SCREW THREADS

SCREW THREADS FOR METRIC MECHANICAL FASTENERS (BOUNDARY PROFILE GAGED)

IFI 500 1982

IFI NOTES:

1. IFI-500 was first published in 1976. Since then it has been accepted by ASME Standards Committee B1 as the basis for an American National Standard which will be designated ANSI B1.18M. This ANSI standard is currently under development and when published it will supersede IFI-500. Copies of ANSI B1.18M will be available from the American Society of Mechanical Engineers, United Engineering Center, 345 E. 47th St., New York, NY 10017.

2. In this 1982 issue of IFI-500 the principal changes from the 1976 edition are a) nominal thread diameters M1.6 thru M4 have been omitted, b) the close tolerance thread fit of 6H/5g 6g has been replaced by tolerance class 6H/4g 6g, c) the nominal thread diameter M6.3 × 1 has been withdrawn and M6 × 1 added, d) the construction formulas given in Appendix A have been simplified, and e) all gage and acceptance gaging requirements have been removed and are now found in ANSI B1.3M, page A—35, and IFI-539, page A—43.

3. Screw threads manufactured to and meeting the requirements of IFI-500 are functionally interchangeable with ANSI B1.13M screw threads of the same nominal thread diameter, pitch, and tolerance class.

1. SCOPE

This IFI Standard establishes screw threads for metric series mechanical fasteners in nominal thread diameters M5 to M100 inclusive. It establishes the basic thread profile, the diameter-pitch series, the maximum and minimum boundary profiles for gaging, and acceptance criteria.

2. BOUNDARY PROFILES FOR GAGING

2.1 Principle. This Standard establishes boundary profiles for gaging. Acceptability of product threads is based entirely on gages conforming to these boundary profiles.

2.2 Definitions.

2.2.1 Boundary profiles for gaging establish the boundaries of the gaging system which determines product acceptance.

2.2.2 The maximum boundary profile for gaging establishes the maximum boundary for the gaging system (GO gages).

2.2.3 The minimum boundary profile for gaging establishes the minimum boundary for the gaging system (NOT GO gages).

3. BASIC THREAD PROFILE

3.1 Definition. The basic thread profile is the cyclical outline, in an axial plane, of the permanently established boundary between the provinces of the external and internal threads. This boundary governs the conditions of assembleability and is the permanent reference profile on which the maximum and minimum boundary profiles for gaging are based.

3.2 Construction. The basic profile (Fig. 1) is derived from ISO 68. It is a continuous cyclical outline having the basic major diameter as its base line, a cycle length which is the pitch (P) of the thread, and a single wave per cycle having:

a. an amplitude (height) of 0.54127P(★) entirely disposed toward the axis from the basic major diameter,
b. a flat crest of length 0.125P coincident with the basic major diameter,
c. straight sides diverging from the ends of the crest at angles of 60° to the basic major diameter, and
d. a flat parallel to and a distance of 0.54127P from the basic major diameter completing the cycle.

(★) Theoretical height of $\frac{(5\sqrt{3})P}{16}$ rounded to 5 decimal places.

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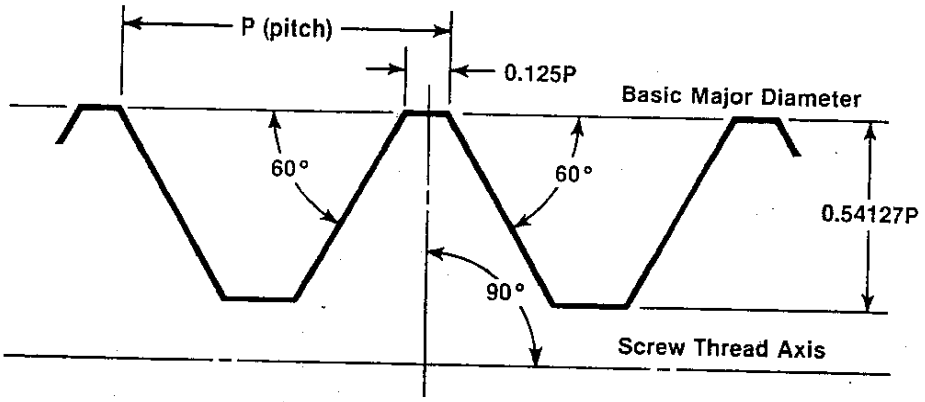

