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NATIONAL BUREAU OF STANDARDS

SUPPLEMENT TO SCREW-THREAD STANDARDS FOR FEDERAL SERVICES 1944

Supplement to Handbook H28 (1944)

NITED STATES DEPARTMENT OF COMMERCE • • • CHARLES SAWYER, *Secretary*
NATIONAL BUREAU OF STANDARDS • E. U. CONDON, *Director*

SUPPLEMENT TO NATIONAL BUREAU OF STANDARDS HANDBOOK H28 (1944)

SUPPLEMENT TO SCREW-THREAD STANDARDS FOR FEDERAL SERVICES 1944

Prepared by direction of the
Interdepartmental Screw-Thread Committee

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Foreword

An extensive revision of the 1944 edition of Handbook H28, Screw Thread Standards for Federal Services, is in process, contingent on international standardization and the development of screw-thread standards, pipe-thread standards, and screw, bolt, and nut standards by Sectional Committees B1, B2, and B18 of the American Standards Association. On account of the uncompleted status of much of this work, publication of a revised edition of Handbook H28 is being deferred.

Revisions and additions that are completed are being published now in order to avoid undue delay in putting them into effect in departments of the Federal Government. This Supplement, which is arranged to correspond to the 1944 edition, is issued for that purpose.

E. U. Condon, *Chairman.*

CONTENTS

APPROVAL BY

THE SECRETARIES OF DEFENSE AND COMMERCE AND THE SECRETARIES OF THE DEPARTMENTS OF THE ARMY, NAVY, AND AIR FORCE

The accompanying supplement to Handbook H28 (1944) on screw-thread standards for Federal Services, submitted by the Interdepartmental Screw Thread Committee, is hereby approved, and the use of these standards by the National Military Establishment and the Department of Commerce, except where a need for deviation therefrom is shown, is hereby ordered.

James Forrestal,
Secretary of Defense.

Charles Sawyer,
Secretary of Commerce.

Kenneth Royall,
Secretary, Department of the Army.

John L. Sullivan,
Secretary, Department of the Navy.

W. Stuart Symington,
Secretary, Department of the Air Force.

SUPPLEMENT TO SCREW-THREAD STANDARDS FOR FEDERAL SERVICES 1944

SECTION I. INTRODUCTION

Page 1, revise the second division of this section as follows:

2. PERSONNEL OF THE COMMITTEE

The personnel of the Interdepartmental Screw Thread Committee is as follows:

Representing the Department of the Army:
- Mr. Stanley Farrow, Industrial Division, Ordnance Department, National Defense Building, Washington 25, D. C.
- Mr. Eugene Von Loesch, Research and Development Division, Corps of Engineers, Room 2422, Building T–7, Gravelly Point, Virginia.

Representing the Department of the Navy:
- Mr. Karl D. Williams, Bureau of Ships (Code 350), Department of the Navy, Washington 25, D. C.
- Mr. Burton H. Slocum, Research and Development Division, Bureau of Ordnance, Department of the Navy, Washington 25, D. C.

Representing the Department of the Air Force:
- Mr. Arthur F. Wentzel, Air Material Command, MCREXU—Engineering Standards Section, Engineering Division, Wright-Patterson Air Force Base, Dayton, Ohio.
- Mr. Frank E. Richardson, Headquarters, U. S. Air Force, Research and Development Division, National Defense Building, Washington 25, D. C.

Representing the Department of Commerce:
- Dr. Edward U. Condon, Chairman, Director, National Bureau of Standards, Washington 25, D. C.
- Mr. David R. Miller, Gage Section, Metrology Division, National Bureau of Standards, Washington 25, D. C.
- Mr. Irvin H. Fullmer, Secretary and Alternate, Gage Section, National Bureau of Standards, Washington 25, D. C.

Liaison Representatives of Sectional Committees Organized Under the Procedure of the American Standards Association:
- Mr. P. M. Delzell, Chief of Gage Division, Ford Motor Company, Dearborn, Michigan. (Member of ASA Committee B1.)
- Mr. H. C. Erdman, Technical Asst. to Vice-Pres., The National Screw & Manufacturing Co., Cleveland, Ohio. (Member of ASA Committees B1 and B18.)
- Mr. H. W. Robb, Standards Division, General Electric Co., Schenectady, N. Y. (Member of ASA Committees B1 and B18.)
- Mr. Paul G. Schulz, Development Engineer, Valve & Fitting Engineering Department, Crane Co., Chicago, Ill. (Member of ASA Committees B1 and B2.)
- Mr. Wm. C. Stewart, Technical Adviser, American Institute of Bolt, Nut, & Rivet Manufacturers, Cleveland, Ohio. (Member of ASA Committees B1 and B18.)

SECTION II. NOMENCLATURE, DEFINITIONS, AND LETTER SYMBOLS

A tentative revision of this section, based on a proposed American Standard for "Nomenclature, Definitions, and Letter Symbols for Screw Threads" is given herein as a revised appendix 6. After possible further revision, it is expected that this appendix will be published as section II of the next edition of this Handbook.

SECTION III. AMERICAN NATIONAL FORM OF THREAD

The following corrections and revisions are to be inserted:

Page 7, table 1, col. 15, change ".09622" to ".09623."

Pages 9 and 13, Figures 4 and 7, change "2×P. D. TOL. ON RADIUS" to "TOLERANCE ON MAJOR DIAMETER OF SCREW IS TWICE THE TOLERANCE ON PITCH DIAMETER."

Pages 9, 13, 16, 19, Figures 4, 7, 10, 13, change "TABLES 7 to 16, INCLUSIVE" to "TABLES 16, 24, ETC."

Pages 19 to 23. Delete class 4 here and wherever it appears elsewhere.

Pages 23 to 28. 5. Class 5 Fit.—

The following is a resolution agreed upon by a subcommittee of the Interdepartmental Screw Thread Committee, Mr. W. S. Brown, chairman, (American Locomotive Co., Schenectady, N. Y.), appointed to investigate the class 5 fit:

> In view of the well-recognized fact that figures for pitch diameter tolerances for interference thread fits, published in the 1944 edition of the H28 Handbook, have not produced an all-round satisfactory solution to the difficulties inherent in the older "Tentative Class 5" and have not been widely accepted commercially; and in view of the large amount of work necessary to produce some possibly improved system of tolerances, it is the opinion of this subcommittee *that the status shown in the H28 (1942) Handbook be restored. This includes the "Tentative Class 5" and the "Alternative Class 5" Tolerances and comments relative to gaging.* This restoration would stand until a further investigation of the whole subject can be made. The desired result might be achieved by republication in the forthcoming supplement to the H28 Handbook. Additional notes could explain the reason for the reinstatement.
>
> The subcommittee further is of the opinion that potential difficulties of *moderate* lead error are probably minimized by effects produced during mating of the studs and tapped holes. Thus, pitch diameter should be measured directly across opposing threads and grooves, that is, NOT BY RING GAGE. Lead error should be checked by independent means to prevent mating of parts with excessive amounts.

The following discussion of interference thread fits was also submitted by the chairman of the subcommittee:

> It is recognized. from the outset, that the problem of producing and mating external and internal components of interference thread fits involves so many vari-

ables that, in the present state of the mechanical arts, it is virtually impossible to set up standards which will satisfy all the requirements. Most users appear to find it necessary to use some version of the principle of "selection" or "fitting" for at least a portion of their products. The main requirements of an interference fit appear to be:

(a) Enough interference allowance between pitch diameters of minimum metal studs and tapped holes to create sufficient grip to prevent unscrewing the stud when the nut, which holds the joint, is backed off the outer end of the stud.

(b) Tolerances on the pitch diameter of the studs and tapped holes, minimum values of which are set by *currently commercially available* equipment and practices.

(c) Possibility of assembling the maximum interference fit as produced by mating maximum metal studs and maximum metal tapped holes. This fit derives from the accumulation of the allowance (par. a), the two maximum limits of tolerances (par. b), of the stud and tapped hole, and the added effects of lead error and error in half-angle of the thread section.

(d) In many cases, attempts to mate such maximum metal components result in seizure by galling, it being impossible to screw the stud either further in or out. Other studs break during driving. Due to this condition it is often expedient to pare the maximum interferences to amounts which permit practical assembly. This in turn pares one or both of the component maximum metal limits below those desirable to producers of components. The tables of pitch diameter tolerances given as "tentative" in publications up to and including H28 (1942), favored the producers of studs. Due to complaints from prominent users, a tentative "alternative" standard was added in the H28 (1942) edition. This gave more tolerance to the producers of tapped holes, largely by reducing the tolerances permitted for the mating studs. In H28 (1944) the "alternative standard" became the *only* set of figures printed, the older "tentative" figures being eliminated. It is now apparent that commercial manufacturers of studs, and many private manufacturers, have not accepted the 1944 tolerances for studs. Some stud users have adopted the 1944 tolerances for holes. Possibly some users have mated manufacturer's studs in the wider toleranced holes resulting in fits which were not tight enough. Some stud manufacturers have warned their clients but this warning should be issued by all who retain the older practice.

In accordance with the above resolution, the tentative class 5, as published in Handbook H28 (1942), is republished below, and the class 5 fit, as published in Handbook H28 (1944), is restored as the alternative class 5 fit.

5. Tentative Class 5 Fit.—(a, b, c, d, e, and f). As in H28 (1944).

(g) *Allowance and tolerance values.*—Allowances and tolerances are specified in tables 6A and 7A for coarse-threaded and fine-threaded studs set in hard materials—namely, cast iron, steel, and bronze. These are based upon data obtained in an experimental investigation and fulfill the conditions outlined in the above specifications. The system is predicated upon the use of the gaging system outlined in the following paragraph. (This gaging system corresponds to that given on page 234 of Handbook H28 (1942), modified in accordance with the resolution quoted above, and substitutes for par. 2 of section (C), page 41, H28 (1944) for the alternate class 5 fit.)

(h) *Gages and gaging.*—The relatively close limits on pitch diameter specified for the class 5 fit necessitate careful and accurate gaging of both the stud and the tapped hole.

The pitch diameter of the stud should be gaged by means of a cone-pointed snap gage, see p. 41, H28 (1944), or measured by means of a thread micrometer, see p. 239, H28 (1944). The major diameter may be gaged by means of "go" and "not go" plain ring or snap gages. Lead error, thread angle, minor diameter, and thread form should be checked by means of a projection comparator, see p. 239, H28 (1944), or other independent means. The minor diameter of the stud should preferably be maintained near the maximum limit.

The hole should be gaged by means of minimum and maximum limit thread plug gages, and the minor diameter by means of "go" and "not go" plain plug gages, after threading.

(i) *Limiting dimensions.*—The tables of limiting dimensions for the class 5 fit are included in section IV, herein, as tables 17A and 25A. Caution: Studs made to the tentative class 5 tolerances will not produce a satisfactory interference fit when assembled with holes made to the alternate class 5 tolerances.

Table 6A. *Class 5 fit for threaded studs, allowances and tolerances for studs and tapped holes, coarse threaded studs in hard materials*

Sizes	Threads per inch	Interference on pitch diameter		Pitch diameter tolerances [1]		Errors in half angle consuming one half of pitch diameter tolerances			
		Minimum	Maximum	Stud	Tapped hole [2]	Stud		Tapped hole	
	2	3	4	5	6	7		8	
		Inch	*Inch*	*Inch*	*Inch*	*Deg*	*Min*	*Deg*	*Min*
1/4	20	0.0003	0.0018	0.0007	0.0008	0	16	0	25
5/16	18	.0005	.0040	.0020	.0015	0	41	0	31
3/8	16	.0005	.0045	.0024	.0016	0	44	0	29
7/16	14	.0006	.0050	.0026	.0018	0	42	0	29
1/2	13	.0007	.0055	.0029	.0019	0	44	0	28
9/16	12	.0008	.0060	.0032	.0020	0	44	0	28
5/8	11	.0008	.0060	.0031	.0021	0	39	0	26
3/4	10	.0009	.0065	.0033	.0023	0	38	0	26
7/8	9	.0010	.0065	.0031	.0024	0	32	0	25
1	8	.0011	.0065	.0027	.0027	0	25	0	25
1 1/8	7	.0011	.0065	.0024	.0030	0	19	0	24
1 1/4	7	.0012	.0065	.0023	.0030	0	18	0	24
1 3/8	6	.0012	.0065	.0017	.0036	0	12	0	25
1 1/2	6	.0013	.0070	.0021	.0036	0	14	0	25

[1] Inasmuch as a moderate difference in lead between stud and tapped hole (about 0.005 inch per inch) has been shown to improve the quality of a stud fit having minimum pitch diameter interference, no lead tolerance is specified. Therefore, the tolerances specified for pitch diameter include all errors of pitch diameter and angle but not of lead. (See "3. Gages and gaging" herein). Excessive lead errors, however, should be avoided, as they increase the tendency of the stud to loosen when subjected to load. Columns 7 and 8 give, for information, the errors in angle which can be compensated for by half the tolerances on pitch diameter given in columns 5 and 6.

[2] The tolerances on the tapped hole given in column 6 are the same as those specified for class 4 fit screws and nuts, with the exception of the 1/4-inch size.

TABLE 7A. *Class 5 fit for threaded studs, allowances and tolerances for studs and tapped holes, fine-threaded studs in hard materials*

Sizes	Threads per inch	Interference on pitch diameter		Pitch diameter tolerances [1]		Errors in half angle consuming one half of pitch diameter tolerances			
		Minimum	Maximum	Stud	Tapped hole [2]	Stud		Tapped hole	
1	2	3	4	5	6	7		8	
		Inch	*Inch*	*Inch*	*Inch*	*Deg*	*Min*	*Deg*	*Min*
1/4	28	0.0005	0.0034	0.0018	0.0011	0	58	0	35
5/16	24	.0005	.0037	.0020	.0012	0	55	0	33
3/8	24	.0006	.0044	.0026	.0012	1	11	0	33
7/16	20	.0006	.0044	.0025	.0013	0	57	0	30
1/2	20	.0007	.0050	.0030	.0013	1	9	0	30
9/16	18	.0007	.0050	.0028	.0015	0	58	0	31
5/8	18	.0008	.0055	.0032	.0015	1	6	0	31
3/4	16	.0008	.0059	.0035	.0016	1	4	0	29
7/8	14	.0008	.0061	.0035	.0018	0	56	0	29
1	14	.0009	.0069	.0042	.0018	1	7	0	29
1 1/8	12	.0009	.0067	.0038	.0020	0	52	0	28
1 1/4	12	.0011	.0060	.0029	.0020	0	40	0	28
1 3/8	12	.0011	.0055	.0024	.0020	0	33	0	28
1 1/2	12	.0012	.0050	.0018	.0020	0	25	0	28

[1] Inasmuch as a moderate difference in lead between stud and tapped bole (about 0.005 inch per inch) has been shown to improve the quality of a stud fit baving minimum pitch diameter interference, no lead tolerance is specified. Therefore, the tolerances specified for pitch diameter include all errors of pitcb diameter and angle but not of lead. (See "3. Gages and gaging" herein.) Excessive lead errors, however, should be avoided, as they increase the tendency of the stud to loosen when subjected to load. Columns 7 and 8 give, for information, the errors in angle which can be compensated for by balf the tolerances on pitch diameter given in columns 5 and 6.

[2] Tbe tolerances on the tapped hole given in column 6 are the same as tbose specified for class 4 fit screws and nuts.

Page 29. Change paragraphs 1 and 2 to read as follows:

1. OBJECT OF GAGING.—The final results sought by gaging are to secure interchangeability, that is, the assembly of mating parts without selection or fitting of one part to another, and to insure that the product conforms to the specified dimensions within the limits of variation establishing the closest and loosest conditions of fit permissible in any given case, as provided for in the foregoing specifications. This is accomplished usually by the use of plug and ring thread gages. This requires the use of maximum-metal limit gages known generally as "go" gages which control the minimum looseness or maximum tightness in the fit of mating parts, and which accordingly control interchangeability, and the use of minimum-metal limit gages known generally as "not go" gages which limit the amount of looseness between mating parts, and thus control in large measure the proper functioning of the parts.

2. PURPOSE OF LIMIT GAGES.—The maximum-metal limit or "go" gages control the extent of the tolerance in the direction of the limit of maximum metal, and represent the maximum limit of external threads and the minimum limit of internal threads. To pass inspection, parts must be acceptable to proper ' go" gages, and such mating parts will always assemble. Successful interchangeable manufacturing has been carried on for many years with the use of "go" gages only.

"Not go" gages control the extent of the tolerance in the direction of the limit of minimum metal, and represent the minimum limit of external threads and the maximum limit of internal threads. All parts shall be accepted if an approved "not go" gage does not enter or is not entered, or if, on or before the third turn of assembly, a definite drag is obtained which is the result of metal to metal contact simultaneously on both flanks of the thread at a number of counter positioned points. Beyond this point the gage shall not be forced by applying a torque sensibly greater than that already applied to obtain the drag fit.

This definition applies only to the use of "not go" plug and ring thread gages. This requirement is to preclude any possibility of accepting internal threads that are oversize for more that three threads or accepting external threads that are undersize, at the entering end, for more than three threads. The requirements of extreme applications such as exceptionally thin or ductile material, small number of threads, etc., may necessitate modification of this practice.

An approved "not go" thread gage is one of nominal size at the minimum metal product limit with tolerance inside this limit, as shown in tables 9 and 10. In case the product is so close to the minimum metal limit that its acceptability is doubtful, a "not go" inspection gage which is at, rather than within, this limit may be used. See paragraph 3, page 42. Furthermore, the purchaser can elect to use an inspection "not go" gage with tolerance outside the minimum metal product limit. See par. 6, page 31.

There is a broad, general principle in regard to limit gages which should be kept in mind; a maximum-metal limit or "go" gage should check simultaneously as many elements as possible, a minimum-metal limit gage, to be effective, can check but one element. By "effective inspection" is meant assurance that specified requirements in regard to size are not exceeded. A minimum-metal limit or "not go" thread gage made to check the pitch diameter is usually sufficient for practical purposes. The minimum-metal limit gage is made to approximate a gage for checking pitch diameter only, by reducing both the length of the thread flank and the length of thread. It is necessary that the crest of the thread be removed so that the major diameter of the plug gage shall be less than that specified for the "go" plug gage and the minor diameter of the ring gage shall be greater than that specified for the "go" ring gage. A correspondingly greater width of relief should be provided at the root of the thread of the "not go" gage than of the "go" gage.

The truncation of the major diameter of the thread of the "not go" thread-plug gage shall be such that the width of flat will be approximately equal to $p/4$, and the truncation of the minor diameter of the thread ot the "not go" thread-ring gage shall be such that the width of flat will be $3p/8$. (See "thread form of thread plug and ring gages," p. 32, H28 (1944). On account of manufacturing conditions incidental to the production of general purpose nuts, it may be necessary, upon agreement between the manufacturer and the user, to modify this practice.

