	2.0	2.8	2.5	2.6	2.0	2.23	1.77	15.54

GENERAL NOTES:
(a) The comparable ISO standard is ISO 2009.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

NOTES:
(1) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 mm and –0.01 mm. The head shall not enter the gage.
(2) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.

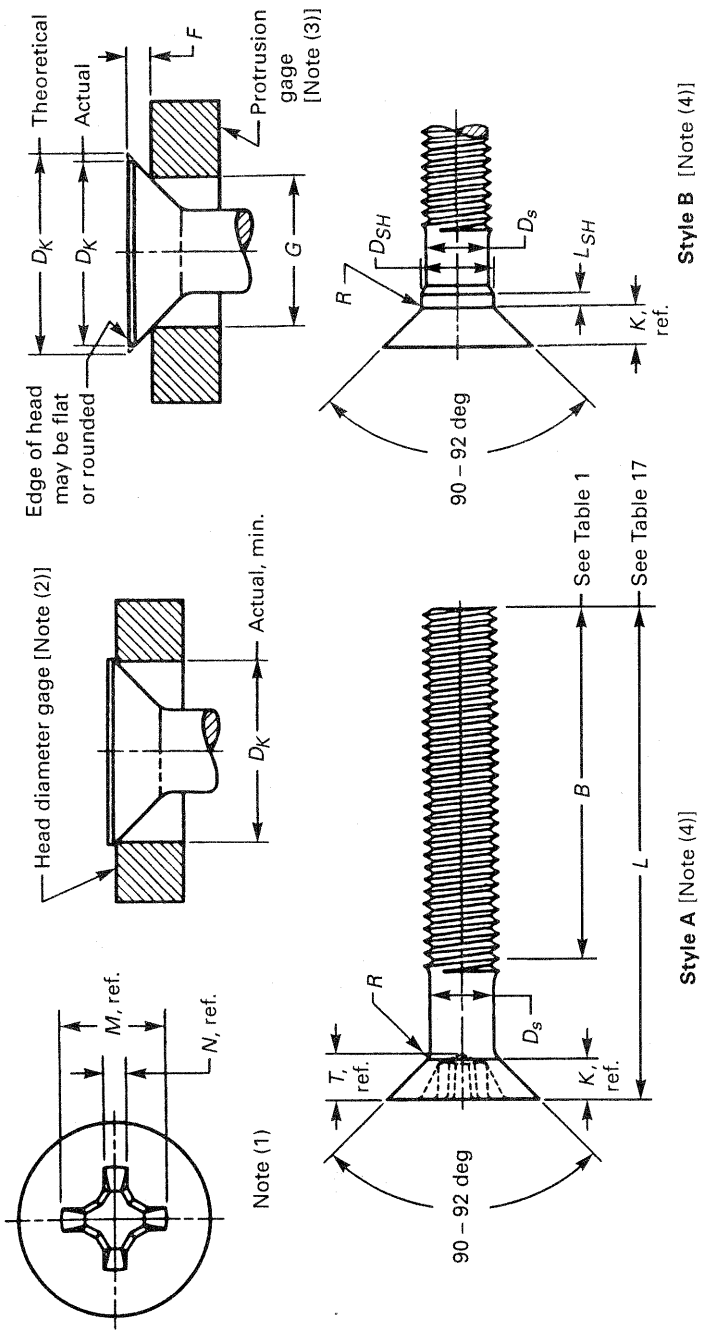


TABLE 3 ILLUSTRATION

TABLE 3 DIMENSIONS OF TYPE I CROSS-RECESSED FLAT COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Max. Body and Shoulder Diameter, D_{SH} [Note (4)]	Min. Shoulder Diameter, D_{SH} [Note (4)]	Min. Body Diameter, D_S	Actual Head Diameter, D_K		Max. Head Height, K, Reference	Shoulder Length, L_{SH} [Note (4)]		Underhead Fillet Radius, R		Recess Diameter, M, Reference	Recess Depth, T, Reference	Recess Width, N, Reference	Driver Size	Recess Penetration Gaging Depth		Head Protrusion Above Gage Diameter, F [Note (3)]		Protrusion Gage Diameter, G [Note (3)]
				Max.	Min. [Note (2)]		Max.	Min.	Max.	Min.					Max.	Min.	Max.	Min.	
M2 × 0.4	2.00	1.86	1.65	3.8	3.5	1.2	0.50	0.30	0.8	0.4	2.14	1.54	0.53	0	1.55	1.25	0.79	0.62	2.82
M2.5 × 0.45	2.50	2.36	2.12	4.7	4.4	1.5	0.55	0.35	1.0	0.5	2.80	1.78	0.74	1	1.80	1.40	0.88	0.66	3.74
M3 × 0.5	3.00	2.86	2.58	5.5	5.2	1.7	0.60	0.40	1.2	0.6	3.10	2.08	0.79	1	2.10	1.70	0.83	0.60	4.65
M3.5 × 0.6	3.50	3.32	3.00	7.3	6.9	2.3	0.70	0.50	1.4	0.7	4.06	2.25	0.91	2	2.20	1.70	1.32	1.03	5.57
M4 × 0.7	4.00	3.82	3.43	8.4	8.0	2.7	0.80	0.60	1.6	0.8	4.46	2.65	0.96	2	2.60	2.10	1.46	1.17	6.48
M5 × 0.8	5.00	4.82	4.36	9.3	8.9	2.7	0.90	0.70	2.0	1.0	5.06	3.25	1.04	2	3.20	2.70	1.05	0.72	8.31
M6 × 1	6.00	5.82	5.21	11.3	10.9	3.3	1.10	0.90	2.4	1.2	6.62	3.61	1.12	3	3.50	3.00	1.23	0.85	10.14
M8 × 1.25	8.00	7.78	7.04	15.8	15.4	4.6	1.40	1.10	3.2	1.6	8.78	4.88	1.80	4	4.60	4.00	1.75	1.30	13.80
M10 × 1.5	10.00	9.78	8.86	18.3	17.8	5.0	1.70	1.30	4.0	2.0	9.88	5.98	1.98	4	5.70	5.10	2.23	1.77	15.54

GENERAL NOTES:
(a) For reference, see Table 3 illustration beginning on page 8.
(b) For additional requirements, refer to section 2, titled General Data.
(c) The comparable ISO standard for Style A is ISO 7046-1, and the comparable ISO standard for Type B is ISO 7046-2.
(d) Dimensions are in millimeters.

NOTES:
(1) This type of recess has a large center opening, tapered wings, and blunt bottom, with all edges relieved or rounded.
(2) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and –0.01 mm. The head shall not enter the gage.
(3) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.
(4) All recessed head heat treated steel screws of property class 9.8 or higher strength shall have the Style B head form. Recessed head screws other than those specifically designated to be Style B in the foregoing shall have the Style A head form. The underhead shoulder on the Style B head form is mandatory, and all other head dimensions shall be common to both the Style A and Style B head forms.

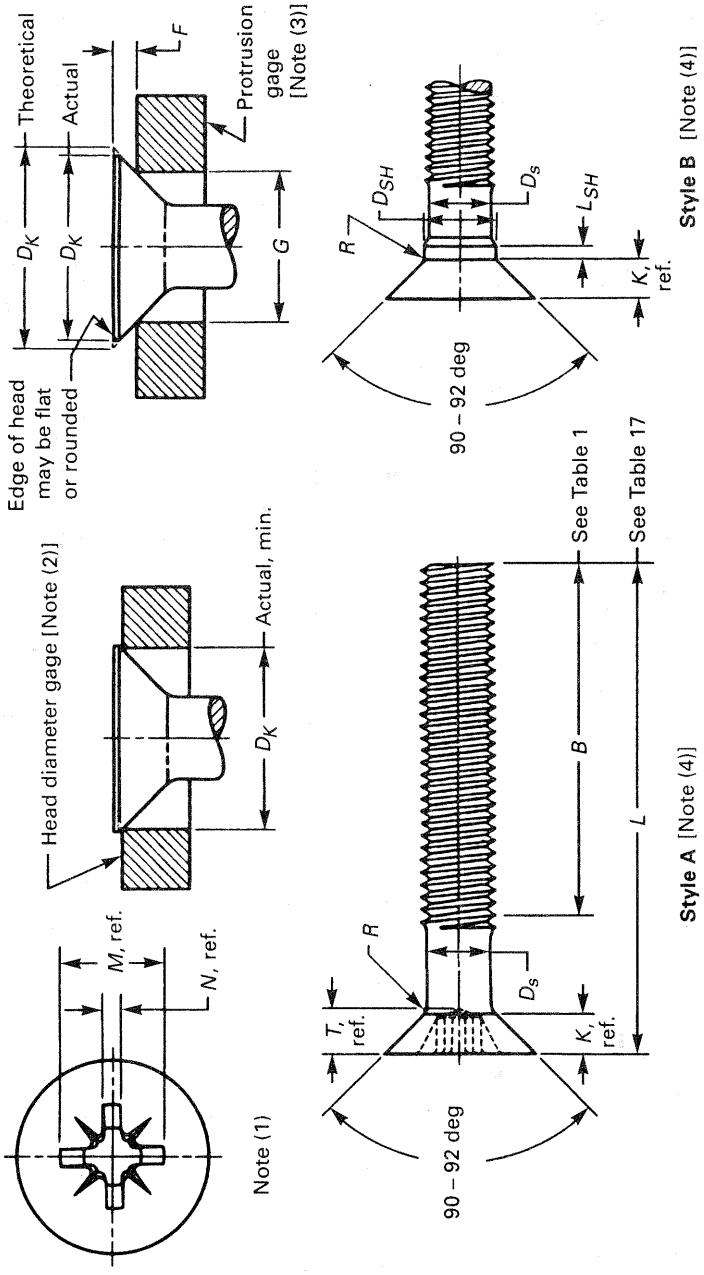


TABLE 4 ILLUSTRATION

TABLE 4 DIMENSIONS OF TYPE IA CROSS-RECESSED FLAT COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Max. Body and Shoulder Diameter, D_{SH} [Note (4)]	Min. Shoulder Diameter, D_{SH} [Note (4)]	Min. Body Diameter, D_S	Actual Head Diameter, D_K		Max. Head Height, K, Reference	Shoulder Length, L_{SH} [Note (4)]		Underhead Fillet Radius, R		Recess Diameter, M, Reference	Recess Depth, T, Reference	Recess Width, N, Reference	Driver Size	Recess Penetration Gaging Depth		Head Protrusion Above Gage Diameter, F [Note (3)]		Protrusion Gage Diameter, G [Note (3)]
				Max.	Min. [Note (2)]		Max.	Min.	Max.	Min.					Max.	Min.	Max.	Min.	
M2 × 0.4	2.00	1.86	1.65	3.8	3.5	1.2	0.50	0.30	0.8	0.4	2.20	1.56	0.47	0	1.55	1.20	0.79	0.62	2.82
M2.5 × 0.45	2.50	2.36	2.12	4.7	4.4	1.5	0.55	0.35	1.0	0.5	2.78	1.83	0.73	1	1.75	1.35	0.88	0.66	3.74
M3 × 0.5	3.00	2.86	2.58	5.5	5.2	1.7	0.60	0.40	1.2	0.6	3.08	2.08	0.73	1	2.00	1.60	0.83	0.60	4.65
M3.5 × 0.6	3.50	3.32	3.00	7.3	6.9	2.3	0.70	0.50	1.4	0.7	4.14	2.38	1.03	2	2.20	1.75	1.32	1.03	5.57
M4 × 0.7	4.00	3.82	3.43	8.4	8.0	2.7	0.80	0.60	1.6	0.8	4.44	2.68	1.03	2	2.50	2.05	1.46	1.17	6.48
M5 × 0.8	5.00	4.82	4.36	9.3	8.9	2.7	0.90	0.70	2.0	1.0	4.98	3.24	1.04	2	3.05	2.60	1.05	0.72	8.31
M6 × 1	6.00	5.82	5.21	11.3	10.9	3.3	1.10	0.90	2.4	1.2	6.66	3.78	1.44	3	3.45	3.00	1.23	0.85	10.14
M8 × 1.25	8.00	7.78	7.04	15.8	15.4	4.6	1.40	1.10	3.2	1.6	8.82	5.06	2.18	4	4.60	4.15	1.75	1.30	13.80
M10 × 1.5	10.00	9.78	8.86	18.3	17.8	5.0	1.70	1.30	4.0	2.0	9.84	6.12	2.19	4	5.65	5.20	2.23	1.77	15.54

GENERAL NOTES:
(a) For reference, see Table 4 illustration beginning on page 10.
(b) For additional requirements, refer to Section 2, titled General Data.
(c) The comparable ISO standard for Style A is ISO 7046-1, and the comparable ISO standard for Type B is ISO 7046-2.
(d) Dimensions are in millimeters.

NOTES:
(1) This type of recess has a large center opening, wide straight wings, and blunt bottom, with all edges relieved or rounded.
(2) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and −0.01 mm. The head shall not enter the gage.
(3) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.
(4) All recessed head heat treated steel screws of property class 9.8 or higher strength shall have the Style B head form. Recessed head screws other than those specifically designated to be Style B in the foregoing shall have the Style A head form. The underhead shoulder on the Style B head form is mandatory, and all other head dimensions shall be common to both the Style A and Style B head forms.