FIG. 1 BASIC THREAD PROFILE

Table 1 Boundary Profiles For Gaging General Purpose External Threads — Class 6g

Basic Major Dia and Thread Pitch (P)	Allowance	Flank Diametral Displacement	Min Root Radius = 0.125P	Maximum Material Boundary						Minimum Material Boundary	
				Non-Plated Threads		Plated Threads		Crest Width = 0.125P	Basic Major Dia Minus 1.08253P	Major Dia	Crest Width W
				Major Dia	Root Width Y	Major Dia	Root Width Y				
				Max	Ref	Max	Ref			Min	
M5 × 0.8	0.024	0.095	0.100	4.976	0.214	5.000	0.200	0.100	4.134	4.826	0.132
M6 × 1	0.026	0.112	0.125	5.974	0.265	6.000	0.250	0.125	4.917	5.794	0.164
M8 × 1.25	0.028	0.118	0.156	7.972	0.329	8.000	0.313	0.156	6.647	7.760	0.211
M10 × 1.5	0.032	0.132	0.188	9.968	0.393	10.000	0.375	0.188	8.376	9.732	0.248
M12 × 1.75	0.034	0.150	0.219	11.966	0.457	12.000	0.438	0.219	10.106	11.701	0.285
M14 × 2	0.038	0.160	0.250	13.962	0.522	14.000	0.500	0.250	11.835	13.682	0.319
M16 × 2	0.038	0.160	0.250	15.962	0.522	16.000	0.500	0.250	13.835	15.682	0.319
M20 × 2.5	0.042	0.170	0.312	19.958	0.649	20.000	0.625	0.312	17.294	19.623	0.408
M24 × 3	0.048	0.200	0.375	23.952	0.778	24.000	0.750	0.375	20.752	23.577	0.476
M30 × 3.5	0.053	0.212	0.438	29.947	0.906	30.000	0.875	0.438	26.211	29.522	0.560
M36 × 4	0.060	0.224	0.500	35.940	1.035	36.000	1.000	0.500	31.670	35.465	0.645
M42 × 4.5	0.063	0.236	0.562	41.937	1.161	42.000	1.125	0.562	37.129	41.437	0.715
M48 × 5	0.071	0.250	0.625	47.929	1.291	48.000	1.250	0.625	42.587	47.399	0.787
M56 × 5.5	0.075	0.265	0.688	55.925	1.418	56.000	1.375	0.688	50.046	55.365	0.858
M64 × 6	0.080	0.280	0.750	63.920	1.546	64.000	1.500	0.750	57.505	63.320	0.935
M72 × 6	0.080	0.280	0.750	71.920	1.546	72.000	1.500	0.750	65.505	71.320	0.935
M80 × 6	0.080	0.280	0.750	79.920	1.546	80.000	1.500	0.750	73.505	79.320	0.935
M90 × 6	0.080	0.280	0.750	89.920	1.546	90.000	1.500	0.750	83.505	89.320	0.935
M100 × 6	0.080	0.300	0.750	99.920	1.546	100.000	1.500	0.750	93.505	99.320	0.923

Note: For formulas see Appendix A.

4. SERIES OF THREADS

4.1 This Standard recognizes only one series of diameter-pitch combinations, as given in Table 1. All are selected from ANSI B1.13M, page A—8.