Page 30, 2d col., par. 5 (b), lines 5 to 11, change two sentences to read:

"Threaded setting plugs are of two standard designs, which are designated as "basic-form setting plugs" and "truncated setting plugs."

"The basic-form setting plug is one having a width of flat at the crest equal to $p/8$."

Page 31, 1st col., line 9, insert after "determined": "In setting the ring gage, extreme care should be taken to prevent damage to the crest of the full portion of the setting plug."

Pages 31 to 34, "1. Gage Tolerances", revise to read as follows:

1. Gage Tolerances.—Screw-thread gages for classes 1, 2, 3, and 5 are classified according to accuracy as W, X, and Y, the W gages being the most accurate. The tolerance limits on W and X gages coincide with the extreme product limits. The tolerance limits on Y "go" gages are placed inside of the extreme product limits to provide allowance for wear of the gages. The tolerances on all minimum-metal limit or "not go" gages, however, are applied from the extreme product limit. The selection of gages from among these designations for use in the inspection of threaded product depends entirely upon the specifications for the product. See "recommended gage practice," p. 41, H28 (1944).

Page 32, 2d col., par. 2 (a), lines 9 through 17, change to read:

"A relief shall be provided at the root of the 'go' thread plug or ring gage, the maximum width of which is one-eighth of the pitch. This relief may be an extension of the sides of the thread from the position corresponding to this maximum width toward a sharp V. The 'go' thread ring gage shall clear the maximum major diameter of the screw, and the 'go' thread plug gage shall clear the minimum minor diameter of the nut."

Page 32, 2d col., par. 2 (b), change to read:

"(b) '*Not go' thread gages*.—(1) The maximum major diameter of the 'not go' thread plug gage shall be equal to the maximum pitch diameter of the nut plus $2h/3$. This corresponds to a width of flat at the crest of the gage equal to one-fourth of the pitch. However, the maximum major diameter of the thread plug gage shall not exceed[9] the minimum major diameter of the nut minus $0.05h$.

"(2) The minimum minor diameter of the 'not go' thread ring gage shall be equal to the minimum pitch diameter of the screw minus $h/3$. This corresponds to a width of flat at the crest of the gage equal to three-eighths of the pitch. However, the minimum minor diameter of the thread ring gage shall not be less than the minimum minor diameter of the nut plus $0.05h$. This requirement is necessary to insure that the minor diameter of the 'not go' thread ring gage is not less than the minor diameter of the 'go' ring gage, which can occur with a three-eighths pitch flat on the 'not go' thread ring crest when there is a pitch diameter allowance on the screw combined with a large pitch diameter tolerance.[9]

(3) A relief shall be provided at the root of the "not go" thread plug or thread ring gage, the width of which is approximately one-fourth of the pitch. In small diameters and fine pitches, this relief may be an extension of the sides of the thread from the position corresponding to this approximate width toward a sharp V. Thus, contact of the thread gage can occur on the sides of the threads, but not on the crest or root. Also the effect of angle error on the fit of the gage with the product is minimized. The "not go" thread ring gage shall clear the maximum major diameter of the screw, and the "not go" thread plug gage shall clear the minimum minor diameter of the nut. The above requirements are illustrated in figure 20.

3. Thread Form of Setting Plug Gages.—The specifications for thread form of setting plug gages are stated in detail below, and are summarized in table 8 and figures 21 and 21A.

(a) *Truncated or basic-form maximum-metal limit thread setting plugs*.—(1) The major diameter of the basic-form setting plug, and of the full portion of the truncated maximum-metal limit thread setting plug corresponds to basic American National form (one-eighth pitch flat) with a plus gage tolerance.

(2) The major diameter of the truncated portion of the truncated maximum-metal limit setting plug is the same as the minimum major diameter of the screw with a minus gage tolerance.

(3) A relief shall be provided at the root of the maximum-metal limit thread setting plug gage, the maximum width of which is one-fourth of the pitch. This relief may be an extension of the sides of the thread from the position corresponding to this maximum width toward a sharp V.

(b) *Truncated minimum-metal limit thread setting plugs*.—(1) The major diameter of the full portion of the minimum-metal limit thread setting plug shall be the same as that of the maximum-metal limit thread setting plug of the same nominal size and having American National form, with the tolerance taken plus, but with the following

[9] This condition occurs in connection with small sizes of class 1 coarse and fine series threads and may occur for extreme combinations of large diameter and fine pitch of class 1 threads of special diameters, pitches, and lengths of engagement.

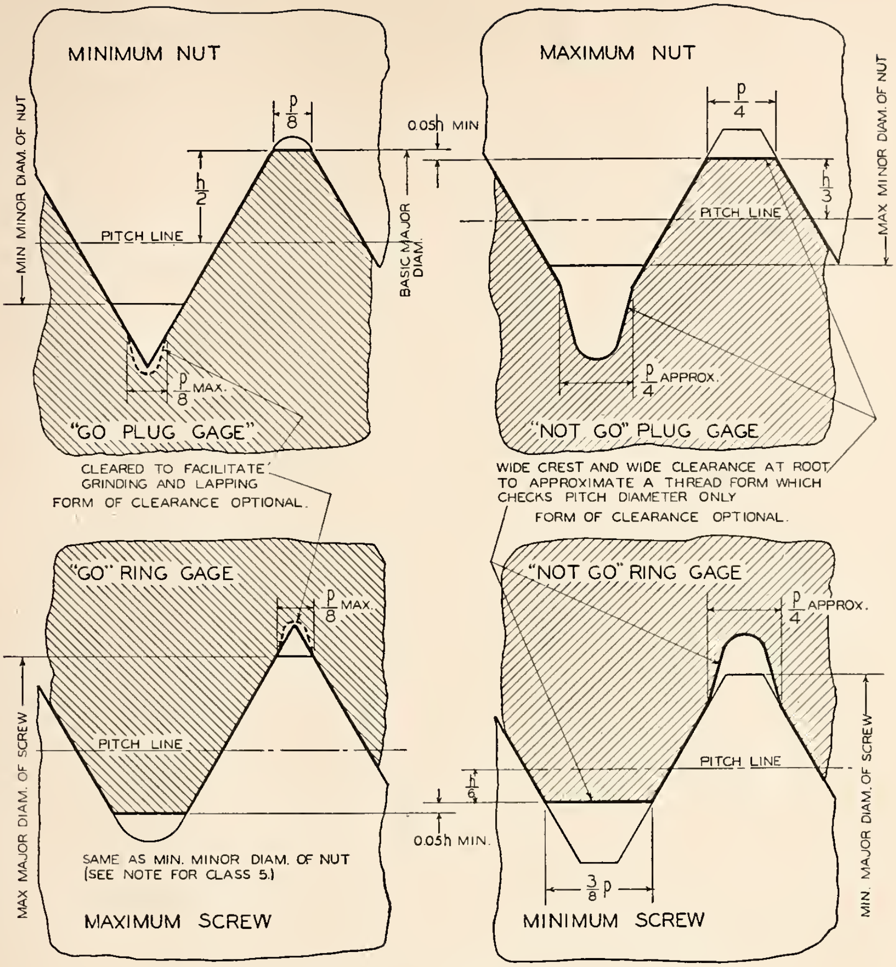


FIGURE 20.—*Thread form of thread plug and ring gages.*

NOTE.—For alternate class 5 the minor diameter of the "go" ring gage is larger than that for the other classes by the amount of the allowance.

exceptions: In no case shall the width of flat at the crest be less than 0.001 inch. This exception represents the maximum practicable sharpness of the crest of the setting plug thread.

When this exception applies, the thread root of a "not go" thread ring set to fit the plug may not clear the maximum major diameter of the screw. Therefore, the ring gage should be made with, and optically inspected for, ample depth of root clearance. (For revised major diameters, see table A, p. 16.)

(2) The truncation at the major diameter of the truncated portion of the minimum-metal limit thread setting plug shall be one-sixth of the basic thread depth from full American National form. Thus, the major diameter is equal to the pitch diameter of the gage plus two-thirds of the basic thread depth, with the tolerance taken minus.

(3) A relief shall be provided at the root of the minimum-metal limit thread setting plug gage, the width of which is approximately one-fourth of the pitch. This relief may be an extension of the sides of the thread from the position corresponding to this approximate width toward a sharp V.

(c) *Basic-form minimum-metal limit thread setting plugs.*—(1) The major diameter of the basic-form minimum-metal limit thread setting plug shall be such that the minimum width of flat at crest equals $p/8$; that is, the maximum major diameter equals the minimum pitch diameter plus the basic thread depth, h.

(2) A relief shall be provided at the root of the minimum-metal limit thread setting plug gage, the width of which shall be approximately one-fourth of the pitch. This relief may be an extension of the sides of the thread from the position corresponding to this approximate width toward a sharp V.

Pages 35 and 36, table 8, revise as herein.

Page 37, table 9, add to footnote 3 the following: The cumulative tolerance applies plus from the minimum pitch diameter limit of thread plug

788794—49——2

TABLE 8. *Specifications for thread form, major, pitch, and minor diameters, and direction of gage tolerances of gages for American National form, and straight pipe thread form of thread* [1]

Type of gage	Major diameter			Pitch diameter			Minor diameter		
	Dimension D_g	Direction of tolerance	Width of relief [2 3]	Dimension E_g	Direction of tolerance: Standard	Direction of tolerance: Optional (see par. 6, p. 31)	Dimension K_g	Direction of tolerance	Width of relief [2 3]
1	2	3	4	5	6	7	8	9	10
MAXIMUM-METAL LIMIT OR "GO" GAGES									
Thread plug, all threads	Min D_n	+		Min E_n	+				p/8 max.
Thread ring:									
Classes 1, 2, 3			p/8 max	Max E_s	−		[6] Min K_n	−	
Class 5			p/8 max	Max E_s	−		Max $E_s-2h/3$	−	
Basic form setting plug, all threads	Max E_s+h	+		Max E_s	−				p/4 max.
Truncated setting plug, all threads:									
Full portion	Max E_s+h	+		Max E_s	−				p/4 max.
Truncated portion	Min D_s	−		Max E_s	−				p/4 max.
Plain snap gage, all threads	Max D_s	−							
Plain plug gage, all threads							Min K_n	+	
Plain check plug gages for thread ring gage: [4]									
"Go"							Min K_g	+	
"Not go"							Max K_g	−	
MINIMUM-METAL LIMIT OR "NOT GO" GAGES									
Thread plug	Max $E_n+2h/3$, hut not to exceed min $D_n-0.05h$.			Max E_n	−	+			p/4 approx.
Thread ring			p/4 approx	Min E_s	+	−	[6] Min $E_s-h/3$, hut not less than min $K_n+0.05h$.	+	
Basic form setting plug, all threads	Min E_s+h	−		Min E_s	+	−			p/4 approx.
Truncated setting plug, all threads:									
Full portion	[5] Max E_s+h	+		Min E_s	+	−			p/4 approx.
Truncated portion	Min $E_s+2h/3$	−		Min E_s	+	−			p/4 approx.
Plain snap gage, all threads	Min D_s	+							
Plain plug[4] gage, all threads							Max K_n		
Plain check plug gages for thread ring gage:									
"Go"							Min K_g	+	
"Not go"							Max K_g	−	

[1] The symhols used in this table are as follows:

h=hasic depth of thread $\begin{cases} =0.649519p \text{ for American National form.} \\ =0.666025p \text{ for straight pipe thread form, except Dryseal.} \end{cases}$ (See tahle 72, col. 3, p. 136, H28(1944).

p=pitch. E_n=pitch diameter of nut.
D_g=major diameter of gage. E_s=pitch diameter of screw.
D_n=major diameter of nut. K_g=minor diameter of thread ring gage.
D_s=major diameter of screw. K_n=minor diameter of nut.
E_g=pitch diameter of gage. H=depth of sharp-V thread.

[2] The thread ring gages shall clear the maximum major diameter of the screw. The thread plug gages shall clear the minimum minor diameter of the nut.

[3] The width of relief on maximum-metal limit or "go" gages for straight pipe threads is p/9, and on minimum-metal limit or "not go" gages is p/4.

[4] For the minor diameter of adjustable thread ring gages, "go" and "not go" plain cylindrical check plug gages made to XX tolerances are required for sizes ½ in. and less, and are desirahle for larger sizes. See tahle 12.

[5] The width of flat crest shall not he less than 0.001 in.; that is, Max E_s+h shall not exceed Min $E_s+H-0.0017$ in. See par. 3(h) herein.

[6] For straight pipe thread ring gages, K_g=Max E_s-h for the maximum-metal limit or "go" gage, and K_g=Min $E_s-2h/3$ for the minimum-metal limit or "not go" gage.

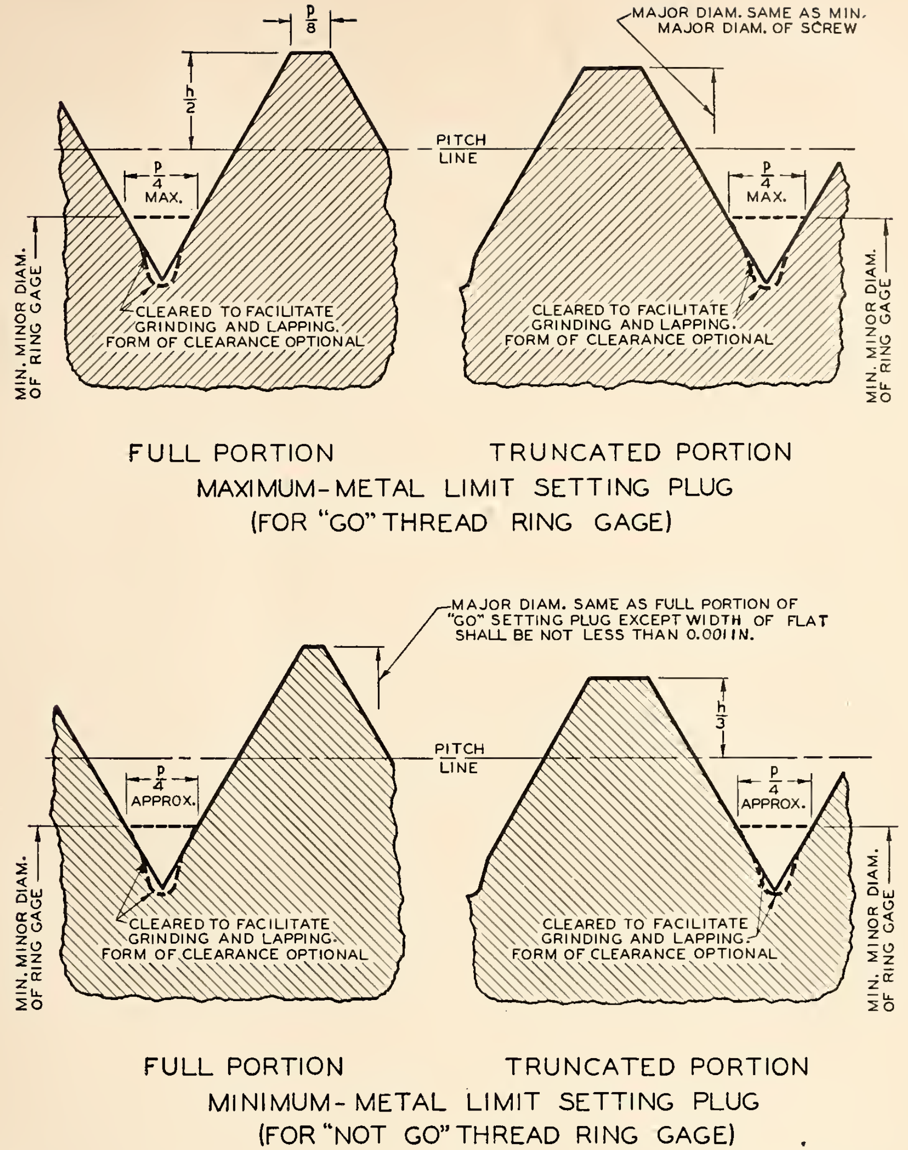


FIGURE 21.—*Thread form of maximum-metal and minimum-metal limit thread setting plug gages.*

gages and minus from the maximum pitch diameter limit of thread ring gages. The diameter equivalents of lead and angle errors are determined by applying formulas given on pages 222 and 223, H28 (1944).

Page 42, first col., par. beginning "Gaging of," line 7, after "sizes" insert: "to reduce failure by shear when torque is applied,".

SECTION IV. AMERICAN NATIONAL THREAD SERIES

The following are corrections and revisions of this section:

Page 47, table 16, delete class 4.

Page 49, table 17, change "class 5 fit" to "alternate class 5 fit."

Pages 50 and 51, table 18. Revise as shown herein.

Page 54, table 19, delete class 4.

Page 55, table 20, delete class 4.

Page 56, table 21, column headed "1¼" change "1.1623" to "1.1023." Under "NOT GO THREAD GAGES FOR SCREWS," first line, delete "full-form setting plug and." (The major diameters for basic-form minimum-metal limit setting plugs should correspond to a p/8 width of flat.) Change "class 5 fit" to "alternate class 5 fit."

Page 57, table 22, change "class 5 fit" to "alternate class 5 fit."

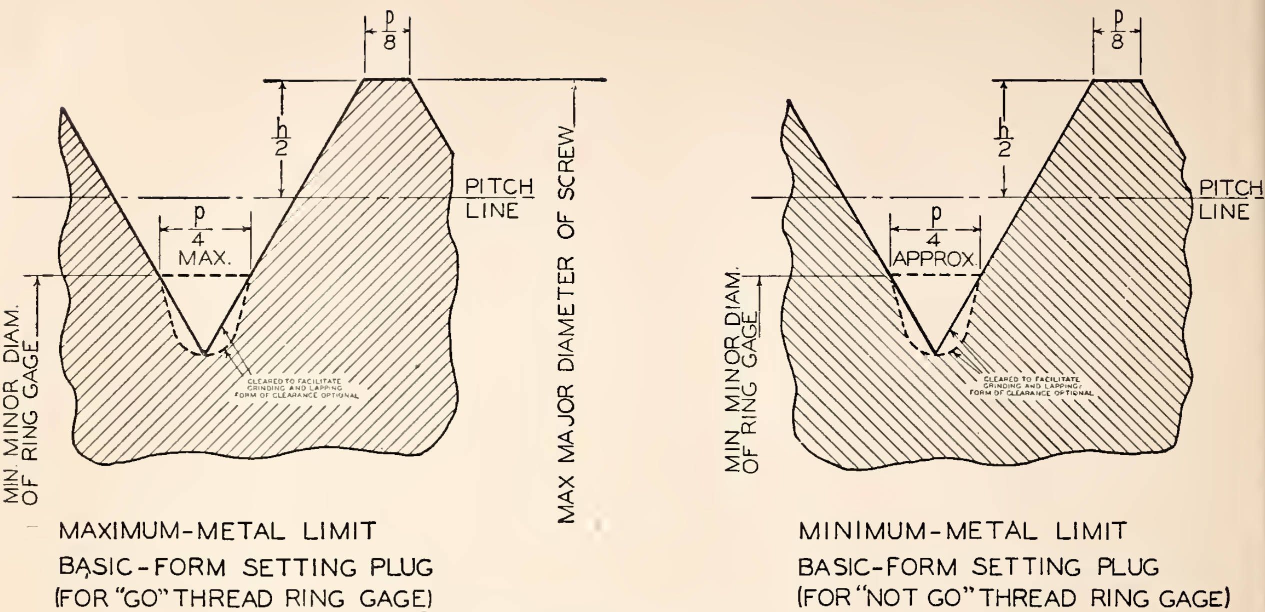


FIGURE 21A.—*Thread form of basic-form thread setting plug gages.*

Page 60, table 24, delete class 4.