TABLE 5 ILLUSTRATION

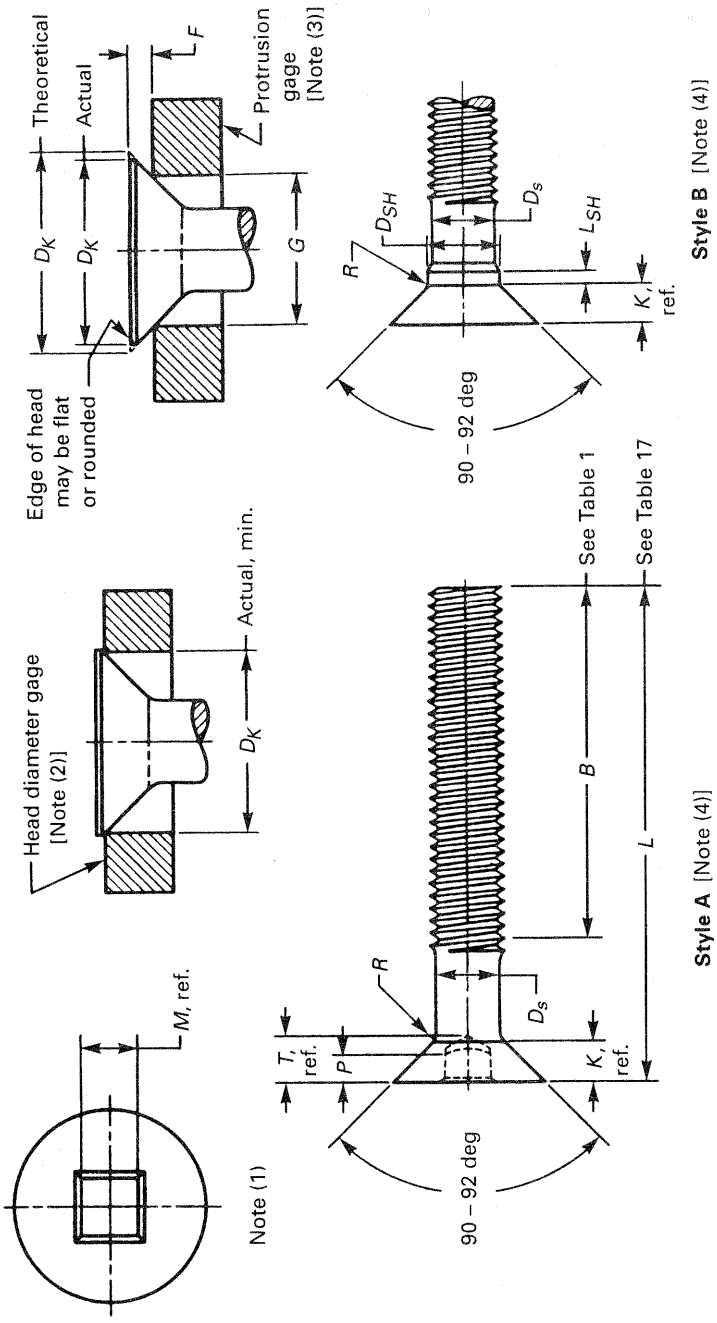


TABLE 5 DIMENSIONS OF TYPE III SQUARE-RECESSED FLAT COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Max. Body and Shoulder Diameter, D_{SH} [Note (4)]	Min. Shoulder Diameter, D_{SH} [Note (4)]	Min. Body Diameter, D_S	Actual Head Diameter, D_K		Max. Head Height, K, Reference	Shoulder Length, L_{SH} [Note (4)]		Underhead Fillet Radius, R		Recess Across Flats, M, Reference	Recess Depth, T, Reference	Driver Size [Note (5)]	Recess Penetration Gaging Depth, P		Head Protrusion Above Gage Diameter, F [Note (3)]		Protrusion Gage Diameter, G [Note (3)]
				Max.	Min. [Note (2)]		Max.	Min.	Max.	Min.				Max.	Min.	Max.	Min.	
M2.5 × 0.45	2.50	2.36	2.12	4.7	4.4	1.5	0.55	0.35	1.0	0.5	1.78	1.68	0	0.97	0.71	0.88	0.66	3.74
M3 × 0.5	3.00	2.86	2.58	5.5	5.2	1.7	0.60	0.40	1.2	0.6	1.78	1.68	0	0.97	0.71	0.83	0.60	4.65
M3.5 × 0.6	3.50	3.32	3.00	7.3	6.9	2.3	0.70	0.50	1.4	0.7	2.31	2.44	1S	1.40	1.01	1.32	1.03	5.57
M4 × 0.7	4.00	3.82	3.43	8.4	8.0	2.7	0.80	0.60	1.6	0.8	2.84	2.92	2S	1.61	1.21	1.46	1.17	6.48
M5 × 0.8	5.00	4.82	4.36	9.3	8.9	2.7	0.90	0.70	2.0	1.0	2.84	3.23	2R	1.91	1.52	1.05	0.72	8.31
M6 × 1	6.00	5.82	5.21	11.3	10.9	3.3	1.10	0.90	2.4	1.2	3.38	4.01	3R	2.42	2.03	1.23	0.85	10.14
M8 × 1.25	8.00	7.78	7.04	15.8	15.4	4.6	1.40	1.10	3.2	1.6	4.85	4.93	4R	2.54	2.15	1.75	1.30	13.80
M10 × 1.5	10.00	9.78	8.86	18.3	17.8	5.0	1.70	1.30	4.0	2.0	4.85	4.93	4R	2.54	2.15	2.23	1.77	15.54

GENERAL NOTES:
(a) For reference, see Table 5 illustration beginning on page 12.
(b) For additional requirements, refer to section 2, titled General Data.
(c) There is no ISO Standard covering Type III square recessed flat countersunk head screws.
(d) Dimensions are in millimeters.

NOTES:
(1) This type of recess has a square center opening, slightly tapered side walls, and a conical bottom, with top edges relieved or rounded.
(2) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and −0.01 mm. The head shall not enter the gage.
(3) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.
(4) All recessed head heat treated steel screws of property class 9.8 or higher strength shall have the Style B head form. Recessed head screws other than those specifically designated to be Style B in the foregoing shall have the Style A head form. The underhead shoulder on the Style B head form is mandatory, and all other head dimensions shall be common to both the Style A and Style B head forms.
(5) R = regular; S = short.

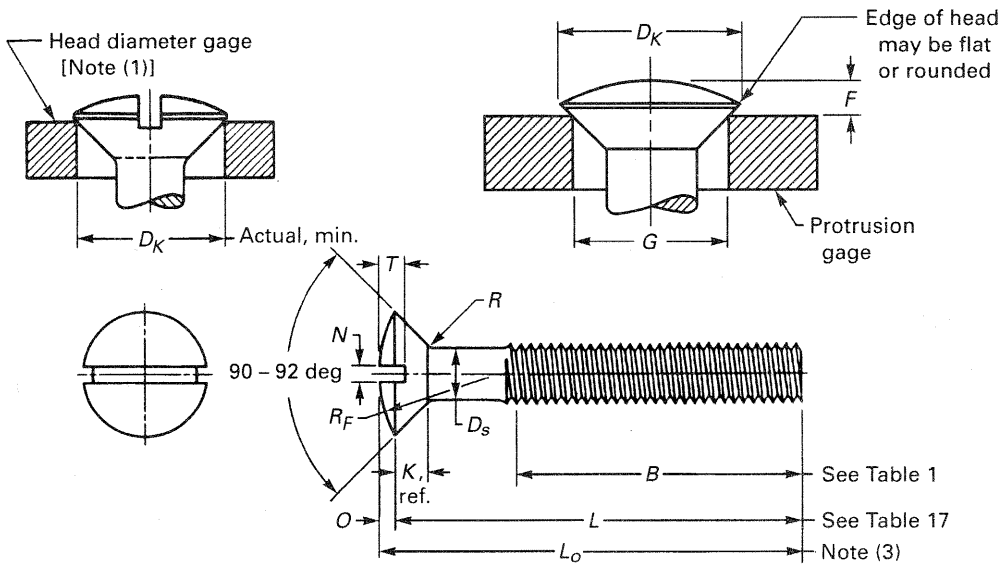


TABLE 6 DIMENSIONS OF SLOTTED OVAL COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Actual Head Diameter, D_K		Max. Head Side Height, K, Reference	Max. Raised Head Height, O	Approx. Head Top Radius, R_F	Underhead Fillet Radius, R		Slot Width, N		Slot Depth, T		Head Protrusion Above Gage Diameter, F [Note (2)]		Protrusion Gage Diameter, G [Note (2)]
	Max.	Min.	Max.	Min. [Note (1)]				Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
M2 × 0.4	2.00	1.65	3.8	3.5	1.2	0.5	5.0	0.8	0.4	0.7	0.5	1.0	0.8	1.29	1.12	2.82
M2.5 × 0.45	2.50	2.12	4.7	4.4	1.5	0.6	6.6	1.0	0.5	0.8	0.6	1.2	1.0	1.48	1.26	3.74
M3 × 0.5	3.00	2.58	5.5	5.2	1.7	0.7	7.4	1.2	0.6	1.0	0.8	1.5	1.2	1.53	1.30	4.65
M3.5 × 0.6	3.50	3.00	7.3	6.9	2.3	0.8	10.9	1.4	0.7	1.2	1.0	1.7	1.4	2.12	1.83	5.57
M4 × 0.7	4.00	3.43	8.4	8.0	2.7	1.0	11.6	1.6	0.8	1.5	1.2	1.9	1.6	2.46	2.17	6.48
M5 × 0.8	5.00	4.36	9.3	8.9	2.7	1.2	11.9	2.0	1.0	1.5	1.2	2.4	2.0	2.25	1.92	8.31
M6 × 1	6.00	5.21	11.3	10.9	3.3	1.4	14.9	2.4	1.2	1.9	1.6	2.8	2.4	2.63	2.25	10.14
M8 × 1.25	8.00	7.04	15.8	15.4	4.6	2.0	19.7	3.2	1.6	2.3	2.0	3.7	3.2	3.75	3.30	13.80
M10 × 1.5	10.00	8.86	18.3	17.8	5.0	2.3	22.9	4.0	2.0	2.8	2.5	4.4	3.8	4.53	4.07	15.54

GENERAL NOTES:
(a) The comparable ISO standard is ISO 2010.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

NOTES:
(1) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and –0.01 mm. The head shall not enter the gage.
(2) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.
(3) See para. 2.2.