5. CLASS OF THREAD FIT

5.1 This Standard establishes two classes of thread fit: one is for general purpose applications and contains tolerance classes 6H/6g;

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Table 2 Boundary Profiles For Gaging Close Tolerance External Threads — Class 4g6g

Basic Major Dia and Thread Pitch (P)	Allowance	Flank Diametral Displacement	Min Root Radius = 0.125P	Maximum Material Boundary						Minimum Material Boundary	
				Non-Plated Threads		Plated Threads		Crest Width = 0.125P	Basic Major Dia Minus 1.08253P	Major Dia	Crest Width W
				Major Dia	Root Width Y	Major Dia	Root Width Y				
				Max	Ref	Max	Ref			Min	
M5 × 0.8	0.024	0.060	0.100	4.976	0.214	5.000	0.200	0.100	4.134	4.826	0.152
M6 × 1	0.026	0.071	0.125	5.974	0.265	6.000	0.250	0.125	4.917	5.794	0.188
M8 × 1.25	0.028	0.075	0.156	7.972	0.329	8.000	0.313	0.156	6.647	7.760	0.235
M10 × 1.5	0.032	0.085	0.188	9.968	0.393	10.000	0.375	0.188	8.376	9.732	0.275
M12 × 1.75	0.034	0.095	0.219	11.966	0.457	12.000	0.438	0.219	10.106	11.701	0.317
M14 × 2	0.038	0.100	0.250	13.962	0.522	14.000	0.500	0.250	11.835	13.682	0.354
M16 × 2	0.038	0.100	0.250	15.962	0.522	16.000	0.500	0.250	13.835	15.682	0.354
M20 × 2.5	0.042	0.106	0.312	19.958	0.649	20.000	0.625	0.312	17.294	19.623	0.445
M24 × 3	0.048	0.125	0.375	23.952	0.778	24.000	0.750	0.375	20.752	23.577	0.519
M30 × 3.5	0.053	0.132	0.438	29.947	0.906	30.000	0.875	0.438	26.211	29.522	0.607
M36 × 4	0.060	0.140	0.500	35.940	1.035	36.000	1.000	0.500	31.670	35.465	0.693
M42 × 4.5	0.063	0.150	0.562	41.937	1.161	42.000	1.125	0.562	37.129	41.437	0.765
M48 × 5	0.071	0.160	0.625	47.929	1.291	48.000	1.250	0.625	42.587	47.399	0.839
M56 × 5.5	0.075	0.170	0.688	55.925	1.418	56.000	1.375	0.688	50.046	55.365	0.918
M64 × 6	0.080	0.180	0.750	63.920	1.546	64.000	1.500	0.750	57.505	63.320	0.992
M72 × 6	0.080	0.180	0.750	71.920	1.546	72.000	1.500	0.750	65.505	71.320	0.992
M80 × 6	0.080	0.180	0.750	79.920	1.546	80.000	1.500	0.750	73.505	79.320	0.992
M90 × 6	0.080	0.180	0.750	89.920	1.546	90.000	1.500	0.750	83.505	89.320	0.992
M100 × 6	0.080	0.190	0.750	99.920	1.546	100.000	1.500	0.750	93.505	99.320	0.987

Note: For formulas see Appendix A.

and the other is used where closer thread fits are required and contains tolerance classes 6H/4g6g.

5.2 The boundary profiles for gaging are based on tolerance grades and tolerance positions selected from ANSI B1.13M.

5.3 External Threads.

5.3.1 General Purpose. The tolerance position is "g" (small allowance). The flank diametral displacement of the boundary profiles for gaging is tolerance grade 6 for pitch diameters. The major diameter displacement is tolerance grade 6 for major diameters (Table 1).

5.3.2 Close Tolerance. The tolerance position is "g" (small allowance). The flank diametral displacement of the boundary profiles for gaging is tolerance grade 4 for pitch diameters. The major diameter displacement is tolerance grade 6 for major diameters (Table 2).