Page 62, table 25, change "class 5 fit" to "alternate class 5 fit."

Pages 63 and 64, table 26. Revise as shown herein.

Page 65, table 27, delete class 4. Change major diameter limits of class 1 minimum-metal limit, "not go", plug gage for size 0-80 from ".0597" and ".0594" to "0.0596" and ".0593".

Page 67, table 28, delete class 4.

Page 68, table 29. Change "class 5 fit" to "alternate class 5 fit". Under "NOT GO THREAD GAGES FOR SCREWS," first line, delete "full-form setting plug, and". (See reference above to p. 56.)

Page 69, table 30, change "class 5 fit" to "alternate class 5 fit."

Page 70, table 31, revise as herein. Certain drills outside of product limits have been eliminated or set in italics.

Page 71, table 32, column headed "1$\frac{1}{16}$", change "1.0216" to "1.0213"; change ".0048" to ".0051" in two places; and change "1.0312" to "1.0315".

Page 72, table 33, change the limits for the major diameter of the full portion of the minimum-metal limit, "not go", setting plugs for the first three sizes to read as follows: (See footnote 1, revised table 18):

Size	¼"	$\frac{5}{16}$"	⅜"
Min	.2492	.3118	.3742
Max	.2497	.3123	.3747

In column head "⅜", change ".2653" to ".3653". Add limits for major diameter of minimum-metal limit basic-form setting plugs as given in table A, p. 16, herein.

Page 73, table 33, column headed "1$\frac{1}{16}$", change "1.0216" to "1.0213" in two places; change "1.0219" to "1.0216"; and change "1.0213" to "1.0210."

Page 75, table 34, column headed "1$\frac{1}{16}$", change "1.0312" to "1.0315" in two places; change "1.0309" to "1.0312"; and change "1.0315" to "1.0318".

Page 80, table 38, add limits for major diameters of minimum-metal limit basic-form setting plugs as given in table A. p. 16, herein.

Page 83, table 40, column 3, change "4.44985" to "4.49985."

Page 88, table 43, add limits for major diameters of minimum-metal limit basic-form setting plugs as given in table A, p. 16, herein.

Page 92, table 44, in col. headed "3¼" change "3.1951" to "3.1961."

Page 93, table 45, column 3, change "4.74980" to "4.74981".

Pages 95 to 97, table 47, change side headings "Major diameter" to "Classes 2 and 3, major diameter;" and "Minor diameter" to "Classes 2 and 3, minor diameter."

Page 96, table 47, column headed "1$\frac{3}{16}$", change heading to "1$\frac{13}{16}$".

Page 98, table 48, add limits for major diameters of minimum-metal limit basic-form setting plugs as given in table A, p. 16, herein.

Page 103, table 50, column 1, change first "2½" to "2¼".

TABLE 17A.—*Limits of size of tentative class 5 fit, American National coarse-thread series, steel studs set in hard materials (cast iron, semisteel, bronze, etc.)*

Sizes	Threads per inch	Stud sizes					Tapped-hole sizes					Recommended tap drill size		Approximate torque at full engagement of 1½*D*	
		Major diameter		Pitch diameter		Minor diameter	Minor diameter		Pitch diameter		Major diameter				
		Maximum	Minimum	Maximum	Minimum	Maximum [1]	Minimum	Maximum	Minimum	Maximum	Minimum [2]	Nominal size	Diameter	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*In.-lb.*	*In.-lb.*
¼ [3]	20	0.2500	0.2428	0.2193	0.2186	0.1904	0.2049	0.2103	0.2175	0.2183	0.2500	0.2090	0.2090	105	35
5/16	18	.3125	.3043	.2804	.2784	.2483	.2622	.2682	.2764	.2779	.3125	.2656	.2656	265	80
⅜	16	.3750	.3660	.3389	.3365	.3028	.3186	.3254	.3344	.3360	.3750	.3230	.3230	420	120
7/16	14	.4375	.4277	.3961	.3935	.3549	.3736	.3813	.3911	.3929	.4375	.3750	.3750	610	180
½	13	.5000	.4896	.4555	.4526	.4111	.4313	.4396	.4500	.4519	.5000	.4375	.4375	850	265
9/16	12	.5625	.5513	.5144	.5112	.4663	.4882	.4972	.5084	.5104	.5625	12.5 mm	.4921	1,170	360
⅝	11	.6250	.6132	.5720	.5689	.5195	.5444	.5542	.5660	.5681	.6250	35/64	.5469	1,450	450
¾	10	.7500	.7372	.6915	.6882	.6338	.6614	.6722	.6850	.6873	.7500	43/64	.6719	2,300	730
⅞	9	.8750	.8610	.8093	.8062	.7452	.7768	.7888	.8028	.8052	.8750	25/32	.7812	3,200	1,080
1	8	1.0000	.9848	.9253	.9226	.8531	.8901	.9036	.9188	.9215	1.0000	57/64	.8906	4,250	1,500
1⅛	7	1.1250	1.1080	1.0387	1.0363	.9562	.9998	1.0152	1.0322	1.0352	1.1250	1	1.0000	5,300	1,875
1¼	7	1.2500	1.2330	1.1637	1 1614	1.0812	1.1248	1.1402	1.1572	1.1602	1.2500	1⅛	1.1250	6,950	2,535
1⅜	6	1.3750	1.3548	1.2732	1.2715	1.1770	1.2286	1.2466	1.2667	1.2703	1.3750	1 15/64	1.2344	8,150	2,970
1½	6	1.5000	1.4798	1.3987	1.3966	1.3025	1.3536	1.3716	1.3917	1.3953	1.5000	1 23/64	1.3594	10,400	3,900

1 Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h, (or $0.6495p$) from the minimum pitch diameter of the screw.

2 Dimensions for the minimum major diameter of the tapped hole correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the tapped hole shall be that corresponding to a flat at the major diameter of the tapped hole equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{9} \times h$ (or $0.7939p$) to the maximum pitch diameter of the nut.

3 Selective assembly in the case of the ¼-inch size may be required on account of the small tolerances necessary on pitch diameter. To avoid breaking a mild steel stud, the maximum interference on pitch diameter of 0.0018 inch must not be exceeded. The use of ¼″–28, instead of ¼″–20, is recommended.

TABLE 18. *Limits of size of setting plug and thread ring gages for screws of classes 1, 2, and 3 fits, American National coarse-thread series*

Limits of size		Size (inches)										
		1	2	3	4	5	6	8	10	12	¼	5/16
		Threads per inch										
		64	56	48	40	40	32	32	24	24	20	18
MAXIMUM-METAL LIMIT OR "GO" GAGES FOR SCREWS												
Major diameter of basic-form setting plug, and full portion of truncated setting plug:		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Class 1	Max	0.0727	0.0856	0.0985	0.1114	0.1244	0.1374	0.1634	0.1892	0.2152	0.2490	0.3114
	Min	.0723	.0852	.0981	.1110	.1240	.1369	.1629	.1887	.2147	.2485	.3109
Classes 2 and 3	Max	.0734	.0864	.0994	.1124	.1254	.1385	.1645	.1905	.2165	.2505	.3130
	Min	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
Major diameter of truncated portion of truncated setting plug:												
Class 1	Max	.0671	.0796	.0919	.1042	.1172	.1293	.1553	.1795	.2055	.2383	.2995
	Min	.0667	.0792	.0915	.1038	.1168	.1288	.1548	.1790	.2050	.2378	.2990
Classes 2 and 3	Max	.0692	.0820	.0946	.1072	.1202	.1326	.1586	.1834	.2094	.2428	.3043
	Min	.0688	.0816	.0942	.1068	.1198	.1321	.1581	.1829	.2089	.2423	.3038
Pitch diameter of setting plug or ring gage:												
Class 1	Max. Y	------	------	------	------	------	------	------	------	------	.2158	.2746
	Min. Y	------	------	------	------	------	------	------	------	------	.2155	.2743
	Max. X	.0622	.0736	.0846	.0948	.1078	.1166	.1426	.1616	.1876	.2160	.2748
	Min. X	.0620	.0734	.0844	.0946	.1076	.1163	.1423	.1613	.1873	.2157	.2745
Classes 2 and 3	Max. Y	------	------	------	------	------	------	------	------	------	.2173	.2762
	Min. Y	------	------	------	------	------	------	------	------	------	.2170	.2759
	Max. X	.0629	.0744	.0855	.0958	.1088	.1177	.1437	.1629	.1889	.2175	.2764
	Min. X	.0627	.0742	.0853	.0956	.1086	.1174	.1434	.1626	.1886	.2172	.2761
Minor diameter of ring gage:												
Classes 1, 2, and 3	Max	.0561	.0667	.0764	.0849	.0979	.1042	.1302	.1449	.1709	.1959	.2524
	Min	.0557	.0663	.0760	.0845	.0975	.1037	.1297	.1444	.1704	.1954	.2519
MINIMUM-METAL LIMIT OR "NOT GO" GAGES FOR SCREWS												
Major diameter of full portion of truncated setting plug:												
Class 1	Min	.0710	.0841	.0974	.1109	.1239	.1369	.1629	.1887	.2147	.2485	.3109
	Max	[1] .0714	[1] .0845	[1] .0978	[1] .1113	[1] .1243	.1374	.1634	.1892	.2152	.2490	.3114
Class 2	Min	.0724	.0857	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
	Max	[1] .0728	[1] .0861	.0994	.1124	.1254	.1385	.1645	.1905	.2165	.2505	.3130
Class 3	Min	.0729	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
	Max	[1] .0733	.0864	.0994	.1124	.1254	.1385	.1645	.1905	.2165	.2505	.3130
Major diameter of truncated portion of truncated setting plug:												
Class 1	Min	.0660	.0781	.0901	.1018	.1148	.1258	.1518	.1745	.2005	.2321	.2927
	Max	.0664	.0785	.0905	.1022	.1152	.1263	.1523	.1750	.2010	.2326	.2932
Class 2	Min	.0674	.0797	.0919	.1038	.1168	.1280	.1540	.1771	.2031	.2351	.2959
	Max	.0678	.0801	.0923	.1042	.1172	.1285	.1545	.1776	.2036	.2356	.2964
Class 3	Min	.0679	.0802	.0925	.1045	.1175	.1288	.1548	.1780	.2040	.2361	.2970
	Max	.0683	.0806	.0929	.1049	.1179	.1293	.1553	.1785	.2045	.2366	.2975
Major diameter of basic-form setting plug:												
Class 1	Min	.0693	.0820	.0946	.1072	.1202	.1326	.1586	.1836	.2096	.2429	.3047
	Max	.0697	.0824	.0950	.1076	.1206	.1331	.1591	.1841	.2101	.2434	.3052
Class 2	Min	.0707	.0836	.0964	.1092	.1222	.1348	.1608	.1862	.2122	.2459	.3079
	Max	.0711	.0840	.0968	.1096	.1226	.1353	.1613	.1867	.2127	.2464	.3084
Class 3	Min	.0712	.0841	.0970	.1099	.1229	.1356	.1616	.1871	.2131	.2469	.3090
	Max	.0716	.0845	.0974	.1103	.1233	.1361	.1621	.1876	.2136	.2474	.3095
Pitch diameter of setting plug or ring gages for production and inspection:												
Class 1	Min	.0596	.0708	.0815	.0914	.1044	.1128	.1388	.1570	.1830	.2109	.2691
	Max	.0598	.0710	.0817	.0916	.1046	.1131	.1391	.1573	.1833	.2112	.2694
Class 2	Min	.0610	.0724	.0833	.0934	.1064	.1150	.1410	.1596	.1856	.2139	.2723
	Max	.0612	.0726	.0835	.0936	.1066	.1153	.1413	.1599	.1859	.2142	.2726
Class 3	Min	.0615	.0729	.0839	.0941	.1071	.1158	.1418	.1605	.1865	.2149	.2734
	Max	.0617	.0731	.0841	.0943	.1073	.1161	.1421	.1608	.1868	.2152	.2737
(OPTIONAL)												
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31):												
Class 1	Min	.0594	.0706	.0813	.0912	.1042	.1125	.1385	.1567	.1827	.2106	.2688
	Max	.0596	.0708	.0815	.0914	.1044	.1128	.1388	.1570	.1830	.2109	.2691
Class 2	Min	.0608	.0722	.0831	.0932	.1062	.1147	.1407	.1593	.1853	.2136	.2720
	Max	.0610	.0724	.0833	.0934	.1064	.1150	.1410	.1596	.1856	.2139	.2723
Class 3	Min	.0613	.0727	.0837	.0939	.1069	.1155	.1415	.1602	.1862	.2146	.2731
	Max	.0615	.0729	.0839	.0941	.1071	.1158	.1418	.1605	.1865	.2149	.2734
Minor diameter of ring gage:												
Class 1	Min	.0566	.0673	.0771	.0860	.0990	.1060	.1320	.1480	.1740	.2001	.2571
	Max	.0570	.0677	.0775	.0864	.0994	.1065	.1325	.1485	.1745	.2006	.2576
Class 2	Min	.0576	.0685	.0788	.0880	.1010	.1082	.1342	.1506	.1766	.2031	.2603
	Max	.0580	.0689	.0792	.0884	.1014	.1087	.1347	.1511	.1771	.2036	.2608
Class 3	Min	.0581	.0690	.0794	.0887	.1017	.1090	.1350	.1515	.1775	.2041	.2614
	Max	.0585	.0694	.0798	.0891	.1021	.1095	.1355	.1520	.1780	.2046	.2619

[1] See footnote at end of table.

TABLE 18. *Limits of size of setting plug and thread ring gages for screws of classes 1, 2, and 3 fits, American National coarse-thread series*—Continued

Limits of size	Size (inches) 3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
Threads per inch	16	14	13	12	11	10	9	8	7	7	6
MAXIMUM-METAL LIMIT OR "GO" GAGES FOR SCREWS											
Major diameter of basic-form setting plug, and full portion of truncated setting plug:	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*
Class 1, Max	0.3738	0.4360	0.4984	0.5607	0.6230	0.7478	0.8726	0.9973	1.1218	1.2468	1.3714
Class 1, Min	.3732	.4354	.4978	.5601	.6224	.7472	.8719	.9966	1.1211	1.2461	1.3706
Classes 2 and 3, Max	.3756	.4381	.5006	.5631	.6256	.7506	.8757	1.0007	1.1257	1.2507	1.3758
Classes 2 and 3, Min	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750
Major diameter of truncated portion of truncated setting plug:											
Class 1, Max	.3606	.4214	.4830	.5443	.6054	.7288	.8519	.9744	1.0963	1.2213	1.3416
Class 1, Min	.3600	.4208	.4824	.5437	.6048	.7282	.8512	.9737	1.0956	1.2206	1.3408
Classes 2 and 3, Max	.3660	.4277	.4896	.5513	.6132	.7372	.8610	.9848	1.1080	1.2330	1.3548
Classes 2 and 3, Min	.3654	.4271	.4890	.5507	.6126	.7366	.8603	.9841	1.1073	1.2323	1.3540
Pitch diameter of setting plug or ring gage:											
Class 1, Max. Y	.3324	.3888	.4476	.5058	.5632	.6820	.7995	.9152	1.0281	1.1531	1.2620
Class 1, Min. Y	.3320	.3884	.4472	.5054	.5628	.6816	.7990	.9147	1.0276	1.1526	1.2615
Class 1, Max. X	.3326	.3890	.4478	.5060	.5634	.6822	.7997	.9154	1.0283	1.1533	1.2623
Class 1, Min. X	.3323	.3887	.4475	.5057	.5631	.6819	.7994	.9150	1.0279	1.1529	1.2619
Classes 2 and 3, Max. Y	.3342	.3909	.4498	.5082	.5658	.6848	.8026	.9186	1.0320	1.1570	1.2664
Classes 2 and 3, Min. Y	.3338	.3905	.4494	.5078	.5654	.6844	.8021	.9181	1.0315	1.1565	1.2659
Classes 2 and 3, Max. X	.3344	.3911	.4500	.5084	.5660	.6850	.8028	.9188	1.0322	1.1572	1.2667
Classes 2 and 3, Min. X	.3341	.3908	.4497	.5081	.5657	.6847	.8025	.9184	1.0318	1.1568	1.2663
Minor diameter of ring gage:											
Classes 1, 2, 3, and 4, Max	.3073	.3602	.4167	.4723	.5266	.6417	.7547	.8647	.9704	1.0954	1.1946
Classes 1, 2, 3, and 4, Min	.3067	.3596	.4161	.4717	.5260	.6411	.7540	.8640	.9697	1.0947	1.1938
MIMINUM-METAL LIMIT OR "NOT GO"[1] GAGES FOR SCREWS											
Major diameter of full portion of truncated setting plug:											
Class 1, Min	.3732	.4354	.4978	.5601	.6224	.7472	.8719	.9966	1.1211	1.2461	1.3706
Class 1, Max	.3738	.4360	.4984	.5607	.6230	.7478	.8726	.9973	1.1218	1.2468	1.3714
Classes 2 and 3, Min	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750
Classes 2 and 3, Max	.3756	.4381	.5006	.5631	.6256	.7506	.8757	1.0007	1.1257	1.2507	1.3758
Major diameter of truncated portion of truncated setting plug:											
Class 1, Min	.3528	.4123	.4731	.5336	.5937	.7157	.8371	.9577	1.0771	1.2021	1.3192
Class 1, Max	.3534	.4129	.4737	.5342	.5943	.7163	.8378	.9584	1.0778	1.2028	1.3200
Class 2, Min	.3564	.4165	.4775	.5383	.5989	.7213	.8432	.9646	1.0849	1.2099	1.3280
Class 2, Max	.3570	.4171	.4781	.5389	.5995	.7219	.8439	.9653	1.0856	1.2106	1.3288
Class 3, Min	.3577	.4178	.4790	.5399	.6006	.7232	.8453	.9668	1.0875	1.2125	1.3310
Class 3, Max	.3583	.4184	.4796	.5405	.6012	.7238	.8460	.9675	1.0882	1.2132	1.3318
Major diameter of basic-form setting plug:											
Class 1, Min	.3663	.4278	.4898	.5516	.6133	.7374	.8612	.9848	1.1080	1.2330	1.3553
Class 1, Max	.3669	.4284	.4904	.5522	.6139	.7380	.8619	.9855	1.1087	1.2337	1.3561
Class 2, Min	.3699	.4320	.4942	.5563	.6185	.7430	.8673	.9917	1.1158	1.2408	1.3641
Class 2, Max	.3705	.4326	.4948	.5569	.6191	.7436	.8680	.9924	1.1165	1.2415	1.3649
Class 3, Min	.3712	.4333	.4957	.5579	.6202	.7449	.8694	.9939	1.1184	1.2434	1.3671
Class 3, Max	.3718	.4339	.4963	.5585	.6208	.7455	.8701	.9946	1.1191	1.2441	1.3679
Pitch diameter of setting plug or ring gages for production and inspection:											
Class 1, Min	.3263	.3820	.4404	.4981	.5549	.6730	.7897	.9043	1.0159	1.1409	1.2478
Class 1, Max	.3266	.3823	.4407	.4984	.5552	.6733	.7900	.9047	1.0163	1.1413	1.2482
Class 2, Min	.3299	.3862	.4448	.5028	.5601	.6786	.7958	.9112	1.0237	1.1487	1.2566
Class 2, Max	.3302	.3865	.4451	.5031	.5604	.6789	.7961	.9116	1.0241	1.1491	1.2570
Class 3, Min	.3312	.3875	.4463	.5044	.5618	.6805	.7979	.9134	1.0263	1.1513	1.2596
Class 3, Max	.3315	.3878	.4466	.5047	.5621	.6808	.7982	.9138	1.0267	1.1517	1.2600
(OPTIONAL)											
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31):											
Class 1, Min	.3260	.3817	.4401	.4978	.5546	.6727	.7894	.9039	1.0155	1.1405	1.2474
Class 1, Max	.3263	.3820	.4404	.4981	.5549	.6730	.7897	.9043	1.0159	1.1409	1.2478
Class 2, Min	.3296	.3859	.4445	.5025	.5598	.6783	.7955	.9108	1.0233	1.1483	1.2562
Class 2, Max	.3299	.3862	.4448	.5028	.5601	.6786	.7958	.9112	1.0237	1.1487	1.2566
Class 3, Min	.3309	.3872	.4460	.5041	.5615	.6802	.7976	.9130	1.0259	1.1509	1.2592
Class 3, Max	.3312	.3875	.4463	.5044	.5618	.6805	.7979	.9134	1.0263	1.1513	1.2596
Minor diameter of ring gage:											
Class 1, Min	.3128	.3665	.4238	.4801	.5352	.6514	.7656	.8772	.9850	1.1100	1.2117
Class 1, Max	.3134	.3671	.4244	.4807	.5358	.6520	.7663	.8779	.9857	1.1107	1.2125
Class 2, Min	.3164	.3707	.4282	.4848	.5404	.6570	.7717	.8841	.9928	1.1178	1.2205
Class 2, Max	.3170	.3713	.4288	.4854	.5410	.6576	.7724	.8848	.9935	1.1185	1.2213
Class 3, Min	.3177	.3720	.4297	.4864	.5421	.6589	.7738	.8863	.9954	1.1204	1.2235
Class 3, Max	.3183	.3726	.4303	.4870	.5427	.6595	.7745	.8870	.9961	1.1211	1.2243