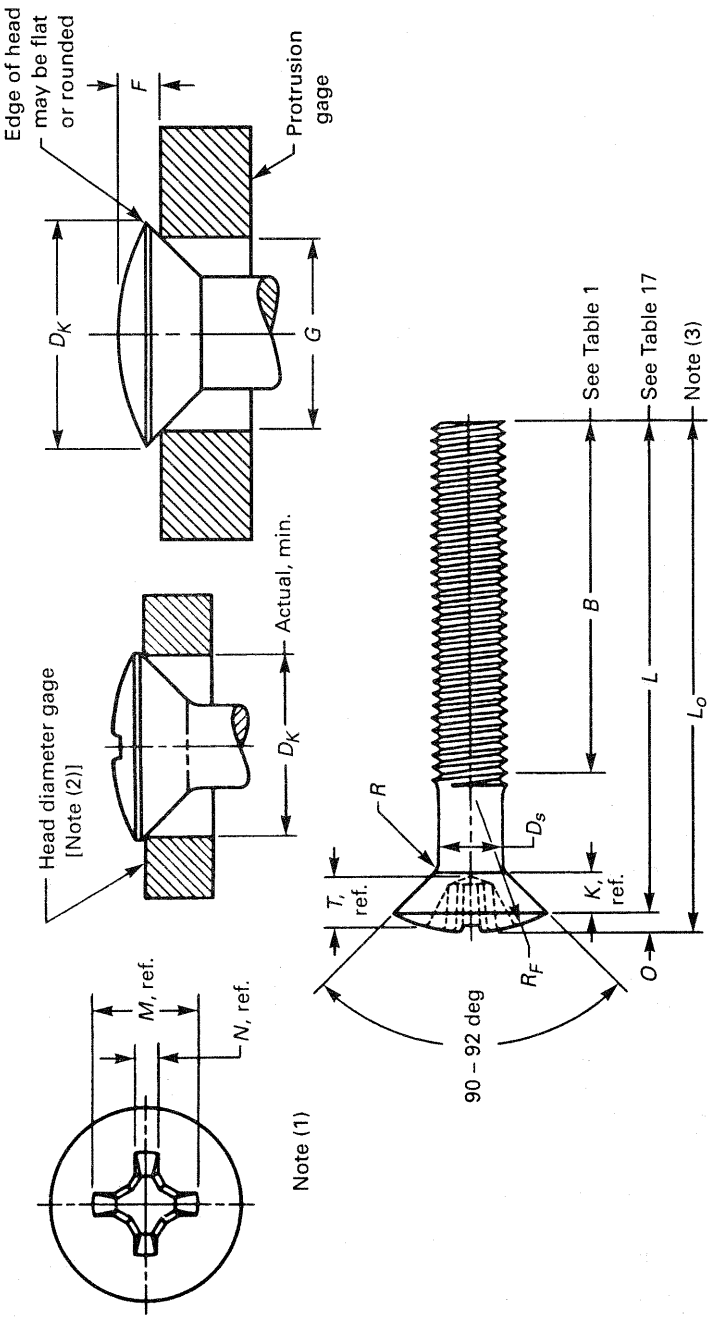


TABLE 7 ILLUSTRATION

TABLE 7 DIMENSIONS OF TYPE I CROSS-RECESSED OVAL COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Actual Head Diameter, D_K		Max. Head Side Height, K, Reference	Max. Raised Head Height, O	Approx. Head Top Radius, R_F	Underhead Fillet Radius, R		Recess Diameter, M, Reference	Recess Depth, T, Reference	Recess Width, N, Reference	Driver Size	Recess Penetration Gaging Depth		Head Protrusion Above Gage Diameter, F [Note (4)]		Protrusion Gage Diameter, G [Note (4)]
	Max.	Min.	Max.	Min. [Note (2)]				Max.	Min.					Max.	Min.	Max.	Min.	
M2 × 0.4	2.00	1.65	3.8	3.5	1.2	0.5	5.0	0.8	0.4	2.36	1.69	0.56	0	1.70	1.40	1.29	1.12	2.82
M2.5 × 0.45	2.50	2.12	4.7	4.4	1.5	0.6	6.6	1.0	0.5	3.06	1.95	0.77	1	1.96	1.56	1.48	1.26	3.74
M3 × 0.5	3.00	2.58	5.5	5.2	1.7	0.7	7.4	1.2	0.6	3.44	2.33	0.83	1	2.43	2.03	1.53	1.30	4.65
M3.5 × 0.6	3.50	3.00	7.3	6.9	2.3	0.8	10.9	1.4	0.7	4.38	2.48	0.94	2	2.43	1.93	2.12	1.83	5.57
M4 × 0.7	4.00	3.43	8.4	8.0	2.7	1.0	11.6	1.6	0.8	4.92	2.99	1.01	2	2.98	2.48	2.46	2.17	6.48
M5 × 0.8	5.00	4.36	9.3	8.9	2.7	1.2	11.9	2.0	1.0	5.66	3.74	1.10	2	3.69	3.19	2.25	1.92	8.31
M6 × 1	6.00	5.21	11.3	10.9	3.3	1.4	14.9	2.4	1.2	7.30	4.26	1.19	3	4.05	3.55	2.63	2.25	10.14
M8 × 1.25	8.00	7.04	15.8	15.4	4.6	2.0	19.7	3.2	1.6	9.86	5.81	1.95	4	5.53	4.93	3.75	3.30	13.80
M10 × 1.5	10.00	8.86	18.3	17.8	5.0	2.3	22.9	4.0	2.0	11.24	7.15	2.17	4	6.87	6.27	4.53	4.07	15.54

GENERAL NOTES:
(a) For reference, see Table 7 Illustration beginning on page 15.
(b) The comparable ISO standard is ISO 7047.
(c) For additional requirements, refer to Section 2, titled General Data.
(d) Dimensions are in millimeters.

NOTES:
(1) This type of recess has a large center opening, tapered wings, and a blunt bottom, with all edges relieved or rounded.
(2) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and −0.01 mm. The head shall not enter the gage.
(3) See para. 2.2.
(4) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.

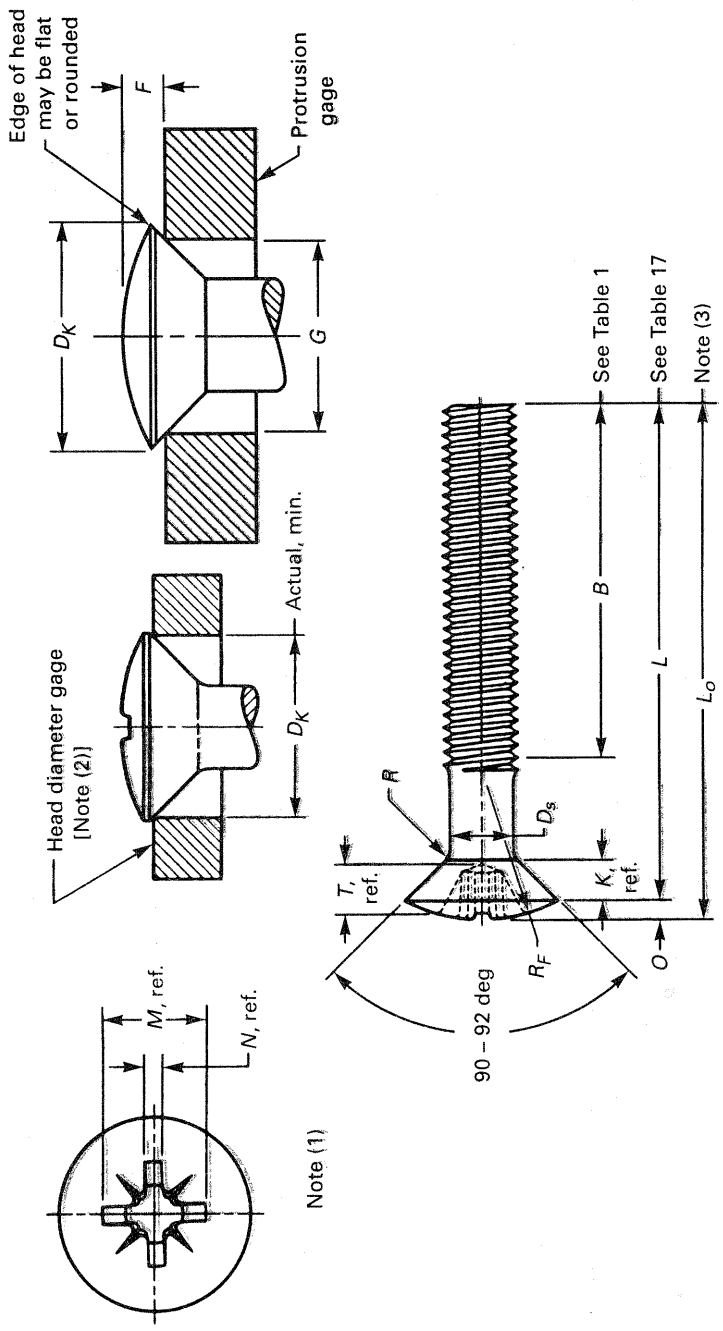


TABLE 8 ILLUSTRATION

TABLE 8 DIMENSIONS OF TYPE IA CROSS-RECESSED OVAL COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Actual Head Diameter, D_K		Max. Head Side Height, K, Reference	Max. Raised Head Height, O	Approximate Head Top Radius, R_F	Underhead Fillet Radius, R		Recess Diameter, M, Reference	Recess Depth, T, Reference	Recess Width, N, Reference	Driver Size	Recess Penetration Gaging Depth		Head Protrusion Above Gage Diameter, F [Note (4)]		Protrusion Gage Diameter, G [Note (4)]
	Max.	Min.	Max.	Min. [Note (2)]	Reference			Max.	Min.	Reference	Reference	Reference		Max.	Min.	Max.	Min.	[Note (4)]
M2 × 0.4	2.00	1.65	3.8	3.5	1.2	0.5	5.0	0.8	0.4	2.40	1.72	0.48	0	1.72	1.37	1.29	1.12	2.82
M2.5 × 0.45	2.50	2.12	4.7	4.4	1.5	0.6	6.6	1.0	0.5	2.62	1.94	0.73	1	1.98	1.58	1.48	1.26	3.74
M3 × 0.5	3.00	2.58	5.5	5.2	1.7	0.7	7.4	1.2	0.6	2.98	2.31	0.74	1	2.32	1.92	1.53	1.30	4.65
M3.5 × 0.6	3.50	3.00	7.3	6.9	2.3	0.8	10.9	1.4	0.7	4.46	2.66	1.03	2	2.48	2.03	2.12	1.83	5.57
M4 × 0.7	4.00	3.43	8.4	8.0	2.7	1.0	11.6	1.6	0.8	4.90	3.10	1.04	2	2.93	2.48	2.46	2.17	6.48
M5 × 0.8	5.00	4.36	9.3	8.9	2.7	1.2	11.9	2.0	1.0	5.58	3.78	1.05	2	3.60	3.15	2.25	1.92	8.31
M6 × 1	6.00	5.21	11.3	10.9	3.3	1.4	14.9	2.4	1.2	7.32	4.38	1.45	3	4.05	3.60	2.63	2.25	10.14
M8 × 1.25	8.00	7.04	15.8	15.4	4.6	2.0	19.7	3.2	1.6	9.90	6.08	2.19	4	5.62	5.17	3.75	3.30	13.80
M10 × 1.5	10.00	8.86	18.3	17.8	5.0	2.3	22.9	4.0	2.0	11.18	7.38	2.20	4	6.92	6.47	4.53	4.07	15.54

GENERAL NOTES:
(a) For reference, see Table 8 illustration beginning on page 17.
(b) The comparable ISO standard is ISO 7047.
(c) For additional requirements, refer to section 2, titled General Data.
(d) Dimensions are in millimeters.

NOTES:
(1) This type of recess has a large center opening, wide straight wings, and a blunt bottom, with all edges relieved or rounded.
(2) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and −0.01 mm. The head shall not enter the gage.
(3) See Para. 2.2.
(4) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.

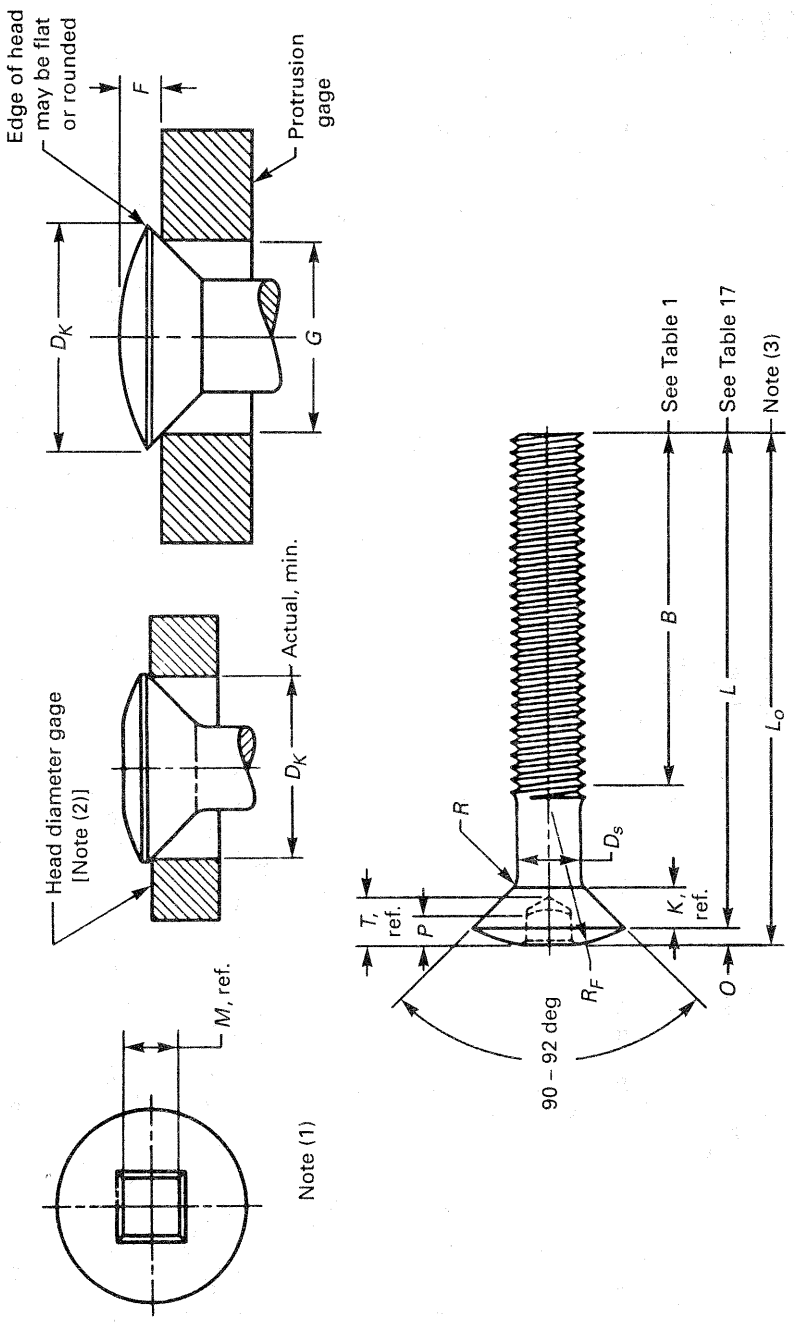


TABLE 9 ILLUSTRATION

TABLE 9 DIMENSIONS OF TYPE III SQUARE-RECESSED OVAL COUNTERSUNK HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Actual Head Diameter, D_K		Max. Head Side Height, K, Reference	Max. Raised Head Height, O	Approx. Head Top Radius, R_F	Under-head Fillet Radius, R		Recess Across Flats M, Reference	Recess Depth, T, Reference	Driver Size [Note (4)]	Recess Pene-tration Gaging Depth, P		Head Protrusion Above Gage Diameter, F [Note (5)]		Protrusion Gage Diameter, G [Note (5)]
	Max.	Min.	Max.	Min. [Note (2)]				Max.	Min.				Max.	Min.	Max.	Min.	
M2.5 × 0.45	2.50	2.12	4.7	4.4	1.5	0.6	6.6	1.0	0.5	1.78	1.68	0	0.97	0.71	1.48	1.26	3.74
M3 × 0.5	3.00	2.58	5.5	5.2	1.7	0.7	7.4	1.2	0.6	1.78	1.68	0	0.97	0.71	1.53	1.30	4.65
M3.5 × 0.6	3.50	3.00	7.3	6.9	2.3	0.8	10.9	1.4	0.7	2.31	2.69	1R	1.66	1.27	2.12	1.83	5.57
M4 × 0.7	4.00	3.43	8.4	8.0	2.7	1.0	11.6	1.6	0.8	2.84	3.23	2R	1.91	1.52	2.46	2.17	6.48
M5 × 0.8	5.00	4.36	9.3	8.9	2.7	1.2	11.9	2.0	1.0	2.84	3.23	2R	1.91	1.52	2.25	1.92	8.31
M6 × 1	6.00	5.21	11.3	10.9	3.3	1.4	14.9	2.4	1.2	3.38	4.01	3R	2.42	2.03	2.63	2.25	10.14
M8 × 1.25	8.00	7.04	15.8	15.4	4.6	2.0	19.7	3.2	1.6	4.85	4.93	4R	2.54	2.15	3.75	3.30	13.80
M10 × 1.5	10.00	8.86	18.3	17.8	5.0	2.3	22.9	4.0	2.0	4.85	4.93	4R	2.54	2.15	4.53	4.07	15.54