5.4 Internal Threads.

5.4.1 The tolerance position is "H" (no allowance). The minor diameter displacement of the boundary profiles for gaging is tolerance grade 6 for minor diameters, and the flank diametral displacement is tolerance grade 6 for pitch diameters (Table 3).

6.0 CONSTRUCTION OF BOUNDARY PROFILES

6.1 The boundary profiles are derived from the basic thread profile illustrated in Fig. 1.

6.2 The boundary profiles for gaging external threads shall be constructed as illustrated in Fig. 2 and using the values given in Tables 1 and 2, as applicable.

6.2.1 Unless otherwise specified, the root of the external thread shall have a non-reversing curvature, no portion of which shall have a radius smaller than 0.125P. The maximum root radius is limited by the boundary profiles. (See Fig. 4.)

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Table 3 Boundary Profiles For Gaging General Purpose Internal Threads — Class 6H

Basic Major Dia and Thread Pitch (P)	Flank Diametral Displacement	Maximum Material Boundary			Minimum Material Boundary		
		Minor Dia	Major Dia	Root Width = 0.125P	Minor Dia	Major Dia	Crest Width U
		Min	Min		Max	Max	
M5 × 0.8	0.125	4.134	5.000	0.100	4.334	5.240	0.243
M6 × 1	0.150	4.917	6.000	0.125	5.153	6.294	0.300
M8 × 1.25	0.160	6.647	8.000	0.156	6.912	8.340	0.373
M10 × 1.5	0.180	8.376	10.000	0.188	8.676	10.396	0.444
M12 × 1.75	0.200	10.106	12.000	0.219	10.441	12.453	0.515
M14 × 2	0.212	11.835	14.000	0.250	12.210	14.501	0.594
M16 × 2	0.212	13.835	16.000	0.250	14.210	16.501	0.594
M20 × 2.5	0.224	17.294	20.000	0.312	17.744	20.585	0.755
M24 × 3	0.265	20.752	24.000	0.375	21.252	24.698	0.886
M30 × 3.5	0.280	26.211	30.000	0.438	26.771	30.785	1.037
M36 × 4	0.300	31.670	36.000	0.500	32.270	36.877	1.173
M42 × 4.5	0.315	37.129	42.000	0.562	37.799	42.965	1.330
M48 × 5	0.335	42.587	48.000	0.625	43.297	49.057	1.466
M56 × 5.5	0.355	50.046	56.000	0.688	50.796	57.149	1.603
M64 × 6	0.375	57.505	64.000	0.750	58.305	65.241	1.745
M72 × 6	0.375	65.505	72.000	0.750	66.305	73.241	1.745
M80 × 6	0.375	73.505	80.000	0.750	74.305	81.241	1.745
M90 × 6	0.375	83.505	90.000	0.750	84.305	91.241	1.745
M100 × 6	0.400	93.505	100.000	0.750	94.305	101.266	1.731

Note: For formulas see Appendix A.

6.3 The boundary profiles for gaging internal threads shall be constructed as illustrated in Fig. 3 and using the values given in Table 3.

6.4 The derivations of values given in Tables 1 thru 3 are outlined in Appendix A.

7. PRODUCT THREAD ACCEPTABILITY

7.1 General Inspection.

7.1.1 Any system conforming to the boundary profiles for gaging, in accordance with IFI-539, page A—43, may be used to inspect fastener threads.

8. THREAD DESIGNATIONS

8.1 Basic Designation. Metric screw threads in this standard shall be designated by the letter "M" followed by the nominal diameter size and the pitch expressed in millimeters, separated by the sign "×" and followed by the tolerance class separated by a dash from the pitch. The full designation will be followed by IFI-500 to indicate boundary profile gaging required. ***(NOTE: When ANSI B1.18M is published, "IFI-500" will be replaced by "ANSI B1.18M" in all thread designations.)***