[1] See footnote at end of table.

TABLE 18. *Limits of size of setting plug and thread ring gages for screws of classes 1, 2, and 3, fits, American National coarse-thread series*—Continued

Limits of size	Size (inches)										
	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
	Threads per inch										
	6	5	4½	4½	4	4	4	4	4	4	4
MAXIMUM METAL LIMIT OR "GO" GAGES FOR SCREWS											
Major diameter of basic form setting plug, and full portion of truncated setting plug:	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Class 1 — Max	1.4964	1.7456	1.9951	2.2451	2.4945	2.7445	2.9945	3.2445	3.4945	3.7445	3.9945
Class 1 — Min	1.4956	1.7448	1.9943	2.2443	2.4936	2.7436	2.9936	3.2436	3.4936	3.7436	3.9936
Classes 2 and 3 — Max	1.5008	1.7508	2.0008	2.2508	2.5009	2.7509	3.0009	3.2509	3.5009	3.7509	4.0009
Classes 2 and 3 — Min	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Major diameter of truncated portion of truncated setting plug:											
Class 1 — Max	1.4666	1.7110	1.9575	2.2075	2.4528	2.7028	2.9528	3.2028	3.4528	3.7028	3.9528
Class 1 — Min	1.4658	1.7102	1.9567	2.2067	2.4519	2.7019	2.9519	3.2019	3.4519	3.7019	3.9519
Classes 2 and 3 — Max	1.4798	1.7268	1.9746	2.2246	2.4720	2.7220	2.9720	3.2220	3.4720	3.7220	3.9720
Classes 2 and 3 — Min	1.4790	1.7260	1.9738	2.2238	2.4711	2.7211	2.9711	3.2211	3.4711	3.7211	3.9711
Pitch diameter of setting plug or ring gage:											
Class 1 — Max Y	1.3870	1.6146	1.8497	2.0997	2.3309	2.5809	2.8309	3.0809	3.3309	3.5809	3.8309
Class 1 — Min Y	1.3865	1.6139	1.8490	2.0990	2.3301	2.5801	2.8301	3.0801	3.3301	3.5801	3.8301
Class 1 — Max X	1.3873	1.6149	1.8500	2.1000	2.3312	2.5812	2.8312	3.0812	3.3312	3.5812	3.8312
Class 1 — Min X	1.3869	1.6144	1.8495	2.0995	2.3307	2.5807	2.8307	3.0807	3.3307	3.5807	3.8307
Classes 2 and 3 — Max Y	1.3914	1.6198	1.8554	2.1054	2.3373	2.5873	2.8373	3.0873	3.3373	3.5873	3.8373
Classes 2 and 3 — Min Y	1.3909	1.6191	1.8547	2.1047	2.3365	2.5865	2.8365	3.0865	3.3365	3.5865	3.8365
Classes 2 and 3 — Max X	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
Classes 2 and 3 — Min X	1.3913	1.6196	1.8552	2.1052	2.3371	2.5871	2.8371	3.0871	3.3371	3.5871	3.8371
Minor diameter of ring gage:											
Classes 1, 2, and 3 — Max	1.3196	1.5335	1.7594	2.0094	2.2294	2.4794	2.7294	2.9794	3.2294	3.4794	3.7294
Classes 1, 2, and 3 — Min	1.3188	1.5327	1.7586	2.0086	2.2285	2.4785	2.7285	2.9785	3.2285	3.4785	3.7285
MINIMUM METAL LIMIT OR "NOT GO" GAGES FOR SCREWS											
Major diameter of full portion of truncated setting plug:											
Class 1 — Min	1.4956	1.7448	1.9943	2.2443	2.4936	2.7436	2.9936	3.2436	3.4936	3.7436	3.9936
Class 1 — Max	1.4964	1.7456	1.9951	2.2451	2.4945	2.7445	2.9945	3.2445	3.4945	3.7445	3.9945
Classes 2 and 3 — Min	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Classes 2 and 3 — Max	1.5008	1.7508	2.0008	2.2508	2.5009	2.7509	3.0009	3.2509	3.5009	3.7509	4.0009
Major diameter of truncated portion of truncated setting plug:											
Class 1 — Min	1.4442	1.6838	1.9270	2.1770	2.4182	2.6682	2.9182	3.1682	3.4182	3.6682	3.9182
Class 1 — Max	1.4450	1.6846	1.9278	2.1778	2.4191	2.6691	2.9191	3.1691	3.4191	3.6691	3.9191
Class 2 — Min	1.4530	1.6943	1.9384	2.1884	2.4310	2.6810	2.9310	3.1810	3.4310	3.6810	3.9310
Class 2 — Max	1.4538	1.6951	1.9392	2.1892	2.4319	2.6819	2.9319	3.1819	3.4319	3.6819	3.9319
Class 3 — Min	1.4560	1.6977	1.9422	2.1922	2.4353	2.6853	2.9353	3.1853	3.4353	3.6853	3.9353
Class 3 — Max	1.4568	1.6985	1.9430	2.1930	2.4362	2.6862	2.9362	3.1862	3.4362	3.6862	3.9362
Major diameter of basic-form setting plug:											
Class 1 — Min	1.4803	1.7271	1.9751	2.2251	2.4723	2.7223	2.9723	3.2223	3.4723	3.7223	3.9723
Class 1 — Max	1.4811	1.7279	1.9759	2.2259	2.4732	2.7232	2.9732	3.2232	3.4732	3.7232	3.9732
Class 2 — Min	1.4891	1.7376	1.9865	2.2365	2.4851	2.7351	2.9851	3.2351	3.4851	3.7351	3.9851
Class 2 — Max	1.4899	1.7384	1.9873	2.2373	2.4860	2.7360	2.9860	3.2360	3.4860	3.7360	3.9860
Class 3 — Min	1.4921	1.7410	1.9903	2.2403	2.4894	2.7394	2.9894	3.2394	3.4894	3.7394	3.9894
Class 3 — Max	1.4929	1.7418	1.9911	2.2411	2.4903	2.7403	2.9903	3.2403	3.4903	3.7403	3.9903
Pitch diameter of setting plug or ring gages for production and inspection:											
Class 1 — Min	1.3728	1.5980	1.8316	2.0816	2.3108	2.5608	2.8108	3.0608	3.3108	3.5608	3.8108
Class 1 — Max	1.3732	1.5985	1.8321	2.0821	2.3113	2.5613	2.8113	3.0613	3.3113	3.5613	3.8113
Class 2 — Min	1.3816	1.6085	1.8430	2.0930	2.3236	2.5736	2.8236	3.0736	3.3236	3.5736	3.8236
Class 2 — Max	1.3820	1.6090	1.8435	2.0935	2.3241	2.5741	2.8241	3.0741	3.3241	3.5741	3.8241
Class 3 — Min	1.3846	1.6119	1.8468	2.0968	2.3279	2.5779	2.8279	3.0779	3.3279	3.5779	3.8279
Class 3 — Max	1.3850	1.6124	1.8473	2.0973	2.3284	2.5784	2.8284	3.0784	3.3284	3.5784	3.8284
(OPTIONAL)											
Pitch diameter of setting plug for ring gages for inspection. (See par. 6, p. 31.):											
Class 1 — Min	1.3724	1.5975	1.8311	2.0811	2.3103	2.5603	2.8103	3.0603	3.3103	3.5603	3.8103
Class 1 — Max	1.3728	1.5980	1.8316	2.0816	2.3108	2.5608	2.8108	3.0608	3.3108	3.5608	3.8108
Class 2 — Min	1.3812	1.6080	1.8425	2.0925	2.3231	2.5731	2.8231	3.0731	3.3231	3.5731	3.8231
Class 2 — Max	1.3816	1.6085	1.8430	2.0930	2.3236	2.5736	2.8236	3.0736	3.3236	3.5736	3.8236
Class 3 — Min	1.3842	1.6114	1.8463	2.0963	2.3274	2.5774	2.8274	3.0774	3.3274	3.5774	3.8274
Class 3 — Max	1.3846	1.6119	1.8468	2.0968	2.3279	2.5779	2.8279	3.0779	3.3279	3.5779	3.3279
Minor diameter of ring gage:											
Class 1 — Min	1.3367	1.5547	1.7835	2.0335	2.2567	2.5067	2.7567	3.0067	3.2567	3.5067	3.7567
Class 1 — Max	1.3375	1.5555	1.7843	2.0343	2.2576	2.5076	2.7576	3.0076	3.2576	3.5076	3.7576
Class 2 — Min	1.3455	1.5652	1.7949	2.0449	2.2695	2.5195	2.7695	3.0195	3.2695	3.5195	3.7695
Class 2 — Max	1.3463	1.5660	1.7957	2.0457	2.2704	2.5204	2.7704	3.0204	3.2704	3.5204	3.7704
Class 3 — Min	1.3485	1.5686	1.7987	3.0487	2.2738	2.5238	2.7738	3.0238	3.2738	3.5238	3.7738
Class 3 — Max	1.3493	1.5694	1.7995	2.0495	2.2747	2.5247	2.7747	3.0247	3.2747	3.5247	3.7747

[1] These major diameters represent the maximum practicable sharpness of crest of the setting plug, in accordance with par. 3 (b), p. 4.

TABLE 25A. *Limits of size of tentative class 5 fit, American National fine-thread series, steel studs set in hard materials (cast iron, semisteel, bronze, etc.)*

Sizes	Threads per inch	Stud sizes					Tapped-hole sizes					Recommended tap drill size		Approximate torque at full engagement of 1½D	
		Major diameter		Pitch diameter		Minor diameter	Minor diameter		Pitch diameter		Major diameter				
		Maximum	Minimum	Maximum	Minimum	Maximum [1]	Minimum	Maximum	Minimum	Maximum	Minimum [2]	Nominal size	Diameter	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*in.lb..*	*in.-lb.*
¼	28	0.2500	0.2438	0.2302	0.2284	0.2096	0.2167	0.2206	0.2268	0.2279	0.2500	0.2187	0.2187	140	45
5/16	24	.3125	.3059	.2891	.2871	.2650	.2743	.2788	.2854	.2866	.3125	.2770	.2770	230	70
⅜	24	.3750	.3684	.3528	.3497	.3282	.3368	.3413	.3479	.3491	.3750	.3390	.3390	410	125
7/16	20	.4375	.4303	.4094	.4069	.3805	.3924	.3978	.4050	.4063	.4375	.3970	.3970	540	170
½	20	.5000	.4928	.4725	.4695	.4436	.4549	.4603	.4675	.4688	.5000	--------	.4576	810	260
9/16	18	.5625	.5543	.5314	.5286	.4993	.5122	.5182	5264	.5279	.5625	33/64	.5156	1,040	330
⅝	18	.6250	.6168	.5944	.5912	.5623	.5747	.5807	.5889	.5904	.6250	37/64	.5781	1,430	460
¾	16	.7500	.7410	.7153	.7118	.6792	.6936	.7004	.7094	.7110	.7500	--------	.6970	2,200	685
⅞	14	.8750	.8652	.8347	.8312	.7935	.8111	.8188	.8286	.8304	.8750	13/16	.8125	3,070	945
1	14	1.0000	.9902	.9605	.9563	.9193	.9361	.9438	.9536	.9554	1.0000	15/16	.9375	4,590	1,410
1⅛	12	1.1250	1.1138	1.0776	1.0738	1.0295	1.0507	1.0597	1.0709	1.0729	1.1250	--------	1.0552	5,620	1,750
1¼	12	1.2500	1.2388	1.2019	1.1990	1.1538	1.1757	1.1847	1.1959	1.1979	1.2500	30.0 mm	1.1811	6,960	2,530
1⅜	12	1.3750	1.3638	1.1364	1.3240	1.2782	1.3007	1.3097	1.3209	1.3229	1.3750	--------	1.3052	8,440	3,225
1½	12	1.5000	1.4888	1.4509	1.4491	1.4028	1.4257	1.4347	1.4459	1.4479	1.5000	--------	1.4302	10,070	4,215

[1] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h, (or $0.6495p$) from the minimum pitch diameter of the screw.

[2] Dimensions for the minimum major diameter of the tapped hole correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the tapped hole shall be that corresponding to a flat at the major diameter of the tapped hole equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{3}{9} \times h$ (or $0.7939p$) to the maximum pitch diameter of the nut.

TABLE 26. *Limits of size of setting plug and thread ring gages for screws of classes 1, 2, and 3 fits, American National fine-thread series*