GENERAL NOTES:
(a) For reference, see Table 9 illustration beginning on page 19.
(b) There is no ISO standard covering Type III square recessed raised countersunk head screws.
(c) For additional requirements, refer to section 2, titled General Data.
(d) Dimensions are in millimeters.

NOTES:
(1) This type of recess has a square center opening, slightly tapered side walls, and a conical bottom, with top edges relieved or rounded.
(2) Acceptability of minimum head diameter shall be determined by using a plain ring gage having a hole diameter equal to the specified D_K actual minimum limit within a tolerance of +0.00 and −0.01 mm. The head shall not enter the gage.
(3) See para. 2.2.
(4) R = regular.
(5) No tolerance for gage diameter is given. If the gage 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 shown in Appendix I.

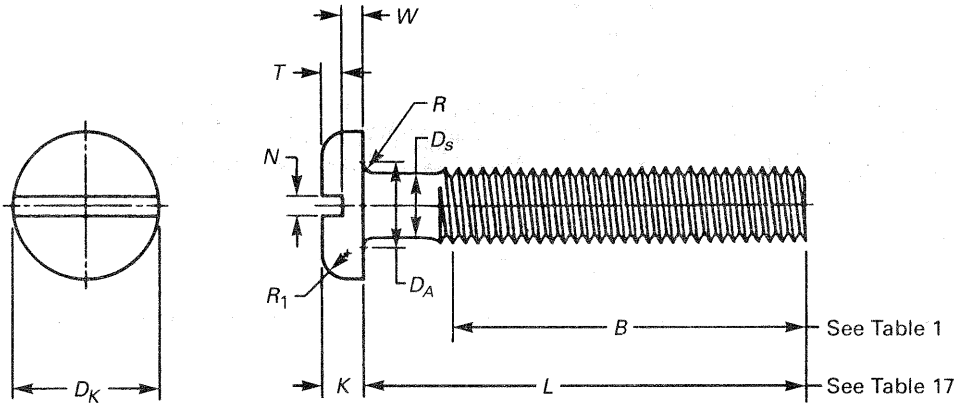
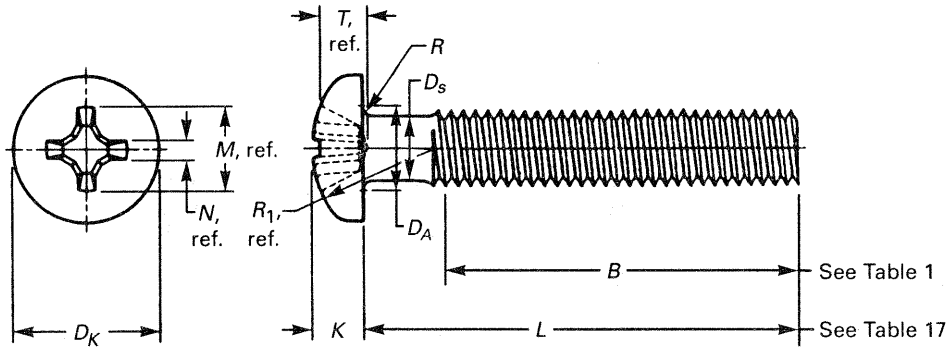


TABLE 10 DIMENSIONS OF SLOTTED PAN HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Head Diameter, D_K		Head Height, K		Max. Head Radius, R_1	Underhead Fillet		Slot Width, N		Min. Slot Depth, T	Min. Unslotted Head Thickness, W
								Max. Transition Diameter, D_A	Min. Radius, R				
	Max.	Min.	Max.	Min.	Max.	Min.				Max.	Min.		
M2 × 0.4	2.00	1.65	4.0	3.7	1.3	1.1	0.8	2.6	0.1	0.7	0.5	0.5	0.4
M2.5 × 0.45	2.50	2.12	5.0	4.7	1.5	1.3	1.0	3.1	0.1	0.8	0.6	0.6	0.5
M3 × 0.5	3.00	2.58	5.6	5.3	1.8	1.6	1.2	3.6	0.1	1.0	0.8	0.7	0.7
M3.5 × 0.6	3.50	3.00	7.0	6.6	2.1	1.9	1.4	4.1	0.1	1.2	1.0	0.8	0.8
M4 × 0.7	4.00	3.43	8.0	7.6	2.4	2.2	1.6	4.7	0.2	1.5	1.2	1.0	0.9
M5 × 0.8	5.00	4.36	9.5	9.1	3.0	2.7	2.0	5.7	0.2	1.5	1.2	1.2	1.2
M6 × 1	6.00	5.21	12.0	11.5	3.6	3.3	2.5	6.8	0.3	1.9	1.6	1.4	1.4
M8 × 1.25	8.00	7.04	16.0	15.5	4.8	4.5	3.2	9.2	0.4	2.3	2.0	1.9	1.9
M10 × 1.5	10.00	8.86	20.0	19.4	6.0	5.7	4.0	11.2	0.4	2.8	2.5	2.4	2.4

GENERAL NOTES:
(a) For additional requirements, refer to section 2, titled General Data.
(b) Dimensions are in millimeters.
(c) The comparable ISO standard is ISO 1580.



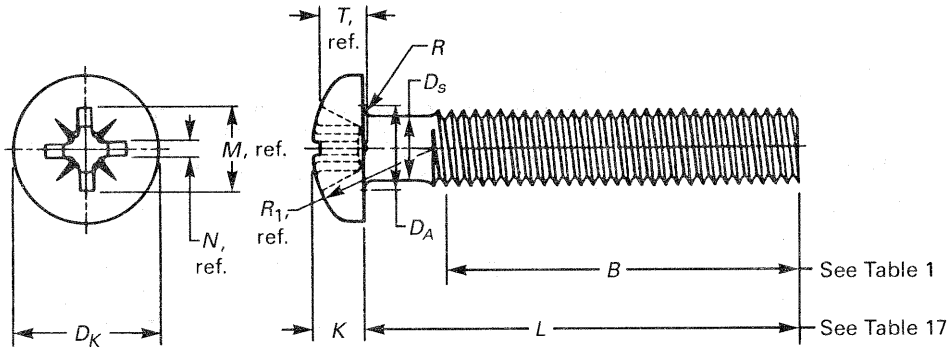
Note (1)

TABLE 11 DIMENSIONS OF TYPE I CROSS-RECESSED PAN HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Head Diameter, D_K		Head Height, K		Head Radius, R_1,	Underhead Fillet		Recess Diameter, M,	Recess Depth, T,	Recess Width, N,	Driver	Recess Penetration Gaging Depth	
								Max. Transition Diameter, D_A	Min. Radius, R						
	Max.	Min.	Max.	Min.	Max.	Min.	Reference			Reference	Reference	Reference	Size	Max.	Min.
M2 × 0.4	2.00	1.65	4.0	3.7	1.6	1.4	3.2	2.6	0.1	1.82	1.19	0.48	0	1.20	0.95
M2.5 × 0.45	2.50	2.12	5.0	4.7	2.1	1.9	4.0	3.1	0.1	2.68	1.53	0.70	1	1.55	1.15
M3 × 0.5	3.00	2.58	5.6	5.3	2.4	2.2	5.0	3.6	0.1	2.90	1.76	0.74	1	1.80	1.40
M3.5 × 0.6	3.50	3.00	7.0	6.6	2.6	2.3	6.0	4.1	0.1	3.92	1.95	0.87	2	1.90	1.40
M4 × 0.7	4.00	3.43	8.0	7.6	3.1	2.8	6.5	4.7	0.2	4.40	2.45	0.93	2	2.40	1.90
M5 × 0.8	5.00	4.36	9.5	9.1	3.7	3.4	8.0	5.7	0.2	4.90	2.95	1.00	2	2.90	2.40
M6 × 1	6.00	5.21	12.0	11.5	4.6	4.3	10.0	6.8	0.3	6.92	3.81	1.14	3	3.60	3.10
M8 × 1.25	8.00	7.04	16.0	15.5	6.0	5.6	13.0	9.2	0.4	9.02	4.88	1.69	4	4.60	4.00
M10 × 1.5	10.00	8.86	20.0	19.4	7.5	7.1	16.0	11.2	0.4	10.18	6.09	1.84	4	5.80	5.20

GENERAL NOTES:
(a) The comparable ISO standard is ISO 7045.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

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



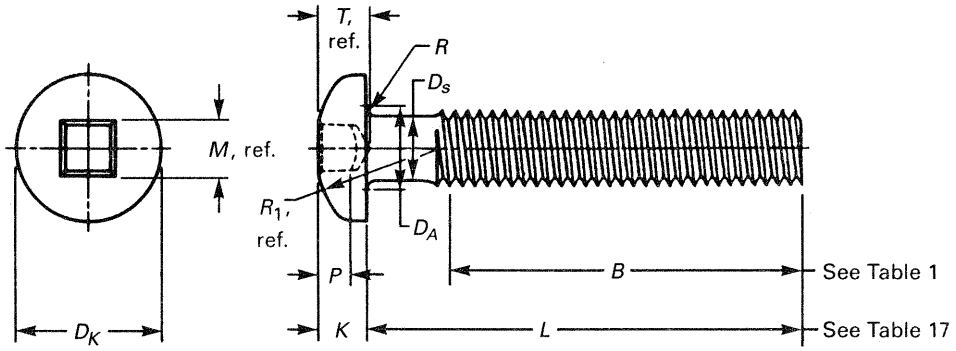
Note (1)

TABLE 12 DIMENSIONS OF TYPE IA CROSS-RECESSED PAN HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Head Diameter, D_K		Head Height, K		Head Radius, R_1,	Underhead Fillet		Recess Diameter, M,	Recess Depth, T,	Recess Width, N,	Driver	Recess Penetration Gaging Depth	
	Max.	Min.	Max.	Min.	Max.	Min.	Reference	Max. Transition Diameter, D_A	Min. Radius, R	Reference	Reference	Reference	Size	Max.	Min.
M2 × 0.4	2.00	1.65	4.0	3.7	1.6	1.4	3.2	2.6	0.1	1.92	1.22	0.47	0	1.20	0.85
M2.5 × 0.45	2.50	2.12	5.0	4.7	2.1	1.9	4.0	3.1	0.1	2.62	1.58	0.73	1	1.50	1.10
M3 × 0.5	3.00	2.58	5.6	5.3	2.4	2.2	5.0	3.6	0.1	2.86	1.83	0.73	1	1.75	1.35
M3.5 × 0.6	3.50	3.00	7.0	6.6	2.6	2.3	6.0	4.1	0.1	3.90	2.14	1.03	2	1.90	1.45
M4 × 0.7	4.00	3.43	8.0	7.6	3.1	2.8	6.5	4.7	0.2	4.36	2.54	1.03	2	2.35	1.90
M5 × 0.8	5.00	4.36	9.5	9.1	3.7	3.4	8.0	5.7	0.2	4.76	2.94	1.04	2	2.75	2.30
M6 × 1	6.00	5.21	12.0	11.5	4.6	4.3	10.0	6.8	0.3	6.80	3.84	1.44	3	3.50	3.05
M8 × 1.25	8.00	7.04	16.0	15.5	6.0	5.6	13.0	9.2	0.4	8.82	4.96	2.18	4	4.50	4.05
M10 × 1.5	10.00	8.86	20.0	19.4	7.5	7.1	16.0	11.2	0.4	10.04	6.16	2.19	4	5.70	5.25