8.1.1 Example of General Purpose External Thread Designation

M5 × 0.8 – 6g – IFI-500

8.1.2 Example of Close Tolerance External Thread Designation

M8 × 1.25 – 4g6g – IFI-500

8.1.3 Example of Internal Thread Designation

M6 × 1 – 6H – IFI-500

8.2 Designations Using All Capital Letters. When computer and teletype thread designations use all capital letters, the external or internal threads should need no further identification since the letter designation in the tolerance class is always "G" for external and "H" for internal threads. However, it is

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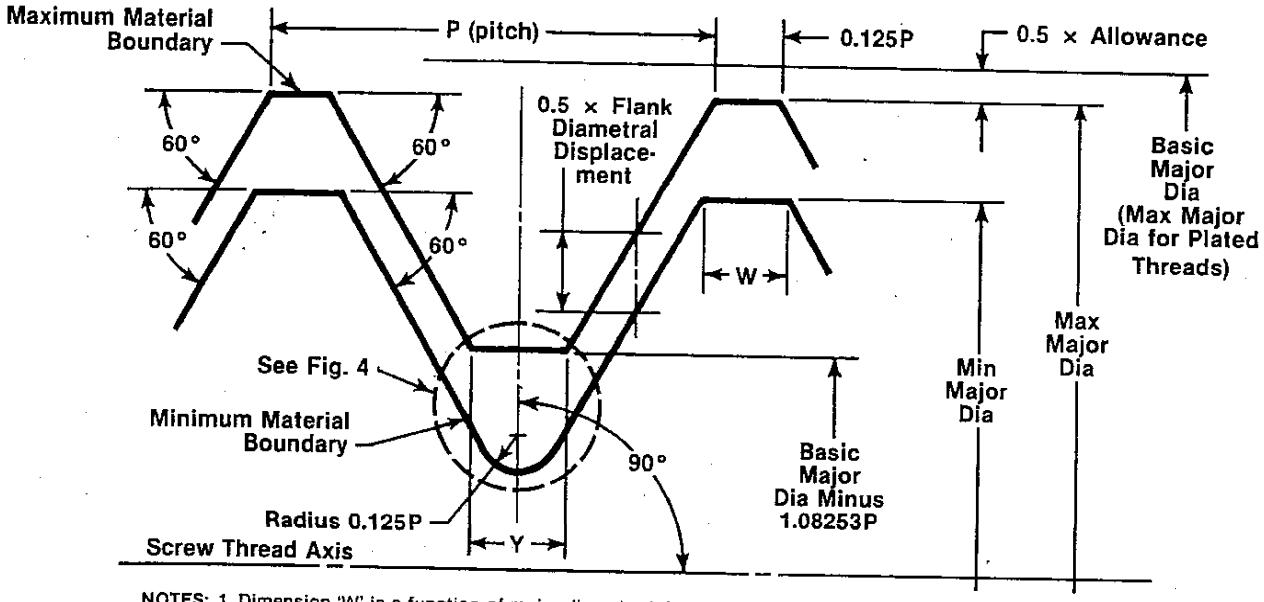
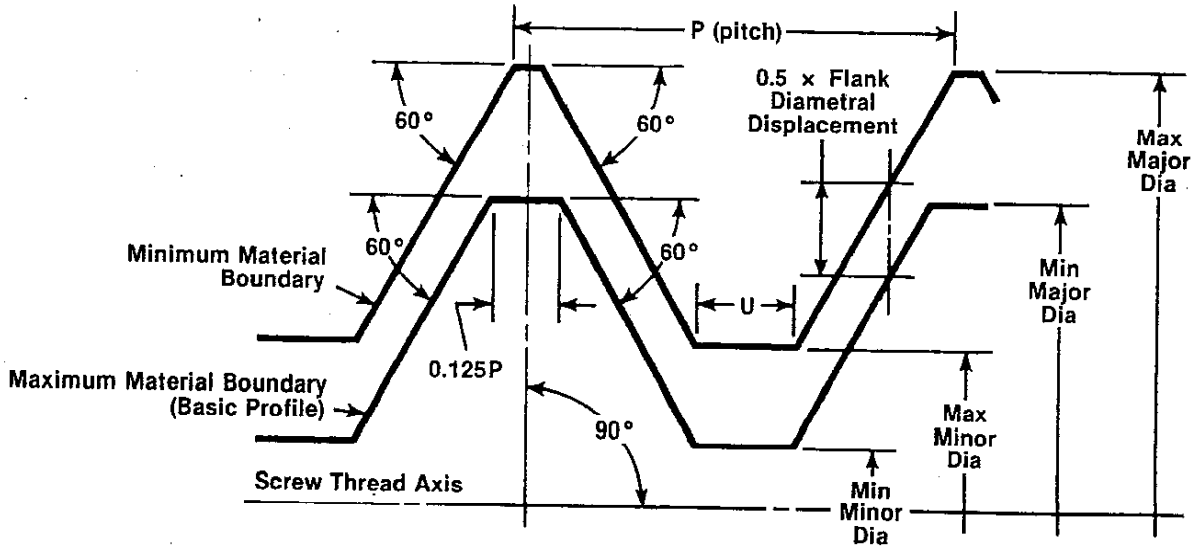