Limits of size		Size (inches): 0	1	2	3	4	5	6	8	10	12	¼	5⁄16
	Threads per inch	80	72	64	56	48	44	40	36	32	28	28	24
MAXIMUM-METAL LIMIT OR "GO" GAGES FOR SCREWS													
Major diameter of basic-form setting plug, and full portion of truncated setting plug:		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Class 1	Max	0.0596	0.0726	0.0857	0.0986	0.1115	0.1245	0.1374	0.1633	0.1894	0.2153	0.2493	0.3117
	Min	.0593	.0723	.0853	.0982	.1111	.1241	.1370	.1629	.1889	.2148	.2488	.3112
Classes 2 and 3	Max	.0603	.0733	.0864	.0994	.1124	.1254	.1384	.1644	.1905	.2165	.2505	.3130
	Min	.0600	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
Major diameter of truncated portion of truncated setting plug:													
Class 1	Max	.0545	.0673	.0801	.0926	.1049	.1177	.1302	.1557	.1813	.2062	.2402	.3020
	Min	.0542	.0670	.0797	.0922	.1045	.1173	.1298	.1553	.1808	.2057	.2397	.3015
Classes 2 and 3	Max	.0566	.0694	.0822	.0950	.1076	.1204	.1332	.1590	.1846	.2098	.2438	.3059
	Min	.0563	.0691	.0818	.0946	.1072	.1200	.1328	.1586	.1841	.2093	.2433	.3054
Pitch diameter of setting plug or ring gage:													
Class 1	Max. Y	------	------	------	------	------	------	------	------	------	------	.2254	.2839
	Min. Y	------	------	------	------	------	------	------	------	------	------	.2251	.2836
	Max. X	.0512	.0633	.0752	.0866	.0976	.1093	.1208	.1449	.1686	.1916	.2256	.2841
	Min. X	.0510	.0631	.0750	.0864	.0974	.1091	.1206	.1447	.1683	.1913	.2253	.2838
Classes 2 and 3	Max. Y	------	------	------	------	------	------	------	------	------	------	.2266	.2852
	Min. Y	------	------	------	------	------	------	------	------	------	------	.2263	.2849
	Max. X	.0519	.0640	.0759	.0874	.0985	.1102	.1218	.1460	.1697	.1928	.2268	.2854
	Min. X	.0517	.0638	.0757	.0872	.0983	.1100	.1216	.1458	.1694	.1925	.2265	.2851
Minor diameter of ring gage: Classes 1, 2, and 3	Max	.0465	.0580	.0691	.0797	.0894	.1004	.1109	.1339	.1562	.1773	.2113	.2674
	Min	.0462	.0577	.0687	.0793	.0890	.1000	.1105	.1335	.1557	.1768	.2108	.2669
MINIMUM-METAL LIMIT OR "NOT GO" GAGES FOR SCREWS													
Major diameter of full portion of truncated setting plug:													
Class 1	Min	.0576	.0708	.0840	.0971	.1104	.1236	.1369	.1629	.1889	.2148	.2488	.3112
	Max	[1].0579	[1].0711	[1].0844	[1].0975	[1].1108	[1].1240	[1].1373	.1633	.1894	.2153	.2493	.3117
Class 2	Min	.0590	.0722	.0854	.0987	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
	Max	[1].0593	[1].0725	[1].0858	[1].0991	.1124	.1254	.1384	.1644	.1905	.2165	.2505	.3130
Class 3	Min	.0594	.0727	.0859	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
	Max	[1].0597	[1].0730	[1].0863	.0994	.1124	.1254	.1384	.1644	.1905	.2165	.2505	.3130
Major diameter of truncated portion of truncated setting plug:													
Class 1	Min	.0539	.0665	.0790	.0911	.1031	.1155	.1278	.1529	.1779	.2023	.2363	.2970
	Max	.0542	.0668	.0794	.0915	.1035	.1159	.1282	.1533	.1783	.2028	.2368	.2975
Class 2	Min	.0553	.0679	.0804	.0927	.1049	.1173	.1298	.1551	.1801	.2047	.2387	.2996
	Max	.0556	.0682	.0808	.0931	.1053	.1177	.1302	.1555	.1805	.2052	.2392	.3001
Class 3	Min	.0557	.0684	.0809	.0932	.1055	.1180	.1305	.1558	.1809	.2056	.2396	.3005
	Max	.0560	.0687	.0813	.0936	.1059	.1184	.1309	.1562	.1813	.2061	.2401	.3010
Major diameter of basic-form setting plug:													
Class 1	Min	.0566	.0695	.0823	.0950	.1076	.1205	.1332	.1589	.1846	.2100	.2440	.3061
	Max	.0569	.0698	.0827	.0954	.1080	.1209	.1336	.1593	.1851	.2105	.2445	.3066
Class 2	Min	.0580	.0709	.0837	.0966	.1094	.1223	.1352	.1611	.1868	.2124	.2464	.3087
	Max	.0583	.0712	.0841	.0970	.1098	.1227	.1356	.1615	.1873	.2129	.2469	.3092
Class 3	Min	.0584	.0714	.0842	.0971	.1100	.1230	.1359	.1618	.1876	.2133	.2473	.3096
	Max	.0587	.0717	.0846	.0975	.1104	.1234	.1363	.1622	.1881	.2138	.2478	.3101
Pitch diameter of setting plug and ring gages for production and inspection:													
Class 1	Min	.0488	.0608	.0726	.0838	.0945	.1061	.1174	.1413	.1648	.1873	.2213	.2795
	Max	.0490	.0610	.0728	.0840	.0947	.1063	.1176	.1415	.1651	.1876	.2216	.2798
Class 2	Min	.0502	.0622	.0740	.0854	.0963	.1079	.1194	.1435	.1670	.1897	.2237	.2821
	Max	.0504	.0624	.0742	.0856	.0965	.1081	.1196	.1437	.1673	.1900	.2240	.2824
Class 3	Min	.0506	.0627	.0745	.0859	.0969	.1086	.1201	.1442	.1678	.1906	.2246	.2830
	Max	.0508	.0629	.0747	.0861	.0971	.1088	.1203	.1444	.1681	.1909	.2249	.2833
(OPTIONAL)													
Pitch diameter of setting plug and ring gages for inspection. (See par. 6, p. 31):													
Class 1	Min	.0486	.0606	.0724	.0836	.0943	.1059	.1172	.1411	.1645	.1870	.2210	.2792
	Max	.0488	.0608	.0726	.0838	.0945	.1061	.1174	.1413	.1648	.1873	.2213	.2795
Class 2	Min	.0500	.0620	.0738	.0852	.0961	.1077	.1192	.1433	.1667	.1894	.2234	.2818
	Max	.0502	.0622	.0740	.0854	.0963	.1079	.1194	.1435	.1670	.1897	.2237	.2821
Class 3	Min	.0504	.0625	.0743	.0857	.0967	.1084	.1199	.1440	.1675	.1903	.2243	.2827
	Max	.0506	.0627	.0745	.0859	.0969	.1086	.1201	.1442	.1678	.1906	.2246	.2830
Minor diameter of ring gage:													
Class 1	Min	.0469	.0585	.0696	.0803	.0901	.1012	.1120	.1353	.1580	.1796	.2136	.2705
	Max	.0472	.0588	.0700	.0807	.0905	.1016	.1124	.1357	.1585	.1801	.2141	.2710
Class 2	Min	.0475	.0592	.0706	.0815	.0918	.1030	.1140	.1375	.1602	.1820	.2160	.2731
	Max	.0478	.0595	.0710	.0819	.0922	.1034	.1144	.1379	.1607	.1825	.2165	.2736
Class 3	Min	.0479	.0597	.0711	.0820	.0924	.1037	.1147	.1382	.1610	.1829	.2169	.2740
	Max	.0482	.0600	.0715	.0824	.0928	.1041	.1151	.1386	.1615	.1834	.2174	.2745

[1] See footnote at end of table.

Table 26. *Limits of size of setting plug and thread ring gages for screws of classes 1, 2, and 3 fits, American National fine-thread series*—Continued

Limits of size		Size (inches)											
		3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
		Threads per inch											
		24	20	20	18	18	16	14	14	12	12	12	12
Maximum-Metal Limit or "Go" Gages for Screws													
Major diameter of basic-form setting plug, and full portion of truncated setting plug:		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Class 1	Max	0.3742	0.4365	0.4990	0.5614	0.6239	0.7488	0.8735	0.9985	1.1232	1.2482	1.3732	1.4982
	Min	.3737	.4360	.4985	.5609	.6234	.7482	.8729	.9979	1.1226	1.2476	1.3726	1.4976
Classes 2 and 3	Max	.3755	.4380	.5005	.5630	.6255	.7506	.8756	1.0006	1.1256	1.2506	1.3756	1.5006
	Min	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000
Major diameter of truncated portion of truncated setting plug:													
Class 1	Max	.3645	.4258	.4883	.5495	.6120	.7356	.8589	.9839	1.1068	1.2318	1.3568	1.4818
	Min	.3640	.4253	.4878	.5490	.6115	.7350	.8583	.9833	1.1062	1.2312	1.3562	1.4812
Classes 2 and 3	Max	.3684	.4303	.4928	.5543	.6168	.7410	.8652	.9902	1.1138	1.2388	1.3638	1.4888
	Min	.3679	.4298	.4923	.5538	.6163	.7404	.8646	.9896	1.1132	1.2382	1.3632	1.4882
Pitch diameter of setting plug or ring gage:													
Class 1	Max Y	.3464	.4033	.4658	.5246	.5871	.7074	.8263	.9513	1.0683	1.1933	1.3183	1.4433
	Min Y	.3461	.4030	.4655	.5243	.5868	.7070	.8259	.9509	1.0679	1.1929	1.3179	1.4429
	Max X	.3466	.4035	.4660	.5248	.5873	.7076	.8265	.9515	1.0685	1.1935	1.3185	1.4435
	Min X	.3463	.4032	.4657	.5245	.5870	.7073	.8262	.9512	1.0682	1.1932	1.3182	1.4432
Classes 2 and 3	Max Y	.3477	.4048	.4673	.5262	.5887	.7092	.8284	.9534	1.0707	1.1957	1.3207	1.4457
	Min Y	.3474	.4045	.4670	.5259	.5884	.7088	.8280	.9530	1.0703	1.1953	1.3203	1.4453
	Max X	.3479	.4050	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
	Min X	.3476	.4047	.4672	.5261	.5886	.7091	.8283	.9533	1.0706	1.1956	1.3206	1.4456
Minor diameter of ring gage:													
Classes 1, 2, and 3	Max	.3299	.3834	.4459	.5024	.5649	.6823	.7977	.9227	1.0348	1.1598	1.2848	1.4098
	Min	.3294	.3829	.4454	.5019	.5644	.6817	.7971	.9221	1.0342	1.1592	1.2842	1.4092
Minimum-Metal Limit or "Not Go" Gages for Screws													
Major diameter of full portion of truncated setting plug:													
Class 1	Min	.3737	.4360	.4985	.5609	.6234	.7482	.8729	.9979	1.1226	1.2476	1.3726	1.4976
	Max	.3742	.4365	.4990	.5614	.6239	.7488	.8735	.9985	1.1232	1.2482	1.3732	1.4982
Classes 2 and 3	Min	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000
	Max	.3755	.4380	.5005	.5630	.6255	.7506	.8756	1.0006	1.1256	1.2506	1.3756	1.5006
Major diameter of truncated portion of truncated setting plug:													
Class 1	Min	.3595	.4196	.4821	.5427	.6052	.7278	.8498	.9748	1.0961	1.2211	1.3461	1.4711
	Max	.3600	.4201	.4826	.5432	.6057	.7284	.8504	.9754	1.0967	1.2217	1.3467	1.4717
Class 2	Min	.3621	.4226	.4851	.5459	.6084	.7314	.8540	.9790	1.1008	1.2258	1.3508	1.4758
	Max	.3626	.4231	.4856	.5464	.6089	.7320	.8546	.9796	1.1014	1.2264	1.3514	1.4764
Class 3	Min	.3630	.4236	.4861	.5470	.6095	.7327	.8553	.9803	1.1024	1.2274	1.3524	1.4774
	Max	.3635	.4241	.4866	.5475	.6100	.7333	.8559	.9809	1.1030	1.2280	1.3530	1.4780
Major diameter of basic-form setting plug:													
Class 1	Min	.3686	.4304	.4929	.5547	.6172	.7413	.8653	.9903	1.1141	1.2391	1.3641	1.4891
	Max	.3691	.4309	.4934	.5552	.6177	.7419	.8659	.9909	1.1147	1.2397	1.3647	1.4897
Class 2	Min	.3712	.4334	.4959	.5579	.6204	.7449	.8695	.9945	1.1188	1.2438	1.3688	1.4938
	Max	.3717	.4339	.4964	.5584	.6209	.7455	.8701	.9951	1.1194	1.2444	1.3694	1.4944
Class 3	Min	.3721	.4344	.4969	.5590	.6215	.7462	.8708	.9958	1.1204	1.2454	1.3704	1.4954
	Max	.3726	.4349	.4974	.5595	.6220	.7468	.8714	.9964	1.1210	1.2460	1.3710	1.4960
Pitch diameter of setting plug and ring gages for production and inspection:													
Class 1	Min	.3420	.3984	.4609	.5191	.5816	.7013	.8195	.9445	1.0606	1.1856	1.3106	1.4356
	Max	.3423	.3987	.4612	.5194	.5819	.7016	.8198	.9448	1.0609	1.1859	1.3109	1.4359
Class 2	Min	.3446	.4014	.4639	.5223	.5848	.7049	.8237	.9487	1.0653	1.1903	1.3153	1.4403
	Max	.3449	.4017	.4642	.5226	.5851	.7052	.8240	.9490	1.0656	1.1906	1.3156	1.4406
Class 3	Min	.3455	.4024	.4649	.5234	.5859	.7062	.8250	.9500	1.0669	1.1919	1.3169	1.4419
	Max	.3458	.4027	.4652	.5237	.5862	.7065	.8253	.9503	1.0672	1.1922	1.3172	1.4422
(OPTIONAL)													
Pitch diameter of setting plug and ring gages for inspection. (See par. 6, p. 31):													
Class 1	Min	.3417	.3981	.4606	.5188	.5813	.7010	.8192	.9442	1.0630	1.1853	1.3103	1.4353
	Max	.3420	.3984	.4609	.5191	.5816	.7013	.8195	.9445	1.0606	1.1856	1.3106	1.4356
Class 2	Min	.3443	.4011	.4636	.5220	.5845	.7046	.8234	.9484	1.0650	1.1900	1.3150	1.4400
	Max	.3446	.4014	.4639	.5223	.5848	.7049	.8237	.9487	1.0653	1.1903	1.3153	1.4403
Class 3	Min	.3452	.4021	.4646	.5231	.5856	.7059	.8247	.9497	1.0666	1.1916	1.3166	1.4416
	Max	.3455	.4024	.4649	.5234	.5859	.7062	.8250	.9500	1.0669	1.1919	1.3169	1.4419
Minor diameter of ring gage:													
Class 1	Min	.3330	.3876	.4501	.5071	.5696	.6878	.8040	.9290	1.0426	1.1676	1.2926	1.4176
	Max	.3335	.3881	.4506	.5076	.5701	.6884	.8046	.9296	1.0432	1.1682	1.2932	1.4182
Class 2	Min	.3356	.3906	.4531	.5103	.5728	.6914	.8082	.9332	1.0473	1.1723	1.2973	1.4223
	Max	.3361	.3911	.4536	.5108	.5733	.6920	.8088	.9338	1.0479	1.1729	1.2979	1.4229
Class 3	Min	.3365	.3916	.4541	.5114	.5739	.6927	.8095	.9345	1.0489	1.1739	1.2989	1.4239
	Max	.3370	.3921	.4546	.5119	.5744	.6933	.8101	.9351	1.0495	1.1745	1.2995	1.4245

[1] These major diameters represent the maximum practicable sharpness of crest of the setting plug, in accordance with par. 3 (b), p. 4.

TABLE A. *Major diameters of minimum-metal limit basic-form setting plugs, American National extra-fine, 8-pitch, 12-pitch, and 16-pitch thread series*

Sizes	Limits of size of major diameters of minimum-metal limit basic-form setting plugs															
	Extra-fine thread series table 33, p. 72 and 73				8-pitch thread series table 38, p. 80 and 81				12-pitch thread series table 43, p. 88 to 90				16-pitch thread series table 48, p. 98 to 100			
	Class 2		Class 3		Class 2		Class 3		Class 2		Class 3		Class 2		Class 3	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
1/4	0.2463	0.2468	0.2473	0.2478												
5/16	.3087	.3092	.3097	.3102												
3/8	.3711	.3716	.3721	.3726												
7/16	.4334	.4339	.4345	.4350												
1/2	.4958	.4963	.4969	.4974					0.4938	0.4944	0.4954	0.4960				
9/16	.5580	.5586	.5592	.5597					.5563	.5569	.5579	.5585				
5/8	.6204	.6209	.6216	.6221					.6188	.6194	.6204	.6210				
11/16	.6829	.6834	.6841	.6846					.6813	.6819	.6829	.6835				
3/4	.7449	.7454	.7463	.7468					.7438	.7444	.7454	.7460	0.7449	0.7455	0.7462	0.7468
13/16	.8074	.8079	.8088	.8093					.8063	.8069	.8079	.8085	.8068	.8074	.8084	.8090
7/8	.8698	.8703	.8712	.8717					.8688	.8694	.8704	.8710	.8693	.8699	.8708	.8714
15/16	.9323	.9328	.9337	.9342					.9313	.9319	.9329	.9335	.9317	.9323	.9333	.9339
1	.9947	.9952	.9961	.9966	0.9917	0.9924	0.9939	0.9946	.9938	.9944	.9954	.9960	.9942	.9948	.9957	.9963
1 1/16	1.0572	1.0577	1.0584	1.0589					1.0563	1.0569	1.0579	1.0585	1.0566	1.0572	1.0582	1.0588
1 1/8	1.1193	1.1198	1.1209	1.1214	1.1164	1.1171	1.1188	1.1195	1.1188	1.1194	1.1204	1.1210	1.1190	1.1196	1.1206	1.1212
1 3/16	1.1818	1.1823	1.1834	1.1839					1.1813	1.1819	1.1829	1.1835	1.1815	1.1821	1.1831	1.1837
1 1/4	1.2442	1.2447	1.2458	1.2463	1.2410	1.2417	1.2435	1.2442	1.2438	1.2444	1.2454	1.2460	1.2439	1.2445	1.2456	1.2462
1 5/16	1.3067	1.3072	1.3083	1.3088					1.3063	1.3069	1.3079	1.3085	1.3064	1.3070	1.3080	1.3086
1 3/8	1.3691	1.3696	1.3707	1.3712	1.3657	1.3664	1.3682	1.3689	1.3688	1.3694	1.3704	1.3710	1.3688	1.3694	1.3705	1.3711
1 7/16									1.4313	1.4319	1.4329	1.4335	1.4313	1.4319	1.4329	1.4335
1 1/2	1.4316	1.4321	1.4332	1.4337	1.4903	1.4910	1.4930	1.4937	1.4938	1.4944	1.4954	1.4960	1.4937	1.4943	1.4954	1.4960
1 9/16	1.4940	1.4945	1.4957	1.4962									1.5561	1.5567	1.5579	1.5585
1 5/8	1.5565	1.5570	1.5581	1.5586	1.6150	1.6157	1.6178	1.6185	1.6180	1.6186	1.6199	1.6205	1.6186	1.6192	1.6203	1.6209
1 11/16	1.6189	1.6194	1.6206	1.6211									1.6811	1.6817	1.6648	1.6654
1 3/4	1.6814	1.6819	1.6831	1.6836	1.7396	1.7403	1.7425	1.7432	1.7429	1.7435	1.7448	1.7454	1.7435	1.7441	1.7453	1.7459
1 13/16	1.7435	1.7441	1.7453	1.7459									1.8060	1.8066	1.8077	1.8083
1 7/8					1.8643	1.8650	1.8673	1.8680	1.8678	1.8684	1.8698	1.8704	1.8684	1.8690	1.8702	1.8708
1 15/16													1.9309	1.9315	1.9327	1.9333
2	1.9933	1.9939	1.9951	1.9957	1.9889	1.9896	1.9920	1.9927	1.9927	1.9933	1.9947	1.9953	1.9333	1.9939	1.9951	1.9957
2 1/16													2.0558	2.0564	2.0576	2.0582
2 1/8					2.1136	2.1143	2.1168	2.1175	2.1176	2.1182	2.1196	2.1202	2.1182	2.1188	2.1201	2.1207
2 3/16													2.1807	2.1813	2.1826	2.1832
2 1/4					2.2383	2.2390	2.2416	2.2423	2.2425	2.2431	2.2446	2.2452	2.2432	2.2438	2.2450	2.2456
2 5/16													2.3056	2.3062	2.3075	2.3081
2 3/8									2.3674	2.3680	2.3695	2.3701	2.3681	2.3687	2.3700	2.3706
2 7/16													2.4305	2.4311	2.4324	2.4330
2 1/2					2.4876	2.4883	2.4911	2.4918	2.4923	2.4929	2.4945	2.4951	2.4930	2.4936	2.4949	2.4955
2 5/8									2.6173	2.6179	2.6194	2.6200	2.6179	2.6185	2.6199	2.6205
2 3/4					2.7369	2.7376	2.7406	2.7413	2.7422	2.7428	2.7444	2.7450	2.7428	2.7434	2.7448	2.7454
2 7/8									2.8671	2.8677	2.8693	2.8699	2.8678	2.8684	2.8698	2.8704
3					2.9863	2.9870	2.9901	2.9908	2.9920	2.9926	2.9943	2.9949	2.9927	2 9933	2.9947	2.9953
3 1/8									3.1170	3.1176	3.1192	3.1198	3.1176	3.1182	3.1197	3.1203
3 1/4					3.2361	3.2368	3.2400	3.2407	3.2419	3.2425	3.2442	3.2448	3.2425	3.2431	3.2446	3.2452
3 3/8									3.3668	3.3674	3.3691	3.3697	3.3675	3.3681	3.3696	3.3702
3 1/2					3.4860	3.4867	3.4900	3.4907	3.4918	3.4924	3.4941	3.4947	3.4924	3.4930	3.4945	3.4951
3 5/8									3.6167	3.6173	3.6190	3.6196	3.6173	3.6179	3.6195	3.6201
3 3/4					3.7359	3.7366	3.7399	3.7406	3.7416	3.7422	3.7440	3.7446	3.7423	3.7429	3.7444	3.7450
3 7/8									3.8666	3.8672	3.8689	3.8695	3.8672	3.8678	3.8694	3.8700
4					3.9858	3.9865	3.9898	3.9905	3.9915	3.9921	3.9939	3.9945	3.9922	3.9928	3.9943	3.9949
4 1/4					4.2356	4.2363	4.2397	4.2404	4.2414	4.2420	4.2438	4.2444				
4 1/2					4.4855	4.4862	4.4896	4.4903	4.4913	4.4919	4.4937	4.4943				
4 3/4					4.7354	4.7361	4.7395	4.7402	4.7411	4.7417	4.7436	4.7442				
5					4.9853	4.9860	4.9894	4.9901	4.9910	4.9916	4.9935	4.9941				
5 1/4					5.2352	5.2359	5.2394	5.2401	5.2409	5.2415	5.2435	5.2441				
5 1/2					5.4851	4.4858	5.4893	5.4900	5.4908	5.4914	5.4934	5.4940				
5 3/4					5.7350	5.7357	5.7392	5.7399	5.7407	5.7413	5.7433	5.7439				
6					5.9849	5.9856	5.9891	5.9898	5.9906	5.9912	5.9932	5.9938				