GENERAL NOTES:
(a) The comparable ISO standard is ISO 7045.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

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



Note (1)

TABLE 13 DIMENSIONS OF TYPE III SQUARE-RECESSED PAN HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diameter, D_S		Head Diameter, D_K		Head Height, K		Head Radius, R_1	Underhead Fillet		Recess Across Flats, M,	Recess Depth, T,	Driver Size,	Recess Penetration Gaging Depth, P	
	Max.	Min.	Max.	Min.	Max.	Min.	Reference	Max. Transition Diameter, D_A	Min. Radius, R	Reference	Reference	[Note (2)]	Max.	Min.
M2.5 × 0.45	2.50	2.12	5.0	4.7	2.1	1.9	4.0	3.1	0.1	1.78	1.68	0	0.97	0.71
M3 × 0.5	3.00	2.58	5.6	5.3	2.4	2.2	5.0	3.6	0.1	1.78	1.68	0	0.97	0.71
M3.5 × 0.6	3.50	3.00	7.0	6.6	2.6	2.3	6.0	4.1	0.1	2.31	2.69	1R	1.66	1.27
M4 × 0.7	4.00	3.43	8.0	7.6	3.1	2.8	6.5	4.7	0.2	2.84	3.23	2R	1.91	1.52
M5 × 0.8	5.00	4.36	9.5	9.1	3.7	3.4	8.0	5.7	0.2	2.84	3.23	2R	1.91	1.52
M6 × 1	6.00	5.21	12.0	11.5	4.6	4.3	10.0	6.8	0.3	3.38	4.01	3R	2.42	2.03
M8 × 1.25	8.00	7.04	16.0	15.5	6.0	5.6	13.0	9.2	0.4	4.85	4.93	4R	2.54	2.15
M10 × 1.5	10.00	8.86	20.0	19.4	7.5	7.1	16.0	11.2	0.4	4.85	4.93	4R	2.54	2.15

GENERAL NOTES:
(a) There is no ISO Standard covering Type III square recessed pan head screws.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

NOTE:
(1) This type of recess has a square center opening, slightly tapered side walls, and a conical bottom, with top edges relieved or rounded.
(2) R = regular.

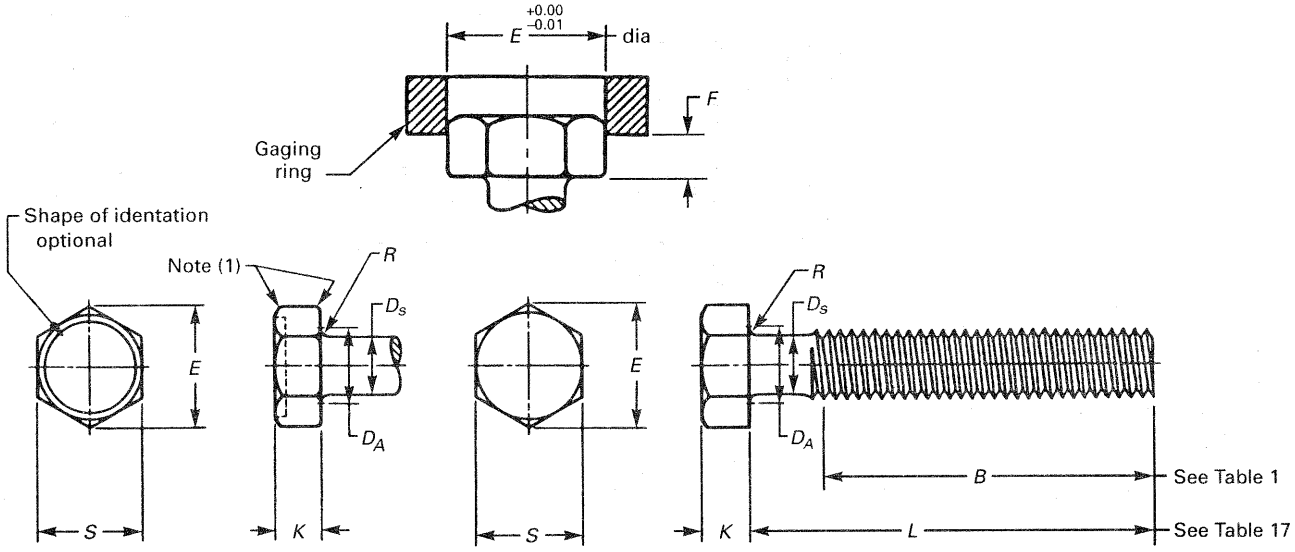


TABLE 14 DIMENSIONS OF HEX HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diam., D_S		Hex Width Across Flats, S [Notes (2), (3)]		Min. Hex Width Across Corners, E [Notes (2), (3)]	Head Height, K		Underhead Fillet		Min. Head Protrusion Beyond Gaging Ring, F [Note (3)]
	Max.	Min.	Max.	Min.		Max.	Min.	Max. Transition Diam., D_A	Min. Radius, R	
M2 × 0.4	2.00	1.65	3.20	3.02	3.38	1.6	1.3	2.6	0.1	0.78
M2.5 × 0.45	2.50	2.12	4.00	3.82	4.28	2.1	1.8	3.1	0.1	1.08
M3 × 0.5	3.00	2.58	5.00	4.82	5.40	2.3	2.0	3.6	0.1	1.20
M3.5 × 0.6	3.50	3.00	5.50	5.32	5.96	2.6	2.3	4.1	0.1	1.38
M4 × 0.7	4.00	3.43	7.00	6.78	7.59	3.0	2.6	4.7	0.2	1.56
M5 × 0.8	5.00	4.36	8.00	7.78	8.71	3.8	3.3	5.7	0.2	1.98
M6 × 1	6.00	5.21	10.00	9.78	10.95	4.7	4.1	6.8	0.3	2.46
M8 × 1.25	8.00	7.04	13.00	12.73	14.26	6.0	5.2	9.2	0.4	3.12
M10 × 1.5	10.00	8.86	16.00	15.73	17.62	7.5	6.5	11.2	0.4	3.90
M12 × 1.75	12.00	10.68	18.00	17.73	19.86	9.0	7.8	13.2	0.4	4.68
M10 × 1.5 [Note (5)]	10.00	8.86	15.00	14.73	16.50	7.5	6.5	11.2	0.4	3.90

GENERAL NOTES:
(a) There is no equivalent ISO standard for hex head screws.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

NOTES:
(1) A slight rounding of all edges of the hexagon surfaces of indented hex heads shall be permissible provided the diameter of the bearing circle is not less than the equivalent of 90% of the specified minimum width across flats dimension.
(2) Dimensions across flats and across corners of the head shall be measured at the point of maximum metal. Taper of sides of head (angle between one side and the axis) shall not exceed 2 deg or 0.1 mm, whichever is greater, the specified width across flats being the large dimension.
(3) The rounding due to lack of fill at 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, within a tolerance of +0.00 and −0.01 mm, is placed on the top and bottom of the head, the head shall protrude a distance equal to or greater than the F value tabulated. See Appendix II, titled Across-Corners Gaging of Hex Heads.
(4) Heads may be indented, trimmed, or fully upset at the option of the manufacturer.
(5) The M10 size screws having heads with 15-mm width across flats are not ISO Standard. Unless M10 size screws with 15-mm width across flats are specifically ordered, M10 size screws with 16-mm width across flats shall be furnished.

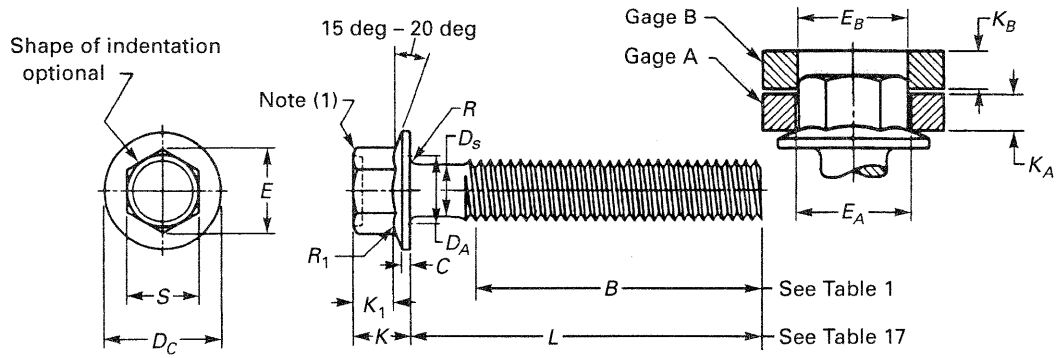


TABLE 15 DIMENSIONS OF HEX FLANGE HEAD MACHINE SCREWS

Nominal Screw Size and Thread Pitch	Body Diam., D_S		Hex Width Across Flats, S [Note (2)]		Min. Hex Width Across Corners, E [Notes (2) and (3)]	Flange Diam., D_C		Max. Overall Head Height, K	Min. Hex Height, K_1 [Note (3)]	Min. Flange Edge Thickness, C [Note (4)]	Max. Flange Top Fillet Radius, R_1	Underhead Fillet		Gage A [Note (3)]		Gage B [Note (3)]	
												Max. Transition Diam., D_A	Min. Radius, R	Gage Inside Diam., E_A, +0.01 −0.00	Gage Thickness, K_A, +0.00 −0.01	Gage Inside Diam., E_B, +0.00 −0.01	Min. Gage Thickness, K_B
	Max.	Min.	Max.	Min.		Max.	Min.										
M2 × 0.4	2.00	1.65	3.00	2.84	3.16	4.5	4.1	2.2	1.3	0.3	0.1	2.6	0.1	3.47	0.85	3.15	2.0
M2.5 × 0.45	2.50	2.12	3.20	3.04	3.39	5.4	5.0	2.7	1.6	0.3	0.2	3.1	0.1	3.70	1.05	3.38	2.0
M3 × 0.5	3.00	2.58	4.00	3.84	4.27	6.4	5.9	3.2	1.9	0.4	0.2	3.6	0.1	4.62	1.25	4.26	2.0
M3.5 × 0.6	3.50	3.00	5.00	4.82	5.36	7.5	6.9	3.8	2.4	0.5	0.2	4.1	0.1	5.77	1.60	5.35	2.0
M4 × 0.7	4.00	3.43	5.50	5.32	5.92	8.5	7.8	4.3	2.8	0.6	0.2	4.7	0.2	6.35	1.80	5.91	3.0
M5 × 0.8	5.00	4.36	7.00	6.78	7.55	10.6	9.8	5.4	3.5	0.7	0.3	5.7	0.2	8.06	2.30	7.54	3.0
M6 × 1	6.00	5.21	8.00	7.78	8.66	12.8	11.8	6.7	4.2	1.0	0.4	6.8	0.3	9.24	2.80	8.65	3.0
M8 × 1.25	8.00	7.04	10.00	9.78	10.89	16.8	15.5	8.6	5.6	1.2	0.5	9.2	0.4	11.55	3.70	10.88	4.0
M10 × 1.5	10.00	8.86	13.00	12.72	14.16	21.0	19.3	10.7	7.0	1.4	0.6	11.2	0.4	15.01	4.60	14.15	4.0
M12 × 1.75	12.00	10.68	15.00	14.72	16.38	24.8	23.3	13.7	8.4	1.8	0.7	13.2	0.4	17.32	5.60	16.37	5.0

GENERAL NOTES:
(a) There is no equivalent ISO standard for hex flange head screws.
(b) For additional requirements, refer to section 2, titled General Data.
(c) Dimensions are in millimeters.

NOTES:
(1) A slight rounding of all edges and corners of the hexagon surfaces of heads shall be permissible and the rounding due to the lack of fill at all six corners of the head shall be reasonably uniform.
(2) Dimensions across flats and across corners of the head shall be measured at the point of maximum metal. Taper of sides of head (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.
(3) The acceptability of hex height, wrenching height, corner fill, and width across corners shall be determined using two ring gages, A and B. Gage A shall be placed over the hex and shall seat on the flange. Gage B shall be placed on the top of head with the faces perpendicular to the screw axis. The two gages shall not be in contact.
(4) The contour of the edge at periphery of flange shall be optional provided the minimum flange thickness is maintained at the minimum flange diameter. The top surface of flange may be straight or slightly rounded (convex) upward.

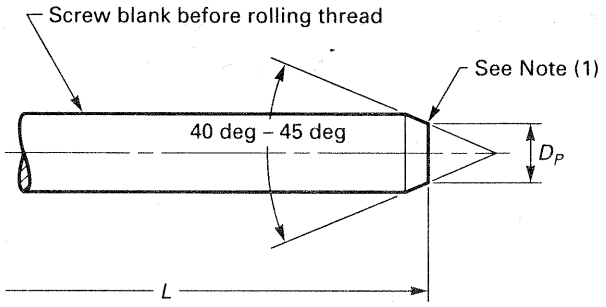


TABLE 16 DIMENSIONS OF HEADER POINTS FOR MACHINE SCREWS BEFORE THREADING

Nominal Screw Size and Thread Pitch	Point Diameter, D_P		Max. Nominal Screw Length, l [Note (2)]
	Max.	Min.	
M2 × 0.4	1.33	1.21	13
M2.5 × 0.45	1.73	1.57	13
M3 × 0.5	2.12	1.93	16
M3.5 × 0.6	2.46	2.24	20
M4 × 0.7	2.80	2.55	25
M5 × 0.8	3.60	3.28	30
M6 × 1	4.25	3.85	40
M8 × 1.25	5.82	5.30	40
M10 × 1.5	7.36	6.71	40
M12 × 1.75	8.90	8.11	45

GENERAL NOTES:
(a) For additional requirements, refer to para. 2.6.
(b) Dimensions are in millimeters.