NOTES: 1. Dimension 'W' is a function of major diameter tolerance and flank diametral displacement.

2. The thread root of property class 8.8 and higher strength externally threaded fasteners shall have a non-reversing curvature, no portion of which shall have a radius less than 0.125P, and blend tangentially into the flanks and any flat portion if present. The maximum root radius is limited by the boundary profiles. The thread root of lower strength externally threaded fasteners shall preferably have a non-reversing curvature, no portion of which shall have a radius less than 0.125P, however, a flat root is optional if permitted by the purchaser.

3. See Appendix A for formulas.

FIG. 2 BOUNDARY PROFILES FOR GAGING EXTERNAL THREADS



NOTES: 1. Dimension 'U' is a function of minor diameter tolerance and flank diametral displacement.

2. See Appendix A for formulas.

FIG. 3 BOUNDARY PROFILES FOR GAGING INTERNAL THREADS

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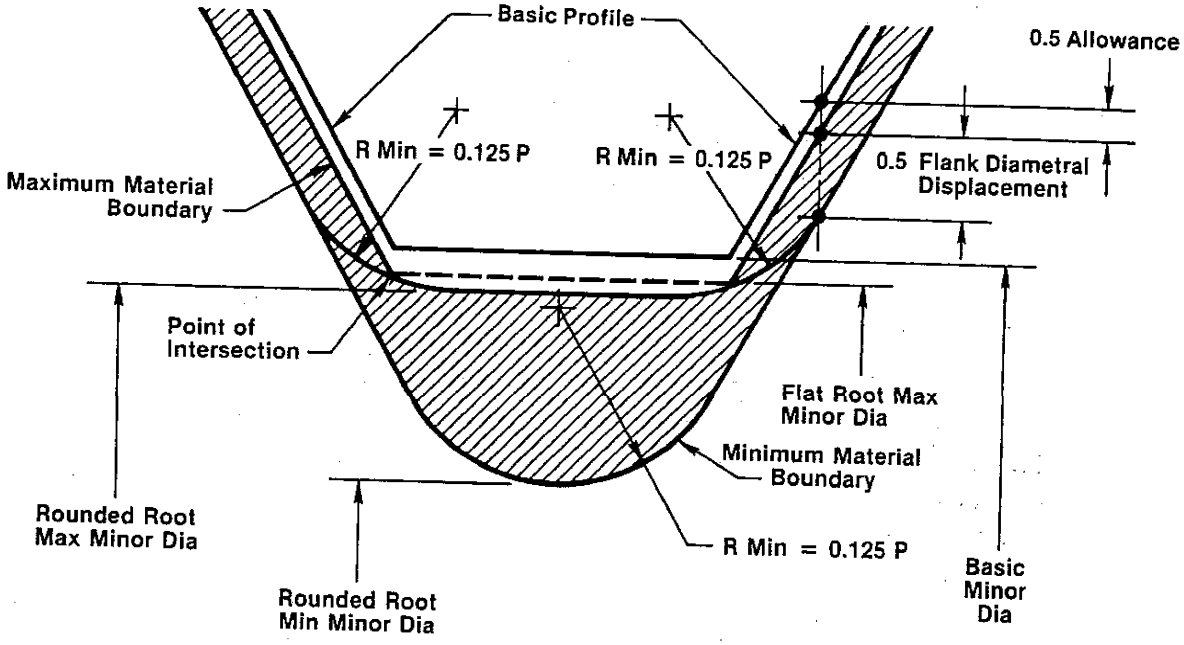