TABLE 31.—*Sizes of tap drills, American National fine thread series* [1]

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth [2]		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inch	*Inch*	*Inch*		*Inch*	
0	80	0.0438	0.0514	0.0465	3/64 in 1.25 mm	0.0469 .0492	81 67
1	72	.0550	.0634	.0580	1.50 mm 1.55 mm	.0591 .0610	77 67
2	64	.0657	.0746	.0691	#50 #49	.0700 .0730	79 64
3	56	.0758	.0856	.0797	#46 2.10 mm	.0810 .0827	78 70
4	48	.0849	.0960	.0894	2.30 mm 3/32 in #41	.0906 .0937 .0960	79 68 59
5	44	.0955	.1068	.1004	2.60 mm #37 #36	.1024 .1040 .1065	77 71 63
6	40	.1055	.1179	.1109	#33 #32	.1130 .1160	77 68
8	36	.1279	.1402	.1339	3.40 mm #29 3.50 mm	.1339 .1360 .1378	83 78 73
10	32	.1494	.1624	.1562	5/32 in #21[3] #20	.1562 .1590 .1610	83 76 71
12	28	.1696	.1835	.1773	#15	.1800	78
1/4	28	.2036	.2173	.2113	#3	.2130	80
5/16	24	.2584	.2739	.2674	I	.2720	75
3/8	24	.3209	.3364	.3299	Q	.3320	79
7/16	20	.3725	.3906	.3834	W 25/64 in	.3860 .3906	79 72
1/2	20	.4350	.4531	.4459	29/64 in	.4531	72
9/16	18	.4903	.5100	.5024	0.5062	.5062	78
5/8	18	.5528	.5725	.5649	14.5 mm	.5709	75
3/4	16	.6688	.6903	.6823	11/16 in 17.5 mm	.6875 .6890	77 75
7/8	14	.7822	.8062	.7977	*51/64 in* *20.5 mm*	*.7969* *.8071*	*84* *73*
1	14	.9072	.9312	.9227	23.5 mm	.9252	81
1 1/8	12	1.0167	1.0438	1.0348	26.5 mm	1.0433	75
1 1/4	12	1.1417	1.1688	1.1598	29.5 mm	1.1614	82
1 3/8	12	1.2667	1.2938	1.2848	*1 9/32 in* *1 19/64 in*	*1.2812* *1.2969*	*87* *72*
1 1/2	12	1.3917	1.4188	1.4098	36 mm	1.4173	76

[1] Sizes in italic type are not within the specified limits for minor diameter of nut. See p. 43, H28 (1944). Sizes of tap drills for class 5 fit are given in table 25.

[2] Drill sizes up to 1/2 inch are in agreement with ASA B5.12–1940, Twist Drills, Straight Shank, published by the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

[3] This size is not included as standard in ASA B5.12–1940 but is listed in an appendix thereto.

SECTION V. SCREW THREADS OF SPECIAL DIAMETERS, PITCHES, AND LENGTHS OF ENGAGEMENT

Page 106, 2d col., line 2, change "four" to "three."

Page 107, par. (*l*). Substitute the following for this paragraph and footnote 15:

"(*l*) The tolerance on minor diameter of a nut of a given diameter, pitch, and length of engagement shall be taken from table 54A."

Page 109, par. 2, substitute the following for this paragraph:

"2. Tolerances on pitch diameter for pitches between those for which values are given in the tables shall be those of the next coarser pitch, except that for screws having 80, 72, 44, 13, 11, 9, 7, 5, or 4½ threads per inch and lengths of engagement of one and one-half diameters or less and diameters less than the standard diameters for the respective pitches as given in section IV, the tolerances given in section III shall be used."

Page 109, insert after par. 5:

"6. For pitches finer than 64 threads per inch, apply the formulas in table 143. If the resulting tolerance is greater than that for 64 threads per inch as given in tables 55 to 57 for the same diameter and class, apply the tolerance for 64 threads.

Page 109, 2d col., insert the following above "5. GAGES":

(*d*) TABLE OF NUT MINOR DIAMETER TOLERANCES.—Table 54A provides tolerances for all diameters and lengths of engagement, and for the selected pitches recommended in this section, with 80 and 72 threads per inch in addition.

The principal practical factors which govern these tolerances are tapping difficulties, particularly tap breakage in the small sizes, and depth of engagement. Depth of engagement correlates with the stripping strength of the thread assembly, and thus also with the length of engagement. It also correlates with the tendency toward disengagement of the threads on one side, when assembly is eccentric. The amount of possible eccentricity is one-half of the sum of the pitch diameter allowance and tolerances. For a given pitch, or depth of thread, this sum increases with the diameter, and accordingly this factor would require a decrease in minor diameter tolerance with increase in diameter.

Thus, for any given pitch and length of engagement, the tolerances do not increase or decrease proportionately with the diameter or a function of the diameter. Starting with the smallest size

TABLE 54A.—*Minor diameter tolerances for internal special screw threads, classes 1, 2, and 3*

Threads per inch	Lengths of engagement		Minor diameter tolerances for thread sizes having basic major diameters													
	Over—	To and incl.—	Above 0.053 to 0.066 in.	Above 0.066 to 0.079 in.	Above 0.079 to 0.092 in.	Above 0.092 to 0.105 in.	Above 0.105 to 0.118 in.	Above 0.118 to 0.131 in.	Above 0.131 to 0.151 in.	Above 0.151 to 0.177 in.	Above 0.177 to 0.203 in.	Above 0.203 to 0.233 in.	Above 0.233 to 0.281 in.	Above 0.281 to 0.344 in.	Above 0.344 to 0.406 in.	Above 0.406 to 0.469 in.
			Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
80	-----	⅓D	0.0027	0.0022	0.0017	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013
	⅓D	⅔D	.0041	.0033	.0026	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020
	⅔D	1½D	.0049	.0044	.0034	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026
	1½D	-----	.0049	.0049	.0042	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033
72	-----	⅓D	.0032	.0027	.0022	.0017	.0013	.0013	.0013	.0013	.0013	.0013	.0013	.0013	.0013	.0013
	⅓D	⅔D	.0048	.0040	.0033	.0025	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020	.0020
	⅔D	1½D	.0054	.0054	.0044	.0033	.0027	.0027	.0027	.0027	.0027	.0027	.0027	.0027	.0027	.0027
	1½D	-----	.0054	.0054	.0054	.0041	.0034	.0034	.0034	.0034	.0034	.0034	.0034	.0034	.0034	.0034
64	-----	⅓D	.0038	.0033	.0028	.0022	.0017	.0014	.0014	.0014	.0014	.0014	.0014	.0014	.0014	.0014
	⅓D	⅔D	.0057	.0049	.0041	.0034	.0026	.0021	.0021	.0021	.0021	.0021	.0021	.0021	.0021	.0021
	⅔D	1½D	.0062	.0062	.0055	.0045	.0035	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028
	1½D	-----	.0062	.0062	.0062	.0056	.0044	.0035	.0035	.0035	.0035	.0035	.0038	.0042	.0044	.0044
56	-----	⅓D	-----	.0040	.0035	.0029	.0024	.0019	.0015	.0015	.0015	.0015	.0015	.0015	.0015	.0015
	⅓D	⅔D	-----	.0060	.0052	.0044	.0037	.0029	.0023	.0023	.0023	.0023	.0023	.0023	.0023	.0023
	⅔D	1½D	-----	.0070	.0069	.0059	.0049	.0038	.0030	.0030	.0030	.0030	.0030	.0030	.0030	.0030
	1½D	-----	-----	.0070	.0070	.0070	.0061	.0048	.0038	.0038	.0038	.0038	.0038	.0044	.0046	.0046
48	-----	⅓D	-----	-----	.0044	.0039	.0033	.0028	.0023	.0016	.0016	.0016	.0016	.0016	.0016	.0016
	⅓D	⅔D	-----	-----	.0066	.0058	.0050	.0042	.0035	.0024	.0024	.0024	.0024	.0024	.0024	.0024
	⅔D	1½D	-----	-----	.0082	.0077	.0067	.0057	.0046	.0032	.0032	.0032	.0032	.0032	.0032	.0032
	1½D	-----	-----	-----	.0082	.0082	.0082	.0071	.0058	.0041	.0041	.0041	.0041	.0046	.0048	.0048
40	-----	⅓D	-----	-----	-----	.0050	.0045	.0040	.0035	.0025	.0020	.0019	.0019	.0019	.0019	.0019
	⅓D	⅔D	-----	-----	-----	.0076	.0068	.0060	.0053	.0037	.0030	.0029	.0029	.0029	.0029	.0029
	⅔D	1½D	-----	-----	-----	.0098	.0091	.0080	.0070	.0050	.0040	.0039	.0039	.0039	.0039	.0039
	1½D	-----	-----	-----	-----	.0098	.0098	.0098	.0088	.0063	.0049	.0049	.0049	.0049	.0049	.0049
36	-----	⅓D	-----	-----	-----	-----	.0053	.0048	.0043	.0032	.0022	.0022	.0022	.0022	.0022	.0022
	⅓D	⅔D	-----	-----	-----	-----	.0079	.0072	.0064	.0049	.0033	.0032	.0032	.0032	.0032	.0032
	⅔D	1½D	-----	-----	-----	-----	.0106	.0095	.0085	.0065	.0044	.0043	.0043	.0043	.0043	.0043
	1½D	-----	-----	-----	-----	-----	.0109	.0109	.0106	.0081	.0055	.0052	.0054	.0054	.0054	.0054
32	-----	⅓D	-----	-----	-----	-----	-----	-----	.0052	.0041	.0031	.0026	.0024	.0024	.0024	.0024
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	.0077	.0062	.0046	.0040	.0037	.0037	.0037	.0037
	⅔D	1½D	-----	-----	-----	-----	-----	-----	.0103	.0082	.0062	.0053	.0049	.0049	.0049	.0049
	1½D	-----	-----	-----	-----	-----	-----	-----	.0123	.0103	.0078	.0066	.0061	.0061	.0061	.0061
28	-----	⅓D	-----	-----	-----	-----	-----	-----	-----	-----	.0042	.0033	.0030	.0028	.0028	.0028
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	-----	-----	.0068	.0050	.0044	0042	.0042	.0042
	⅔D	1½D	-----	-----	-----	-----	-----	-----	-----	-----	.0084	.0066	.0059	.0056	.0056	.0056
	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0104	.0083	.0074	.0070	.0070	.0070
24	-----	⅓D	-----	-----	-----	-----	-----	-----	-----	-----	.0055	.0045	.0038	.0032	.0032	.0032
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	-----	-----	.0083	.0067	.0057	.0049	.0049	.0049
	⅔D	1½D	-----	-----	-----	-----	-----	-----	-----	-----	.0110	.0090	.0077	.0065	.0065	.0065
	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0138	.0112	.0096	.0081	.0081	.0081
20	-----	⅓D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0050	.0044	.0037	.0036
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0076	.0066	.0056	.0054
	⅔D	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0101	.0088	.0075	.0072
	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0126	.0110	.0094	.0090
18	-----	⅓D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0052	.0045	.0039
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0078	.0068	.0058
	⅔D	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0104	.0091	.0078
	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0130	.0113	.0097
16	-----	⅓D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0055	.0049
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0083	.0073
	⅔D	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0110	.0097
	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0138	.0131
14	-----	⅓D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0061
	⅓D	⅔D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0092
	⅔D	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0123
	1½D	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.0154

TABLE 54A.—*Minor diameter tolerances for internal special screw threads, classes 1, 2, and 3*—Continued

Threads per inch	Lengths of engagement		Minor diameter tolerances for thread sizes having basic major diameters												
	Over—	To and incl.—	Above 0.469 to 0.531 in.	Above 0.531 to 0.594 in.	Above 0.594 to 0.656 in.	Above 0.656 to 0.719 in.	Above 0.719 to 0.781 in.	Above 0.781 to 0.844 in.	Above 0.844 to 0.906 in.	Above 0.906 to 0.969 in.	Above 0.969 to 1.031 in.	Above 1.031 to 1.500 in.	Above 1.500 to 2.5 in.	Above 2.5 to 4.5 in.	Above 4.5 in.
			Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	
72	------	⅓D	0.0013	0.0014	0.0014	0.0015	0.0015	------	------	------	------	------	------	------	Same as respective pitch diameter tolerances for each class but not less than values in preceding column.
	⅓D	⅔D	.0020	.0021	.0022	.0022	.0023	------	------	------	------	------	------	------	
	⅔D	1½D	.0027	.0028	.0029	.0030	.0031	------	------	------	------	------	------	------	
	1½D	------	.0034	.0039	.0042	.0042	.0042	------	------	------	------	------	------	------	
64	------	⅓D	.0014	.0014	.0014	.0015	.0015	0.0016	0.0016	0.0017	0.0017	0.0018	------	------	
	⅓D	⅔D	.0021	.0021	.0022	.0022	.0023	.0024	.0025	.0025	.0025	.0026	------	------	
	⅔D	1½D	.0028	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0034	.0035	------	------	
	1½D	------	.0044	.0044	.0047	.0047	.0047	.0050	.0050	.0050	.0050	.0052	------	------	
56	------	⅓D	.0015	.0015	.0016	.0016	.0016	.0016	.0017	.0018	.0018	.0020	------	------	
	⅓D	⅔D	.0023	.0023	.0023	.0024	.0024	.0025	.0025	.0026	.0027	.0031	------	------	
	⅔D	1½D	.0030	.0030	.0031	.0032	.0032	.0033	.0034	.0035	.0036	.0041	------	------	
	1½D	------	.0046	.0049	.0049	.0052	.0052	.0056	.0056	.0056	.0056	.0056	------	------	
48	------	⅓D	.0016	.0016	.0016	.0018	.0018	.0020	.0020	.0020	.0020	.0022	0.0022	------	
	⅓D	⅔D	.0024	.0024	.0024	.0028	.0028	.0029	.0029	.0029	.0029	.0033	.0033	------	
	⅔D	1½D	.0034	.0037	.0037	.0037	.0037	.0039	.0039	.0039	.0039	.0044	.0044	------	
	1½D	------	.0048	.0051	.0051	.0057	.0057	.0059	.0062	.0062	.0062	.0062	.0062	------	
40	------	⅓D	.0019	.0019	.0019	.0019	.0019	.0019	.0019	.0019	.0020	.0022	.0024	------	
	⅓D	⅔D	.0029	.0029	.0029	.0029	.0029	.0029	.0029	.0029	.0031	.0034	.0036	------	
	⅔D	1½D	.0039	.0039	.0039	.0039	.0039	.0041	.0041	.0041	.0041	.0045	.0048	------	
	1½D	------	.0051	.0054	.0054	.0057	.0057	.0062	.0068	.0068	.0068	.0068	.0068	------	
36	------	⅓D	.0022	.0022	.0022	.0022	.0022	.0022	.0022	.0022	.0022	.0023	.0025	0.0025	
	⅓D	⅔D	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0035	.0038	.0038	
	⅔D	1½D	.0043	.0043	.0043	.0043	.0043	.0043	.0043	.0043	.0043	.0046	.0050	.0050	
	1½D	------	.0054	.0057	.0057	.0057	.0057	.0065	.0070	.0070	.0070	.0072	.0072	.0072	
32	------	⅓D	.0024	.0024	.0024	.0024	.0024	.0024	.0024	.0024	.0024	.0024	.0027	.0027	
	⅓D	⅔D	.0037	.0037	.0037	.0037	.0037	.0037	.0037	.0037	.0037	.0037	.0041	.0041	
	⅔D	1½D	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0054	.0054	.0054	
	1½D	------	.0061	.0061	.0061	.0061	.0061	.0065	.0070	.0070	.0070	.0076	.0076	.0076	
28	------	⅓D	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0031	
	⅓D	⅔D	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0046	
	⅔D	1½D	.0056	.0056	.0056	.0056	.0056	.0056	.0056	.0056	.0056	.0056	.0062	.0062	
	1½D	------	.0070	.0070	.0070	.0070	.0070	.0070	.0070	.0070	.0070	.0079	.0086	.0086	
24	------	⅓D	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0032	.0033	
	⅓D	⅔D	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	.0049	
	⅔D	1½D	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0066	
	1½D	------	.0081	.0081	.0081	.0081	.0081	.0081	.0081	.0081	.0081	.0081	.0089	.0092	
20	------	⅓D	.0036	.0036	.0036	.0036	.0036	.0036	.0036	.0036	.0036	.0036	.0036	.0036	
	⅓D	⅔D	.0054	.0054	.0054	.0054	.0054	.0054	.0054	.0054	.0054	.0054	.0054	.0054	
	⅔D	1½D	.0072	.0072	.0072	.0072	.0072	.0072	.0072	.0072	.0072	.0072	.0072	.0072	
	1½D	------	.0090	.0090	.0090	.0090	.0090	.0090	.0090	.0090	.0102	.0102	.0102	.0102	
18	------	⅓D	.0038	.0038	.0038	.0038	.0038	.0038	.0038	.0038	.0038	.0038	.0038	.0038	
	⅓D	⅔D	.0057	.0057	.0057	.0057	.0057	.0057	.0057	.0057	.0057	.0057	.0057	.0057	
	⅔D	1½D	.0076	.0076	.0076	.0076	.0076	.0076	.0076	.0076	.0076	.0076	.0076	.0082	
	1½D	------	.0095	.0095	.0095	.0095	.0095	.0095	.0095	.0095	.0114	.0114	.0114	.0114	
16	------	⅓D	.0042	.0040	.0040	.0040	.0040	.0040	.0040	.0040	.0040	.0040	.0040	.0040	
	⅓D	⅔D	.0063	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060	
	⅔D	1½D	.0084	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0085	
	1½D	------	.0114	.0100	.0100	.0100	.0100	.0100	.0100	.0100	.0115	.0120	.0123	.0126	
14	------	⅓D	.0055	.0048	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	.0042	
	⅓D	⅔D	.0083	.0072	.0062	.0062	.0062	.0062	.0062	.0062	.0062	.0062	.0062	.0062	
	⅔D	1½D	.0110	.0096	.0083	.0083	.0083	.0083	.0083	.0083	.0083	.0096	.0098	.0098	
	1½D	------	.0138	.0120	.0103	.0103	.0103	.0103	.0103	.0103	.0115	.0127	.0133	.0139	
12	------	⅓D	------	.0065	.0058	.0052	.0045	.0045	.0045	.0045	.0045	.0045	.0045	.0045	
	⅓D	⅔D	------	.0097	.0087	.0077	.0067	.0067	.0067	.0067	.0067	.0067	.0067	.0067	
	⅔D	1½D	------	.0129	.0116	.0103	.0090	.0090	.0090	.0090	.0090	.0090	.0098	.0108	
	1½D	------	------	.0161	.0145	.0129	.0112	.0112	.0112	.0112	.0127	.0131	.0137	.0143	
10	------	⅓D	------	------	------	.0074	.0068	.0061	.0054	.0054	.0054	.0054	.0054	.0054	
	⅓D	⅔D	------	------	------	.0111	.0101	.0092	.0081	.0081	.0081	.0081	.0081	.0081	
	⅔D	1½D	------	------	------	.0148	.0135	.0122	.0108	.0108	.0108	.0108	.0108	.0112	
	1½D	------	------	------	------	.0185	.0169	.0152	.0135	.0135	.0135	.0135	.0184	.0184	
8	------	⅓D	------	------	------	------	------	.0094	.0087	.0081	.0074	.0063	.0063	.0063	
	⅓D	⅔D	------	------	------	------	------	.0140	.0130	.0121	.0111	.0101	.0101	.0101	
	⅔D	1½D	------	------	------	------	------	.0187	.0174	.0161	.0148	.0135	.0135	.0135	
	1½D	------	------	------	------	------	------	.0234	.0218	.0201	.0180	.0169	.0195	.0210	
6	------	⅓D	------	------	------	------	------	------	------	------	.0090	.0090	.0090	.0090	
	⅓D	⅔D	------	------	------	------	------	------	------	------	.0135	.0135	.0135	.0135	
	⅔D	1½D	------	------	------	------	------	------	------	------	.0180	.0180	.0180	.0180	
	1½D	------	------	------	------	------	------	------	------	------	.0226	.0226	.0226	.0226	
4	------	⅓D	------	------	------	------	------	------	------	------	------	.0135	.0135	.0135	
	⅓D	⅔D	------	------	------	------	------	------	------	------	------	.0203	.0203	.0203	
	⅔D	1½D	------	------	------	------	------	------	------	------	------	.0270	.0270	.0270	
	1½D	------	------	------	------	------	------	------	------	------	------	.0337	.0337	.0337	