NOTES:
(1) The edge of the point may be rounded and the end of point need not be flat nor perpendicular to the axis of screw shank.
(2) Header points shall apply to these nominal lengths or shorter. The pointing of longer lengths may require machining to the dimensions specified.

TABLE 17 RECOMMENDED NOMINAL SCREW LENGTHS FOR MACHINE SCREWS

Nominal Screw Length	Nominal Screw Size									
	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10	M12
2.5	PH	...	...	...	...	...	...	...	...	...
3	A	PH	...	...	...	...	...	...	...	...
4	A	A	PH	...	...	...	...	...	...	...
5	A	A	A	PH	PH	...	...	...	...	...
6	A	A	A	A	A	PH	...	...	...	...
8	A	A	A	A	A	A	A	...	...	...
10	A	A	A	A	A	A	A	A	...	...
13	A	A	A	A	A	A	A	A	A	...
16	A	A	A	A	A	A	A	A	A	H
20	A	A	A	A	A	A	A	A	A	H
25	...	A	A	A	A	A	A	A	A	H
30	...	...	A	A	A	A	A	A	A	H
35	...	...	...	A	A	A	A	A	A	H
40	...	...	...	...	A	A	A	A	A	H
45	...	...	...	...	...	A	A	A	A	H
50	...	...	...	...	...	A	A	A	A	H
55	...	...	...	...	...	...	A	A	A	H
60	...	...	...	...	...	...	A	A	A	H
65	...	...	...	...	...	...	...	A	A	H
70	...	...	...	...	...	...	...	A	A	H
80	...	...	...	...	...	...	...	A	A	H
90	...	...	...	...	...	...	...	...	A	H

GENERAL NOTE:
The nominal screw lengths recommended for the respective screw sizes and screw head styles are designated by the symbols below:
A = screws of all head styles covered in this Standard
H = hex and hex flange head screws
P = pan head screws

MANDATORY APPENDIX I
PROTRUSION GAGING OF FLAT AND OVAL COUNTERSUNK HEADS

I1 FLAT COUNTERSUNK HEAD

Suitability of flat countersunk head screws for application in countersinks designed to the principal dimensions of the screws may be determined by use of a protrusion gage as illustrated in Fig I1.

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:

Maximum Protrusion:[1]

$$\text{Max. } F = \frac{\text{Max. Sharp Head Diameter} - \text{Gage Hole Diameter}}{2} \times \tan\left(90 \text{ deg} - \frac{\text{Min. Head Angle}}{2}\right)$$

Minimum Protrusion:[1]

$$\text{Min. } F = \frac{\text{Min. Sharp Head Diameter} - \text{Gage Hole Diameter}}{2} \times \tan\left(90 \text{ deg} - \frac{\text{Max. Head Angle}}{2}\right)$$

or correction of protrusion in accordance with the following formula:

$$F' = F\,\frac{D_K - G'}{D_K - G}$$

where:

D_K = head diameter (maximum or minimum for maximum or minimum protrusion, respectively)
F = tabulated protrusion value
F' = corrected protrusion value
G = tabulated gage diameter
G' = measured gage diameter

Tabulated gage diameters are determined from the following formulas:

$G = 1.83D - 0.838$ mm for screw sizes 8 mm and smaller
$G = 1.79D - 2.360$ mm for the 10 mm size

To ensure adequate service life, the protrusion gage should be made of tool steel having a hardness no less than 60 HRC.

I2 OVAL COUNTERSUNK HEADS

Suitability of oval countersunk head screws for application in countersinks designed to the principal dimensions of the screws may be determined by use of a protrusion gage as illustrated in Fig I2.

The gaging dimensions and the gage diameters are specified in the dimensional tables for oval 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:

Maximum Protrusion:[2]

$$\text{Max. } F = \frac{\text{Max. Sharp Head Diameter} - \text{Gage Hole Diameter}}{2} \times \tan\left(90 \text{ deg} - \frac{\text{Min. Head Angle}}{2}\right)$$

Minimum Protrusion:[2]

[1] Protrusion values shown in Tables 2 through 5 are determined from these formulas and rounded to the nearest 0.01 mm, upward for the maximum and downward for the minimum.

[2] Protrusion values shown in Tables 6 through 9 are determined from these formulas and rounded to the nearest 0.01 mm, upward for the maximum and downward for the minimum.

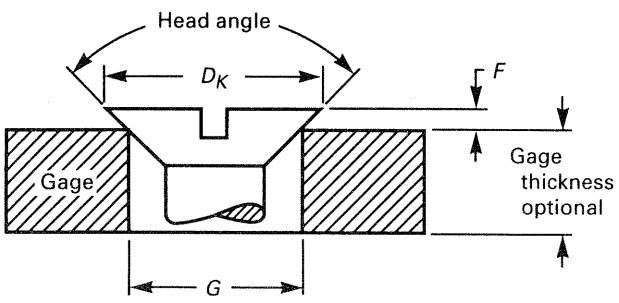


FIG. I1 PROTRUSION GAGE FOR FLAT COUNTERSUNK HEADS

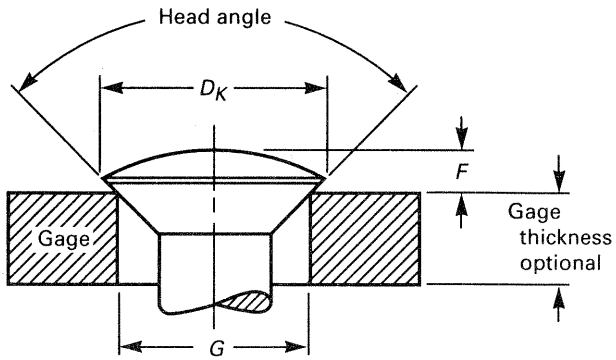


FIG. I2 PROTRUSION GAGE FOR OVAL COUNTERSUNK HEADS

$$\text{Min. } F = \frac{\text{Min. Sharp Head Diameter} - \text{Gage Hole Diameter}}{2} \times \tan\left(90 \text{ deg} - \frac{\text{Max. Head Angle}}{2}\right)$$

or correction of protrusion in accordance with the following formula:

$$F' = O \text{ Max.} + (F - O \text{ Max.}) \times \frac{D_K - G'}{D_K - G}$$

where:

D_K = head diameter (maximum or minimum for maximum or minimum protrusion, respectively)

F = tabulated protrusion value
F' = corrected protrusion value
G = tabulated gage diameter
G' = measured gage diameter

Tabulated gage diameters are determined from the follwoing formulas:

G = $1.83D$ – 0.838 mm for screw sizes 8 mm and smaller

G = $1.79D$ – 2.360 mm for the 9.5 mm and 10 mm size

D = Basic screw diameter of Types D, F, and T tapping screws and 5.50 mm on the 5.5 mm size of Types AB, B, BF, and BT tapping screws

To ensure adequate service life, the protrusion gage should be made of tool steel having a hardness no less than 60 HRC.

MANDATORY APPENDIX II
ACROSS-CORNERS GAGING OF HEX HEADS

Suitability of across corners dimensions of hex head screws may be determined using gaging rings as described below.

When the gaging ring (Fig. II1) is placed on the top and 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% of the specified minimum head height, *K*. For convenience, the applicable minimum protrusion values are given in the dimensional table for hex head screws.

The gaging ring shall have an inside diameter equal to the tabulated minimum width across corners, *E*, within a tolerance of +0.00 mm and −0.01 mm. The gaging edges of the ring shall be sharp and opposite faces shall be parallel. To ensure adequate service life, the ring should be made of tool steel and have a hardness no less than 60 HRC.

A typical gaging fixture is shown in Fig II2 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 shall be 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 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.

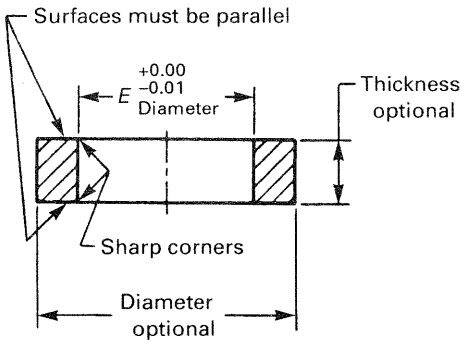


FIG. II1 GAGING RING

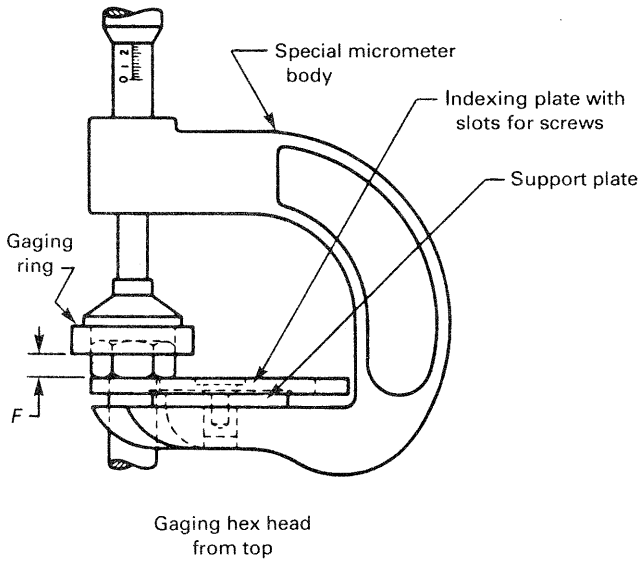


FIG. II2 TYPICAL GAGING FIXTURE

MANDATORY APPENDIX III
PENETRATION GAGING OF RECESSED HEADS

Penetration gaging is a test to determine the suitability of recesses in the heads of screws and may be used to indicate deficiencies in the dimensions of the recesses specified in the dimensional tables. (Refer to Figs. III1, III2, and III3 for illustrations of penetration gages for Types I, IA, and III recesses, respectively.) Penetrations that are too deep indicate the possible presence of a thin section between the head and shank of the screw, a weakness that might result in the twisting-off of screw heads during tightening of the screws. Use of screws having shallow penetrations might result in such production problems as reaming of recesses or excessive wear on driver bits.

Penetration gaging depth values for the various styles of recessed heads are included in Tables III1 through III5. These values were predicated originally on the gaging of plain finish (unplated or uncoated) screws. Subsequent experience, however, has shown the Type I recess penetration limits, as tabulated, and 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 (8 μm) on significant surfaces.

For screws having heavier coatings it is not practical to use penetration gaging for acceptance of finished product. Where it is considered desirable, however, to verify the suitability of the recess in such screws before plating or coating, the screws shall be stripped of finish and gaged in the plain condition.

Dimensions of gage points to be used for penetration gaging of Types I, IA, and III recesses are presented in Tables III2, III3, and III5, respectively. Also specified in Tables III1 and III5 are gage heads that adapt the gage points for all of the recess types to standard dial gage shafts. The threaded hole specified for the set screw in existing gage heads is $^1/_4$-20 UNC-2B per ASME B1.1.

A threaded hole of M6 × 1 size, conforming with B1.13M for use with a mating metric set screw, would be considered comparable where desired for application in new gage heads.

Penetration is gaged relative to a reference plane defined by the intersection of the edge of the recess wings on Types I and IA recesses and the sides of the square on Type III recess with the top surface of the screw head. This plane is the same as the top surface of a flat head screw, but for Types I and IA recesses, it is somewhat below the topmost portion of heads that have rounded top surfaces. Knife edges or tapered ridge on the gage heads for Types I and IA are used to establish the reference plate. 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.