FIG. 4 ROUNDED ROOT PROFILES — EXTERNAL THREADS

recommended that the abbreviations EXT and INT be added to the tolerance class designation to eliminate any possibility of misunderstanding.

Examples:

M10 × 1.5 – 6G EXT – IFI-500
M14 × 2 – 4G6G EXT – IFI-500
M30 × 3.5 – 6H INT – IFI-500

8.3 Designations for Coated or Plated Threads. Unless the basic designation indicates otherwise, the allowance on the external thread may be used to accommodate the coating or plating thickness on coated or plated threads, i.e., the thread after coating or plating is subject to acceptance using a basic (tolerance position h) size GO thread gage. When the allowance must be retained on coated or plated external threads, the basic designation must be followed by the words "AFTER COATING" or "AFTER PLATING."

Examples:

M5 × 0.8 – 6g AFTER COATING – IFI-500
M8 × 1.25 – 4g6g AFTER PLATING – IFI-500

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APPENDIX A

FORMULAS FOR DERIVATION OF DIMENSIONS

The values given in Tables 1 thru 3 are derived as follows:

1. Basic major diameter and thread pitch series is selected from ANSI B1.13M, Table 2, page A—15. Basic major diameter, D = nominal thread diameter; P = thread pitch.
2. Allowance (external thread). Allowances are in accordance with ANSI B1.13M, Table 4, page A—17, fundamental deviation 'g.'
3. Flank diametral displacement (external thread) = tolerance grade 6 or 4 as applicable, for pitch diameters as given in ANSI B1.13M, Table 8, page A—21.
4. Root radius, min, (external thread) = 0.125P.
5. Major Diameter, max, (external thread) = basic major dia minus allowance for non-plated threads; and basic major diameter for plated threads.
6. Major diameter, min, (external thread) = max major dia minus tolerance grade 6 for major diameters as given in ANSI B1.13M, Table 7, page A—20.
7. W, crest width of min boundary profile, external thread = 0.125P + 0.57735 (major dia tolerance of external thread minus flank diametral displacement of external thread) (Fig. 2).
8. Y, root width of max boundary profile, external thread = 0.250P + 0.57735 (allowance of external thread) for non-plated threads; and 0.250P for plated threads.
9. Flank diametral displacement (internal thread) = tolerance grade 6 for pitch diameters as given in ANSI B1.13M, Table 9, page A—22.
10. Minor diameter, min, (internal thread) = basic major dia minus 1.08253P.
11. Minor diameter, max, (internal thread) = min minor dia + tolerance grade 6 for minor diameters as given in ANSI B1.13M, Table 6, page A—19.
12. Major diameter, min, (internal thread) = basic major dia.
13. Major diameter, max, (internal thread) = basic major dia + 0.14434P + tolerance grade 6 for pitch diameters as given in ANSI B1.13M, Table 9, page A—22.
14. U, crest width of min boundary profile, internal thread = 0.25P + 0.57735 (minor diameter tolerance of internal thread minus flank diametral displacement of internal thread) (Fig. 3).