at the left of table 54A the tolerance is large, and decreases as the diameter increases, then remains constant over a considerable range, and increases in the larger diameters in accordance with the general tendency for tolerances to increase with increase in diameter. The large values at the left minimize tap breakage, but with short lengths of engagement the stripping strength is sacrificed to the extent that the full tensile strength of the screw is not developed. However, strength in small sizes is usually not important, but in larger sizes strength is the primary factor determining the selection of size, and smaller but adequate minor diameter tolerances tend to permit the selection of a smaller size than would otherwise be possible for a given strength.

The tolerances in table 54A increase with increases in length of engagement and in pitch.

The fundamental basis of table 54A is the present set of minor diameter tolerances established for the American National coarse and fine thread series on the basis of experience in production. That is, values in the table corresponding to standard diameters and pitches, and lengths of engagement from $\frac{2}{3}D$ to $1\frac{1}{2}D$, are in close agreement with the NC and NF values, with slight deviations in some cases to conform with formulas used. These formulas express curves of a General Motors Engineering Standard chart, which subdivide the tolerance-diameter relationship into four zones, with a particular proportion of tolerance to diameter applicable in each zone, and apply to lengths of engagement from $\frac{2}{3}D$ to $1\frac{1}{2}D$. Tolerances for lengths of engagement less than $\frac{1}{3}D$ are ½ of these, for $\frac{1}{3}D$ to $\frac{2}{3}D$ are ¾ of these, and for over $1\frac{1}{2}D$ are 1¼ times these. However, where the resulting tolerance would result in a depth of thread less than 53 percent of the basic thread depth, the values are adjusted to produce the 53 percent depth of thread. In the fourth zone, corresponding to the larger diameters at the right of the table, tolerances for lengths of engagement from $\frac{2}{3}D$ to $1\frac{1}{2}D$ are adjusted to equality with class 2 pitch diameter tolerances, and for lengths greater than $1\frac{1}{2}D$ to equality with class 1 pitch diameter tolerances.

Table 54A thus provides a specific internal minor diameter tolerance for any given choice of diameter, pitch, and length of engagement, which is expected to fulfill all requirements of good design.

Page 111, table 54. Omit column 12, which is replaced by table 54A.

Page 115. Delete table 58. (See reference to p. 19 to 23 herein.)

SECTION VI. AMERICAN STANDARD PIPE THREADS [18]

This section is to be brought into agreement with ASA B2.1–1945, "Pipe Threads" by making the following revisions and corrections:

Throughout the section, change "American National" to "American Standard." The term "American National" is thus reserved to identify the thread form specified in section III.

Page 116. Revise the introduction to read as follows:

"The American Standard for Pipe Threads, originally known as the Briggs Standard, was formulated by Mr. Robert Briggs. For several years around 1862 Mr. Briggs was superintendent of the Pascal Iron Works of Morris, Tasker & Co., Philadelphia, Pa., and later engineering editor of the Journal of the Franklin Institute. After his death on July 24, 1882, a paper by Mr. Briggs containing detailed information regarding American pipe and pipe thread practice, as developed by him when superintendent of the Pascal Iron Works, was read before the Institution of Civil Engineers of Great Britain. This is recorded in the Excerpt Minutes, volume LXXI, Session 1882–83, part 1, of that Society.

"It is of interest to note that the nominal sizes (diameters) of pipe 10 inches and under, and the pitches of the thread were for the most part established between 1820 and 1840.

"By publishing his data, based on years of practice, Mr. Briggs was the means of establishing definite detail dimensions. The Briggs formula did not provide for the internal threads or gaging requirements for making taper threaded joints. It established only the external thread on pipe, with no tolerance.

"In 1886 the large majority of American manufacturers threaded pipe to practically the Briggs Standard, and acting jointly with the American Society of Mechanical Engineers they adopted it as a standard practice that year, and master plug and ring gages were made.

"Later, at various conferences, representatives of the manufacturers and the ASME established additional sizes, certain details of gaging, tolerances, special applications of the standard and, in addition, tabulated the formulas and dimensions more completely than was done by Mr. Briggs.

[18] This standard, in substantially the same form, has been adopted by the American Standards Association. It is published as ASA B2.1–1945, "American Standard Pipe Threads," by the ASME, 29 West Tbirty-ninth Street, New York 18, N. Y. The specifications for gages are in agreement with Federal Specification GGG–P–351a, "Pipe Threads; Taper (American National)."

"In 1913 a Committee on the Standardization of Pipe Threads was organized for the purpose of reediting and expanding the Briggs Standard. The American Gas Association and The American Society of Mechanical Engineers served as joint sponsors. After 6 years of work this committee completed the revised standard for taper-pipe threads, which was published in the ASME Transactions of 1919. During this period the thin ring gage was established, and the crests of the thread plug and ring gages were truncated. This standard was adopted by, and appeared in the various reports of the National Screw Thread Commission.

"In the years which followed, the need for a further revision of this American Standard became evident, as well as the necessity of adding to it the recent developments in pipe threading practice. Accordingly, the Sectional Committee on the Standardization of Pipe Threads, B2, was organized in 1927 under the joint sponsorship of the AGA and the ASME. The specifications in this section are in agreement with the current standard developed by that committee.

"Substantially the same standard for taper pipe threads, but with various additional refinements in gaging, is issued as Army-Navy Aeronautical Specification AN–GGG–P–363."

Page 117, at bottom, correct formula to read "$L_2=(0.8D+6.8)/n$."

Page 118, figure 23, revise as follows:

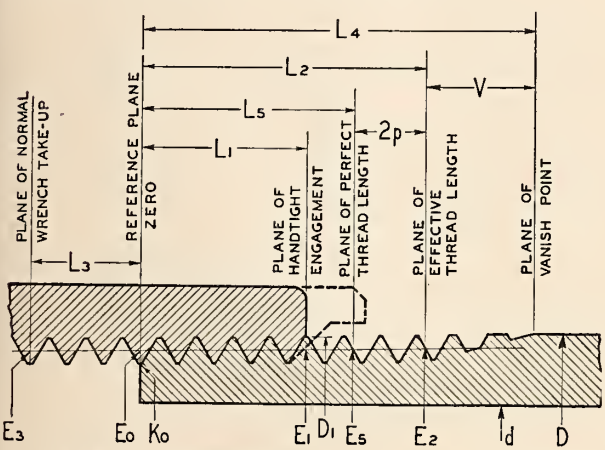


FIGURE 23. *American Standard taper pipe thread notation.*

NOTATION

$$E_0=D-(0.05D+1.1)1/n$$
$$E_1=E_0+0.0625L_1$$
$$L_2=\left(\frac{0.8D+6.8}{n}\right)$$

Page 118, 2d col., revise par. 1 to read as follows:

"1. MANUFACTURING TOLERANCE ON PRODUCT USING WORKING GAGES.—The maximum allowable variation in the commercial product is 1 turn large or 1 turn small from the gaging notch on plug and gaging face of ring when working gages are screwed up firmly by hand on or in the product. (See figs. 27 and 28.) This is equivalent to a maximum allowable variation of the product of 1½ turns large or small from the basic dimensions, on account of the permissible tolerance of ½ turn large or small on working gages."

Page 119, table 59, add to table heading, "NPT." Delete the 2-inch API line pipe from table and corresponding footnote number 7.

Page 120, footnote 8, add at end of first sentence: "for the 3-inch size and smaller."

Page 121, table 60, add "NPT" at end of table heading. In note at bottom, line 3, change "elimination" to "eliminating."

Page 122, 1st col., par. 2 and table 61, revise to read as follows:

"2. TOLERANCES ON THREAD ELEMENTS.—The permissible variations in thread elements on steel products and all pipe made of steel, wrought iron, or brass, exclusive of butt-weld pipe, are given in tables 60, 61, and 66. These tables are a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product threads.

"On pipe fittings and valves (not steel) for steam pressures 300 lb and below, it is intended that plug and ring gage practice, as set up in this standard, will provide for a satisfactory check of accumulated variations in such product of taper, lead, and angle. Therefore, no tolerances on thread elements have been established for this class.

"For service conditions, where more exact check is required, procedures have been developed by industry to supplement the regulation plug and ring gage method of gaging. See pars. (d) 1 (*b*) and (d) 1 (*c*), p. 123, H28(1944)."

TABLE 61. *Tolerances on taper, lead, and angle of pipe threads of steel products and of all pipe of steel, wrought-iron, or brass*

Nominal pipe size (inches)	Threads per inch	Limits on taper at pitch line, per foot		Lead in length of effective thread [1]	60° angle of thread
		Maximum	Minimum		
		Inch	*Inch*	*Inch* ±	*Degrees* ±
1/16, 1/8	27	7/8	1 1/16	0.003	2½
¼, 3/8	18	7/8	1 1/16	.003	2
½, ¾	14	27/32	1 1/16	[1].003	2
1, 1¼, 1½, 2	11½	27/32	1 1/16	[1].003	1½
2½ and larger	8	13/16	23/32	[1].006	1½

[1] The tolerance on lead shall be ±0.003 in. per in. on any size threaded to an effective thread length greater than 1 in.

NOTE.—For tolerances on depth of thread, see table 60, and for tolerances on pitch diameter, see par. (*c*) 1. For tolerances on Dryseal threads, see table 66.

Page 122, figure 24, change "L_3" to "L_2."

Page 123, 1st col., line 8, change "basic" to "reference." Line 18, after "notch," insert "is not essential but."

Page 123. Insert figure 26A, as follows:

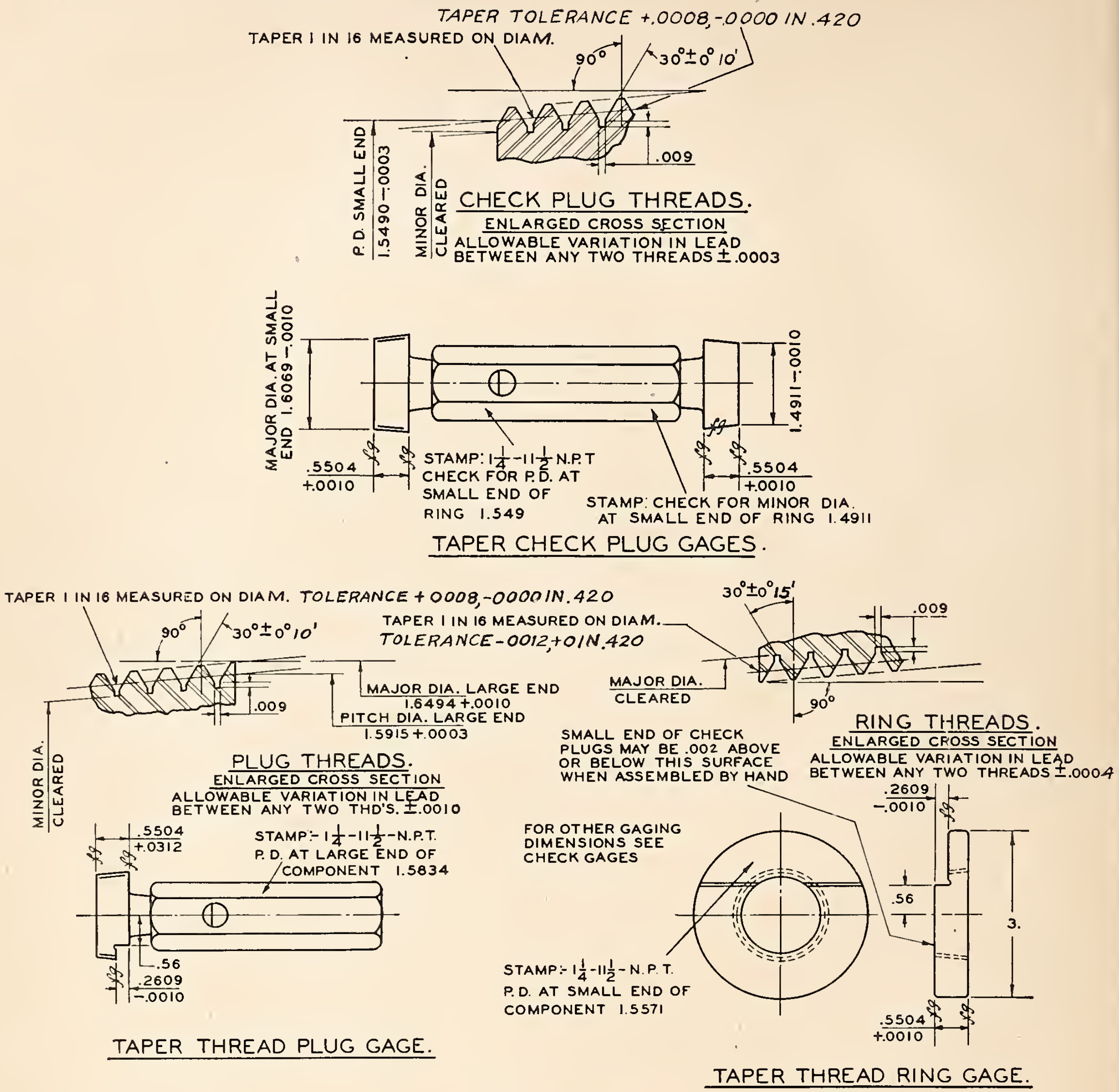


FIGURE 26A. *Methods of dimensioning taper pipe thread gages.*

Page 125, 1st col., under par. (c), add:

"It is to be noted that these gages are truncated at the crest an amount equal to 0.1p, so that they bear only on the flanks of the thread. Thus, although they do not check the crest truncations specified in table 60, they are satisfactory for the inspection of the general run of product. When it is deemed necessary to determine whether or not such truncations are within the limits specified, or particularly to see that the maximum truncation is not exceeded, it is necessary to make further inspection. For this purpose optical projection, or Army-Navy aeronautical specification gages, may be used.