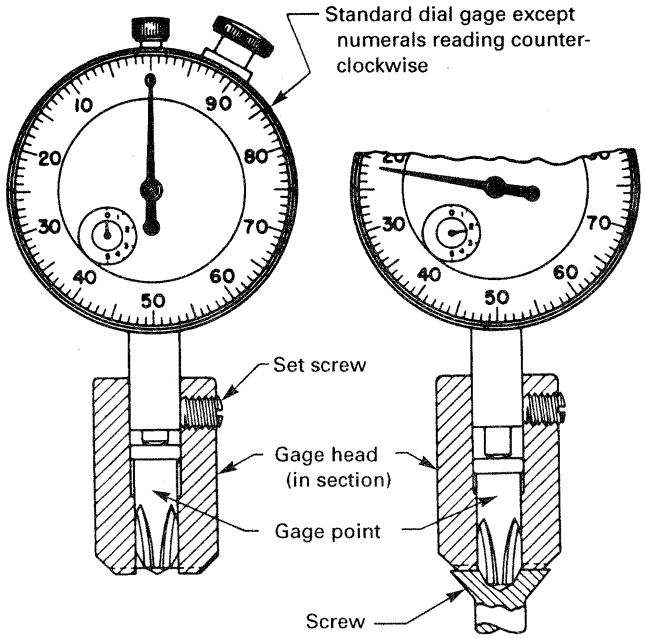
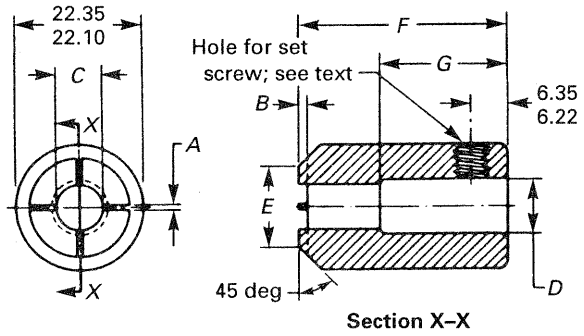


FIG. III1 PENETRATION GAGE FOR TYPE I RECESS



Gage Head

TABLE III1 DIMENSIONS OF GAGE HEADS FOR TYPE I AND IA RECESSES

Size of Recess Gage	Edge Width, *A*, ±0.05	Edge Height, *B*, ±0.08	Hole Diameter, *C*, ±0.005	Counterbore Diameter, *D*, ±0.03	Nose Diameter, *E*, ±0.13	Overall Length, *F*, ±0.13	Counterbore Depth, *G*, ±0.13
No. 0	0.20	0.38	1.168	9.58	14.27	42.88	28.60
No. 1	0.30	0.51	2.235	9.58	14.27	42.88	28.60
No. 2	0.46	0.79	3.607	9.58	14.27	42.88	28.60
No. 3	0.56	0.94	5.334	9.58	14.27	42.88	28.60
No. 4	0.79	1.57	7.950	9.58	14.27	42.88	28.60

GENERAL NOTE: Dimensions are in millimeters.

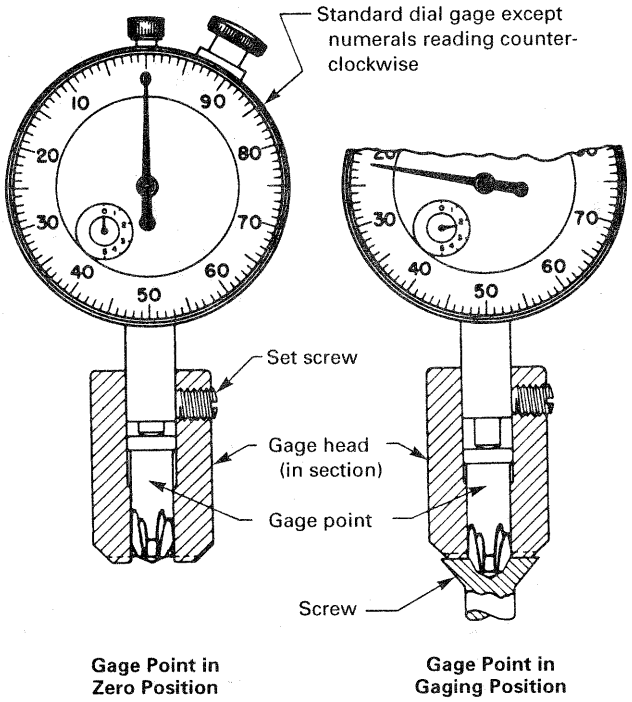


FIG. III2 PENETRATION GAGE FOR TYPE IA RECESS

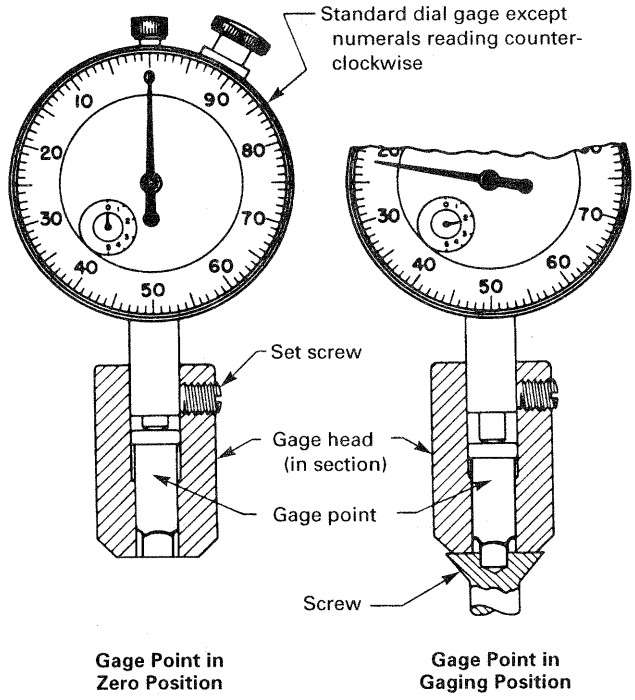


FIG. III3 PENETRATION GAGE FOR TYPE III RECESS

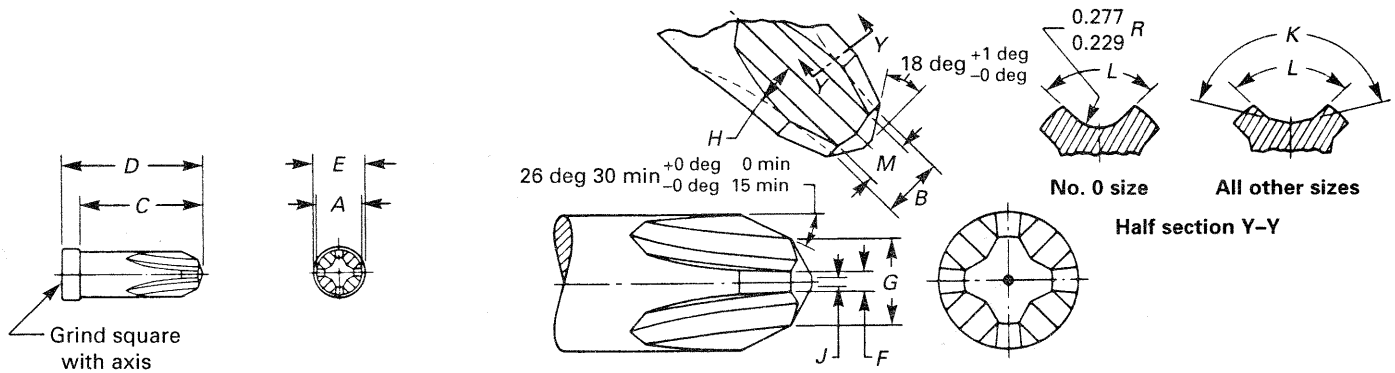


TABLE III2 DIMENSIONS OF GAGE POINTS FOR TYPE I RECESS

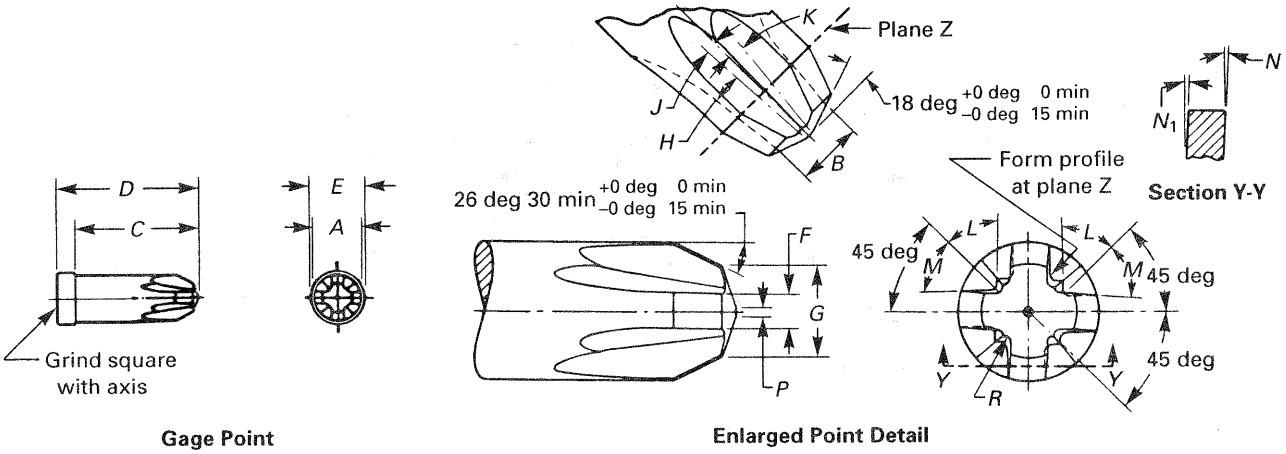
Size of Recess Gage	Point Diameter, *A*, ±0.005	Point Width, *B*, +0.000 −0.025	Length, *C*, ±0.13	Overall Length, *D*, ±0.13	Diameter, *E*, ±0.13	Wing Thickness, *F* Max.	Wing Thickness, *F* Min.	Point Width, *G*, +0.025 −0.000	Milling Angle, *H*, +0 deg 0 min −0 deg 15 min	Flat on End, *J* Max.	Flat on End, *J* Min.	Base Flute Angle, *K*, +0 deg 15 min −0 deg 0 min	Side Flute Angle, *L*, +0 deg 15 min −0 deg 0 min	Flute Width at Bottom, *M*, +0.000 −0.025
No. 0	1.143	0.610	16.66	19.84	2.39	0.30	0.25	0.813	7 deg 0 min	0.38	0.25	[Note (1)]	92 deg 0 min	0.384 [Note (2)]
No. 1	2.210	1.001	17.48	20.62	3.96	0.51	0.46	1.270	7 deg 0 min	0.51	0.38	138 deg 0 min	92 deg 0 min	0.513
No. 2	3.581	1.539	19.05	22.22	5.56	0.64	0.58	2.286	5 deg 45 min	0.51	0.38	140 deg 0 min	92 deg 0 min	1.102
No. 3	5.309	2.497	19.84	23.01	6.35	0.79	0.74	3.810	5 deg 45 min	0.51	0.38	146 deg 0 min	92 deg 0 min	2.098
No. 4	7.925	3.574	21.44	24.61	9.12	1.12	1.07	5.080	7 deg 0 min	0.51	0.38	153 deg 0 min	92 deg 0 min	2.738

GENERAL NOTE: Dimensions are in millimeters.

NOTES:

(1) Base of the flute on recess size No. 0 is a 0.229 mm to 0.277 mm radius.

(2) Tolerance on recess size No. 0 is +0.000 and −0.066 mm.



Gage Point

Enlarged Point Detail

TABLE III3 DIMENSIONS OF GAGE POINTS FOR TYPE IA RECESS

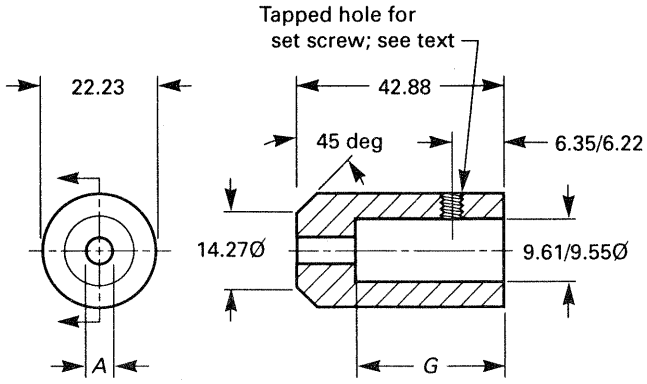
Size of Recess Gage	Point Diameter, *A*, ±0.005	Point Width (at Base of *R* Radius), *B*		Length, *C*, ±0.13	Overall Length, *D*, ±0.13	Diameter, *E*, ±0.13	Wing Thickness, *F*, +0.025 −0.000	Point Width, *G*, +0.025 −0.000	Milling Angle, *H*, +0 deg, 0 min −0 deg, 6 min	Milling Offset Angle, *J*, +0 deg, 6 min −0 deg, 0 min
		Max.	Min.							
No. 0	1.143	0.711	0.673	16.66	19.84	2.39	0.420	0.889	7 deg, 0 min	4 deg, 23 min
No. 1	2.210	1.112	1.074	17.48	20.62	3.96	0.673	1.372	7 deg, 0 min	4 deg, 23 min
No. 2	3.581	1.702	1.664	19.05	22.22	5.56	0.965	2.413	5 deg, 45 min	3 deg, 0 min
No. 3	5.309	2.591	2.553	19.84	23.01	6.35	1.346	3.937	5 deg, 45 min	3 deg, 0 min
No. 4	7.925	3.861	3.823	21.44	24.61	9.12	2.057	5.156	7 deg, 0 min	4 deg, 23 min

Size of Recess Gage	Milling Offset Angle, *K*, +0 deg, 6 min −0 deg, 0 min	Rib Form Angle, *L*, +0 deg, 7 min −0 deg, 0 min [Note (1)]	Wing Form Angle, *M*, +0 deg, 7 min −0 deg, 0 min [Note (1)]	Wing Offset Angle, *N*	Wing Offset Angle, N_1	Flat on End, *P*, +0.13 −0.00	Radius, *R*	
							Max.	Min.
No. 0	7 deg, 45 min	46 deg, 0 min	46 deg, 0 min	0 deg, 22 min	2 deg, 0 min	0.25	0.101	0.076
No. 1	7 deg, 45 min	46 deg, 0 min	46 deg, 0 min	0 deg, 22 min	2 deg, 0 min	0.38	0.127	0.102
No. 2	6 deg, 20 min	46 deg, 0 min	46 deg, 0 min	0 deg, 17 min	2 deg, 4 min	0.38	0.203	0.152
No. 3	6 deg, 20 min	56 deg, 15 min	46 deg, 0 min	0 deg, 17 min	2 deg, 4 min	0.38	0.305	0.203
No. 4	7 deg, 45 min	56 deg, 15 min	46 deg, 0 min	0 deg, 22 min	2 deg, 0 min	0.38	0.508	0.356

GENERAL NOTE: Dimensions are in millimeters.

NOTE:

(1) Angles *L* and *M* shall be measured perpendicular to the milling cut.



Gage Head

TABLE III4 DIMENSIONS OF GAGE HEADS FOR TYPE III RECESS

Size of Recess Gage		00	0	1	2	3	4
A	±0.005	2.578	2.578	3.607	4.102	5.334	6.896
G	±0.13	28.60	28.60	28.60	28.60	28.60	28.60

GENERAL NOTE: Dimensions are in millimeters.

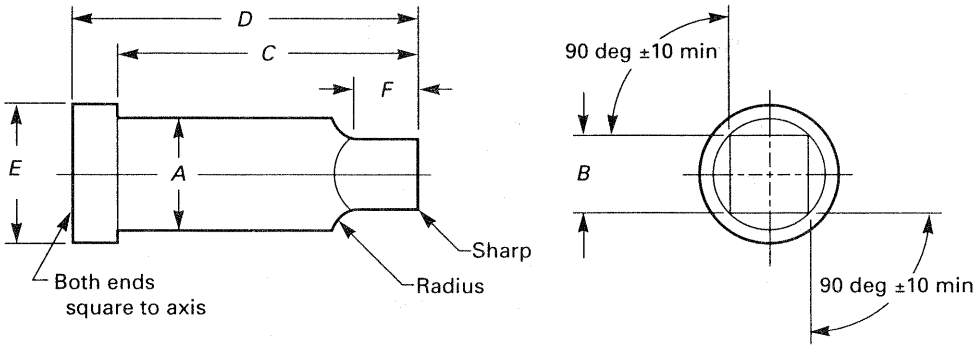


TABLE III5 DIMENSIONS OF PENETRATION GAGE POINTS FOR TYPE III RECESS

Recess Gage Size	Gage Point Diameter, *A*, +0.013 −0.000	Width Across Flats, *B*, +0.0127 −0.0000	Length, *C*, ±0.13	Overall Length, *D*, ±0.13	Diameter, *E*, +0.00 −0.38	Point Length, *F*, +0.76 −0.00
00	2.553	1.245	19.94	22.23	4.75	1.91
0	2.553	1.753	19.94	22.23	4.75	3.18
1	3.569	2.286	19.94	22.23	4.75	4.75
2	4.077	2.820	19.94	22.23	6.35	4.75
3	5.296	3.340	19.94	22.23	6.35	4.75
4	6.871	4.814	19.94	22.23	7.93	5.38

GENERAL NOTE: Dimensions are in millimeters.

MANDATORY APPENDIX IV
WOBBLE AND FIT GAGING OF RECESSED HEADS

Wobble gaging provides a means for determining the compatibility of cross recesses in the heads of screws with companion screw drivers and will indicate the point where deviations in the recess contours affect satisfactory driver engagement. Recesses that exhibit excessive wobble characteristics will result in poor screw driveability because of driver camout before normal torque level is attained; damage to recesses; and/or accelerated driver wear. Dimensions for Types I and IA recesses are included in Tables IV1 and IV2. The Type III recess is not subject to wobble gaging because the nearly parallel sides of the square recess and driver are essentially wobble free. It is, however, subject to a "fit" check, in which a tapered plug gage is inserted into the recess and must fit tightly. This is sometimes referred to as a "stick fit". Dimensions for these gages are included in Table IV3.

The allowable total wobble gaging limits for the various types of recesses included herein were predicated originally on the gaging of plain finish (unplated or uncoated) screws. Subsequent experience, however, has shown these limits to be suitable for the gaging of screws having coating thickness up to and including 0.008 mm (8 μm) on significant surfaces. For screws having heavier coatings it is not practical to use wobble gaging to determine satisfactory driver engagement in the finished product; however, where it is considered desirable to verify the suitability of wobble characteristics in such screws before plating or coating, the screws shall be stripped of finish and gaged in the plain condition.

A wobble gaging fixture is illustrated in Fig. IV1. Appropriate cross recess master plug gages with handles and position indicators for the various recess types are available through the screw suppliers. Dimensions of the points on master plug gages are, except for the body diameters tabulated in this Standard, the same as those specified for the respective gage points in Appendix III.

TABLE IV1 GAGING LIMITS FOR TYPES I AND IA RECESSES

Size of Recess Gage	Maximum Allowable Total Wobble, deg	
	Type I	Type IA
No. 0 [Note (1)]	...	...
No. 1	15	12
No. 2	12	10
No. 3	10	8
No. 4	10	8

NOTE:
(1) Values for the No. 0 size recesses are under development.

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 in this manner, 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 the top plate and the point of the plug gage shall be 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 is 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 are 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 in Table IV1. Cross lines on the gage pointer should be rechecked with plug gage wings to make certain cross lines and gage wings are registered on identical radials.

TABLE IV2 GAGE BODY DIAMETERS FOR TYPES I AND IA RECESSES

Size of Recess Gage	Gage Body Diameter	
	Max.	Min.
No. 0	3.43	2.92
No. 1	5.03	4.52
No. 2	6.60	6.10
No. 3	8.20	7.70
No. 4	9.78	9.27

GENERAL NOTE: Dimensions are in millimeters.

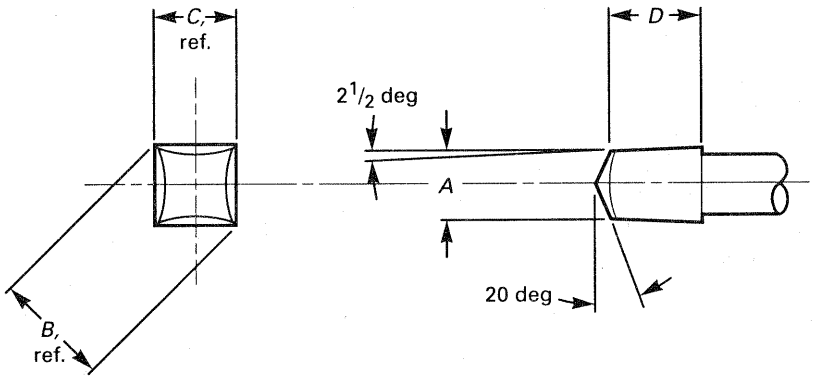


TABLE IV3 DIMENSIONS OF FIT GAGE POINTS

Recess Size	A		B,	C,	D	
	Max.	Min.	Reference	Reference	Max.	Min.
00	1.270	1.257	2.187	1.547	3.18	2.66
0	1.778	1.765	2.929	2.070	3.69	3.17
1	2.307	2.293	3.675	2.598	3.69	3.17
2	2.848	2.834	4.539	3.208	4.47	3.96
3	3.371	3.357	5.377	3.802	5.26	4.75
4	4.839	4.826	7.650	5.410	6.86	6.35

GENERAL NOTE: Dimensions are in millimeters.

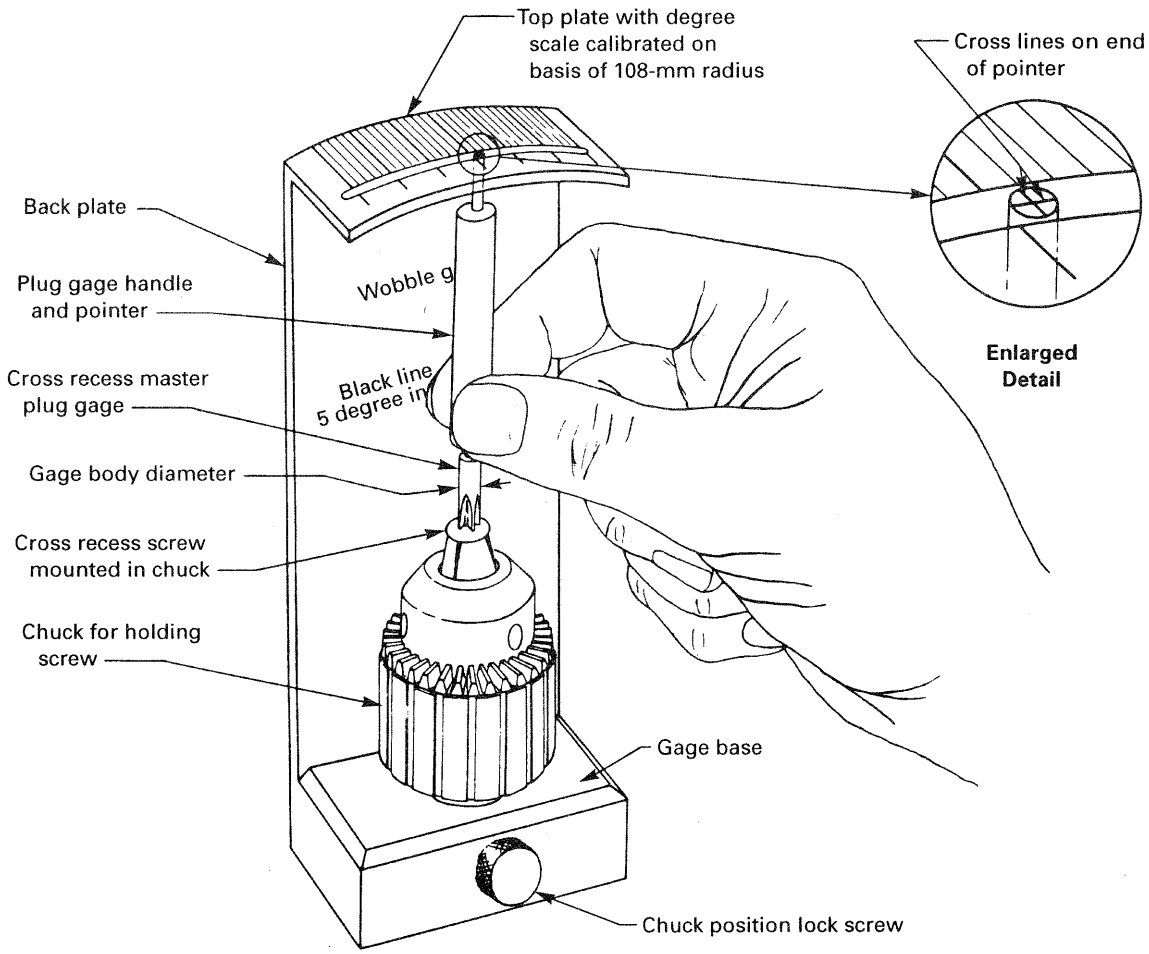


FIG. IV1 GAGING FIXTURE

MANDATORY APPENDIX V
RECOMMENDED CLEARANCE HOLES FOR METRIC MACHINE SCREWS

The recommended basic clearance holes for metric machine screws are specified in Table V1. Three recommendations are provided to suit various design conditions as described in the following:

Normal Clearance. The normal clearance hole sizes are preferred for general purpose applications and should be specified unless special design considerations dictate the need for either a close or loose clearance hole.

Close Clearance. The close clearance hole sizes should be specified only where conditions such as critical alignment of assembled components, wall thickness, or other limitations necessitate the use of a minimal hole.

When close clearance holes are specified, special provisions, such as countersinking or counterboring at the fastener entry side, may be necessary to ensure proper seating of the head.

Loose Clearance. The loose clearance hole sizes should be specified only for applications where maximum adjustment capability between the components being assembled is necessary.

Tolerance Considerations. In general, it is recommended that basic clearance hole diameters given in the table be considered as the minimum limit. The recommended plus tolerances for the respective clearance hole types and sizes are shown in Table V2.

TABLE V1 CLEARANCE HOLES FOR METRIC MACHINE SCREWS

Nominal Screw Size	Basic Clearance Hole Diameter, mm		
	Close Clearance	Normal Clearance (Preferred)	Loose Clearance
M2	2.20	2.40	2.60
M2.5	2.70	2.90	3.10
M3	3.20	3.40	3.60
M3.5	3.70	3.90	4.20
M4	4.30	4.50	4.80
M5	5.30	5.50	5.80
M6	6.40	6.60	7.00
M8	8.40	9.00	10.00
M10	10.50	11.00	12.00
M12	13.00	13.50	14.50

TABLE V2 RECOMMENDED PLUS TOLERANCES FOR CLEARANCE HOLES TYPES AND SIZES

Clearance Hole Diameter		Plus Tolerance, mm		
Over	To and Including	Close Clearance	Normal Clearance	Loose Clearance
1.70	5.80	0.12	0.20	0.30
5.80	14.50	0.18	0.30	0.45

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