Page 127, table 62: Add "NPT" to table heading. Correct figures in table as follows:

Column	*Now reads*	*Should read*
4	1. 27155	1. 27154
4	1. 61505	1. 61504
4	2. 32694	2. 32693
5	1. 29655	1. 29654
5	1. 64130	1. 64129
5	2. 35419	2. 35418
10	1. 15571	1. 15572
10	1. 49921	1. 49922
10	3. 25737	3. 25738
11	2. 67890	2. 67891
12	2. 70737	2. 70738
12	3. 33237	2. 33238

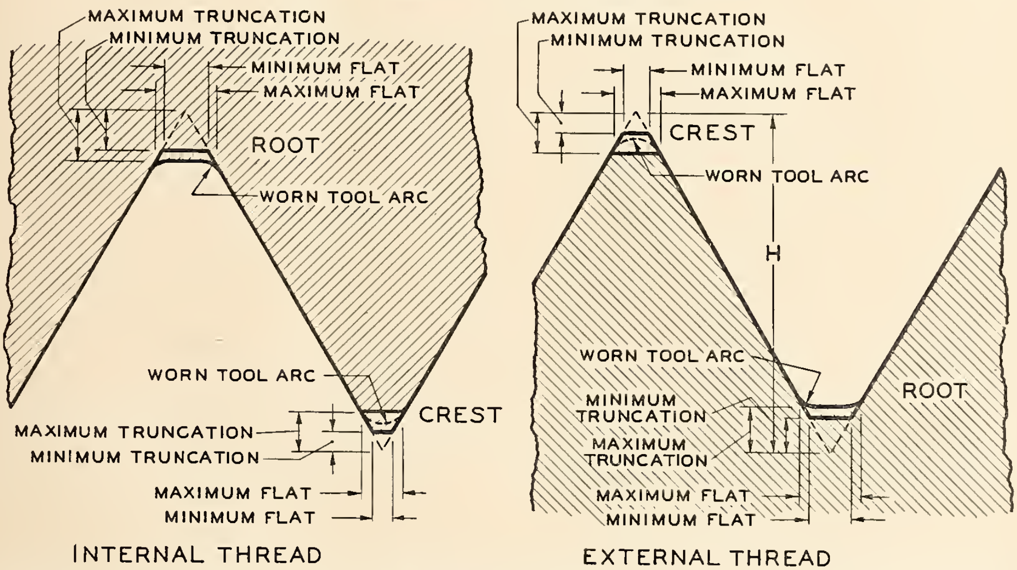
In footnote 1 insert after "when": "the product thread is."

Page 129, table 64, add "NPT" to table heading.

Page 131, table 66: Add "NPTF" to table heading.

Page 132, table 67, revise as shown:

TABLE 67. *Limits of size on crest and root of Dryseal American Standard external and internal taper pipe threads;*[1] *(pressure-tight joints without lubricant or sealer), NPTF*



Threads per inch	Depth of sharp V thread, H	Depth of pipe thread		Truncation				Tolerance on truncation	Equivalent width of flat [2]				Tolerance on equivalent width of flat
		Maximum, h	Minimum	Minimum		Maximum			Minimum		Maximum		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Inch	*Inch*	*Inch*	*Formula*	*Inch*	*Formula*	*Inch*	*Inch*	*Formula*	*Inch*	*Formula*	*Inch*	*Inch*
27—													
Crest	0. 03208	0. 02685	0. 02426	0. 047p	0. 0017	0. 094p	0. 0035	0. 0018	0. 054p	0. 0020	0. 108p	0. 0040	0. 0020
Root				. 094p	. 0035	. 140p	. 0052	. 0017	. 108p	. 0040	. 162p	. 0060	. 0020
18—													
Crest	. 04811	. 04117	. 03856	. 047p	. 0026	. 078p	. 0043	. 0017	. 054p	. 0030	. 090p	. 0050	. 0020
Root				. 078p	. 0043	. 109p	. 0061	. 0018	. 090p	. 0050	. 126p	. 0070	. 0020
14—													
Crest	. 06186	. 05500	. 05236	. 036p	. 0026	. 060p	. 0043	. 0017	. 042p	. 0030	. 070p	. 0050	. 0020
Root				. 060p	. 0043	. 085p	. 0061	. 0018	. 070p	. 0050	. 098p	. 0070	. 0020
11½—													
Crest	. 07531	. 06661	. 06313	. 040p	. 0035	. 060p	. 0052	. 0017	. 046p	. 0040	. 069p	. 0060	. 0020
Root				. 060p	. 0052	. 090p	. 0078	. 0026	. 069p	. 0060	. 103p	. 0090	. 0030
8—													
Crest	. 10825	. 09613	. 09275	. 042p	. 0052	. 055p	. 0069	. 0017	. 048p	. 0060	. 064p	. 0080	. 0020
Root				. 055p	. 0069	. 076p	. 0095	. 0026	. 064p	. 0080	. 088p	. 0110	. 0030

[1] Although these threads are designed for use without a lubricant or sealer, its use may be found to be desirable.

[2] The major diameter of plug gages and the minor diameter of ring gages used for gaging Dryseal threads shall be truncated 0.20p for 27 threads per inch, and 0.15p for 18, 14, 11½, and 8 threads per inch.

NOTE.—Dimensions are specified to 4 and 5 decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are so expressed for the purpose of eliminating errors in computations.

Page 133, table 68, add "NPTR" to table heading.

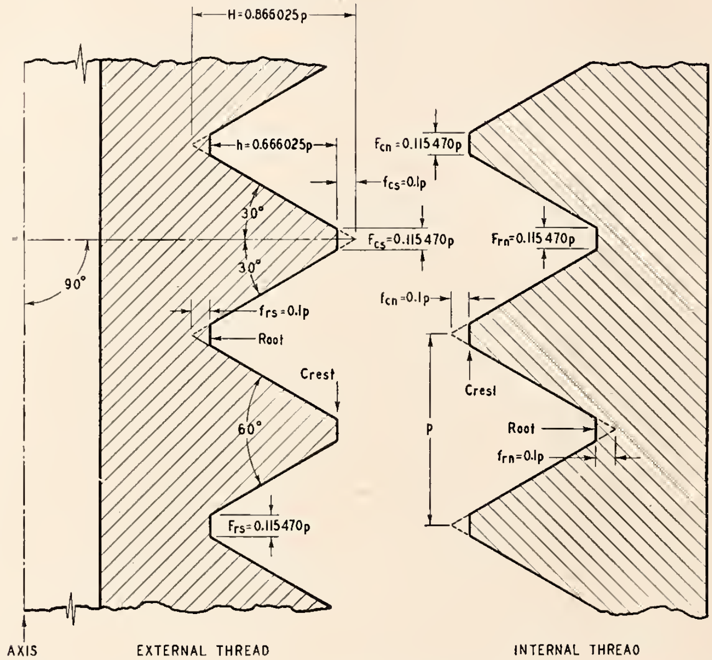
Page 134, table 69, revise figures in table as follows:

Column	Now reads	Should read
9	0. 36	0. 357
9	. 43	. 435
9	. 81	. 812
9	. 94	. 937
11	1. 31	1. 312
11	1. 44	1. 437

Page 135, table 70, add to table heading, "NPSC."

Page 136, table 71, add to table heading, "NPSF."

Page 136 table 72, add to table heading, "NPSM," and insert the following illustration:



Page 136, last sentence of text, revise to read: "Major and minor diameters have been calculated on the basis of a truncation of $0.1p$, to provide no interference at crest and root when product is gaged with gages made in accordance with par. (c) 4, below."

Page 137, add at end of text: "Major and minor diameters have been calculated on the basis of a truncation of $0.1p$."

On page 137, table 73, add to table heading, "NPSL," and insert the above illustration, as indicated for table 72.

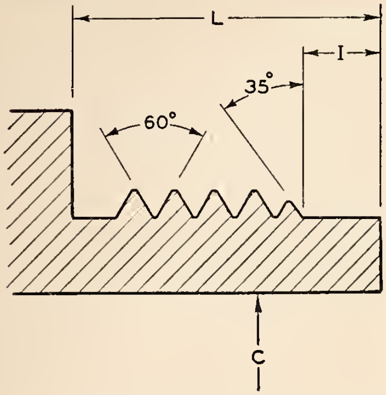
SECTION VII. AMERICAN NATIONAL HOSE-COUPLING AND FIRE-HOSE COUPLING THREADS

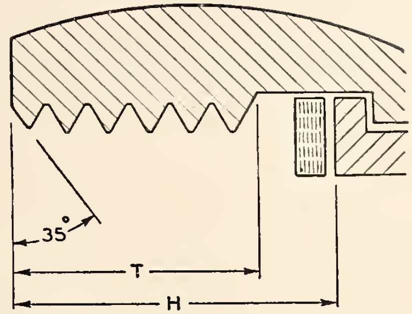
Page 140, 2d col. of text, add to end of sentence above "Examples:—" "to be made up with standared pipe threads."

Page 140, table 74, insert as 2d col., heading "Identification symbol." Insert as symbols "NH" for first three items, and "NPSH" for remaining six items. Make corresponding insertions in tables 76, 77, and 78, with symbol "NH" for fire-hose threads.

Page 141, table 75, add to table heading "NH."

Page 144, table 78, revise illustration to show truncated threads, thus:





Page 145, table 79, add to table heading "NH."

Pages 146, 147, tables 80 and 81, in headings for 2d, 3d, and 4th columns insert "NH," and for 5th column insert "NPSH."

SECTION VIII. MISCELLANEOUS STANDARDIZED PRODUCT THREADS OF AMERICAN NATIONAL FORM, OR AMERICAN STANDARD PIPE THREAD FORM (PAGE 148)

1. GAS CYLINDER VALVE THREADS

The valves for cylinders containing compressed gases embody several screw threads, namely: (1) The outlet connection, (2) the neck, or valve to cylinder connection, (3) the safety device cap or plug, and (4) the various threads associated with the valve mechanism. While the practice for all of these threads is fairly well established, only the outlet threads (1) have been fully standardized.

(a) OUTLET CONNECTIONS.

The threads for valve outlets were not specifically defined in the past and their form, tolerances, and sizes varied considerably in practice. Such threads were not officially recorded by the industry but were simply made in accordance with the best understanding and judgment of various manufacturers and users who usually handled either the cylinder with its valve, and not the connecting equipment, or the other way around. This separation of interests at the valve outlet caused wide discrepancies as compared, for example, with a special thread on a pipe union where the entire fitting is made as one unit by one manufacturer.

The Compressed Gas Manufacturers' Association, Inc., had had valve outlet standards for industrial and medical oxygen for a good many years, revising them from time to time to bring them closer to National practice. Likewise, the Chlorine Institute had set up its standard for chlorine some time ago.

The Valve Thread Standardization Committee of the Compressed Gas Manufacturers' Association, working in conjunction with federal services and other interested groups, was given a splendid opportunity during the late war to study valve outlets, especially those for federal services which were made and inspected to strict specifications. The study resulted in a closer definition and appreciation of each outlet, and in a more balanced relationship of the many outlets to each other to achieve the utmost in safety. In January, 1946, the findings and formulated standards, upon which the federal data contained herein are based, appeared in the Committee's report "Standard Compressed Gas Cylinder Valve Outlets."

Either a single gas, or else several gases which create no hazard if interchanged, are assigned to the same outlet. With the exception of outlets having taper pipe threads which seal at the threads, each outlet provides for a seat and nipple which make a gas-tight joint against leaks and also provides for 14-pitch American National form screw threads not in the regular series. These threads do not seal but merely hold the nipple against its seat.

The threads on the valves fall into four divisions, right-hand or left-hand (RH or LH) and external or internal (EXT or INT). These four basic divisions are so vital to prevent undesirable cross-connecting that the full designation of each gas-outlet thread includes the terms RH or LH and EXT or INT. In general, where practicable, right-hand threads are used for nonfuel or for water-pumped gases, and left-hand threads for fuel or for oil-pumped gases. Left-hand threads are identified by a groove across the corners of the hexagon nut.

The nominal diameters of the threads in each division are spaced far enough apart so they will not engage with the thread of an adjoining size. An allowance (minimum clearance) of 0.0050 inch between the mating parts is established to provide the desired looseness of fit at the threads and to assure uninterrupted interchangeability between products of different manufacturers, who lacked a common standard in the past. The tolerances are in the direction of greater looseness and are determined on the basis of NS–3 data, except for the major diameter of the external thread where the tolerance is 0.0050 inch instead of 0.0098 inch.

Screw threads meeting the above specifications bear the designation NGO, National Gas Outlet, as a separate and distinct symbol for valve outlet threads. This symbol was suggested and designated by the Interdepartmental Screw Thread Committee, representing the Federal agencies, to provide for the peculiar needs of the industry. The designation NGO (Cl) applies to the alternate chlorine thread which has been used successfully without change for many years.

The data in table 85 list the industrial and

Table 85.—*U. S. A. compressed gas cylinder valve outlet threads*

Number	Gas	Thread of valve	Mating thread
1	2	3	4
1	Acetylene, standard	0.885″–14NGO–LH–INT	0.880″–14NGO–LH–EXT.
2	Acetylene, alternate [1]	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
3	Air, water-pumped	.965″–14NGO–RH–INT	.960″–14NGO–RH–EXT.
4	Air, oil-pumped	.965″–14NGO–LH–INT	.960″–14NGO–LH–EXT.
5A 5B	Ammonia, anhydrous, standard [2]	3/8″–18NPT–RH–INT, or 1/2″–14NPT–RH–INT	3/8″–18NPT–RH–EXT, or 1/2″–14NPT–RH–EXT.
6	Ammonia, anhydrous, alternate [1]	3/8″–18NPT–RH–INT, with 1″–14NF–2LH–EXT for nut	3/8″–18NPT–RH–EXT, with 1″–14NF–2LH–INT for nut.
7	Argon, water-pumped	.965″–14NGO–RH–INT	.960″–14NGO–RH–EXT.
8	Argon, oil-pumped	.965″–14NGO–LH–INT	.960″–14NGO–LH–EXT.
9	Butadiene	.885″–14NGO–LH–INT	.880″–14NGO–LH–EXT.
10	Butane, standard	.885″–14NGO–LH–INT	.880″–14NGO–LH–EXT.
11	Butane, No. 1 alternate [1]	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
12	Butane, No. 2 alternate [1]	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
13	Carbon dioxide, standard	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
14	Carbon dioxide, medical	Standard medical gas flush outlet for yoke	Standard medical gas flush outlet for yoke.
15	Chlorine, standard	1.030″–14NGO–RH–EXT	1.035″–14NGO–RH–INT.
16	Chlorine, alternate [1]	1.034″–14NGO(Cl)–RH–EXT	1.035″–14NGO(Cl)–RH–INT.
17	Cyclopropane	Standard medical gas flush outlet for yoke	Standard medical gas flush outlet for yoke.
18	Dichlorodifluoro-methane	1.030″–14NGO–RH–EXT	1.035″–14NGO–RH–INT.
19	Ethane	0.825″–14NGO–LH–EXT	0.830″–14NGO–LH–INT.
20	Ethyl chloride	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
21	Ethylene, industrial and medical	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
22	Ethylene, medical	Standard medical gas flush outlet for yoke	Standard medical gas flush outlet for yoke.
23	Ethylene oxide, standard	.885″–14NGO–LH–INT	.880″–14NGO–LH–EXT.
24	Ethylene oxide, alternate [1]	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
25	Helium, water-pumped, standard	.965″–14NGO–RH–INT	.960″–14NGO–RH–EXT.
26	Helium, medical	Standard medical gas flush outlet for yoke	Standard medical gas flush outlet for yoke.
27	Helium, oil-pumped, standard	.965″–14NGO–LH–INT	.960″–14NGO–LH–EXT.
28	Helium, oil-pumped, alternate [4]	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
29	Hydrogen	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
30	Isobutane, standard	.885″–14NGO–LH–INT	.880″–14NGO–LH–EXT.
31	Isobutane, alternate [1]	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
32	Methane	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
33	Methyl chloride, standard	1.030″–14NGO–RH–EXT	1.035″–14NGO–RH–INT.
34	Methyl chloride, alternate [1]	1/2″–14NPT–RH–EXT	1/2″–14NPT–RH–INT.
35	Nitrogen, water-pumped	.965″–14NGO–RH–INT	.960″–14NGO–RH–EXT.
36	Nitrogen, oil-pumped	.965″–14NGO–LH–INT	.960″–14NGO–LH–EXT.
37	Nitrous oxide, standard	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
38	Nitrous oxide, medical	Standard medical gas flush outlet for yoke	Standard medical gas flush outlet for yoke.
39	Oxygen, industrial and medical	.903″–14NGO–RH–EXT	.908″–14NGO–RH–INT.
40	Oxygen, medical [3]	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
41	Oxygen, medical	Standard medical gas flush outlet for yoke	Standard medical gas flush outlet for yoke.
42	Propane, standard	.885″–14NGO–LH–INT	.880″–14NGO–LH–EXT.
43	Propane, No. 1 alternate [1]	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
44	Propane, No. 2 alternate [1]	.825″–14NGO–RH–EXT	.830″–14NGO–RH–INT.
45	Propylene, standard	.885″–14NGO–LH–INT	.880″–14NGO–LH–EXT.
46	Propylene, alternate [1]	.825″–14NGO–LH–EXT	.830″–14NGO–LH–INT.
47	Sulfur dioxide, standard	1.030″–14NGO–RH–EXT	1.035″–14NGO–RH–INT.
48	Sulfur dioxide, alternate [1]	1/2″–14NPT–RH–EXT	1/2″–14NPT–RH–INT.

[1] Alternate outlet dimensions are shown to indicate valve outlet threads widely used by industry in addition to the approved standards. Federal services shall not specify alternate outlet dimensions. In areas where gases cannot be readily procured commercially in cylinders equipped with valves complying with these standards, cylinders equipped with valves complying with the alternate standards may be accepted, provided authority to do so is specifically granted by the Government department concerned. Alternates may be used only during a limited transition period.

[2] Outlet 5A is standard for Federal services.

[3] Outlet 40, extensively used by the medical profession for oxygen, is not authorized for Federal services.

[4] Outlet 28 is past practice and is authorized for interim use but not for new procurement by Federal services.

Note.—Details of valve outlets and connections are published by the Compressed Gas Manufacturers' Association, Inc., 11 West Forty-second Street, New York 18, N. Y.

medical gases with the threads used on the respective valves and on their mating parts, while the data in table 85A give complete thread information for the use of toolmakers, manufacturers, and inspectors. Table 85B is a rearrangement of the data in the first three columns of table 85 to show interchangeability among gases and outlet threads. Attention is directed to footnote 1 of table 85 relative to alternates, which are to be eliminated as rapidly as possible.

For a complete and detailed design of each gas outlet and its connecting parts, see "Standard Compressed Gas Cylinder Valve Outlets" published by the Compressed Gas Manufacturers' Association, Inc., 11 West Forty-second Street, New York 18, N. Y.

Gages for "NGO" threads specified in table 85A shall be made in accordance with the gage specifications in section III. Gages for the "NPT" threads listed in table 85 shall be made in accordance with the gage specifications in section VI.

(b) INLET CONNECTIONS

The screw threads on the inlet connections on the valve and in the cylinder neck are taper pipe threads subject to very high pressures and are longer than the American Standard taper pipe threads but otherwise conform to the dimensions given in tables 59 and 60. Proper control of the dimensions within the tolerances specified for all elements of the threads is necessary to prevent leakage and requires gages of special design.

[The remainder of this subsection is in process of being revised.]

Further corrections:

Page 151, table 86 column 3, next to last line, change "1″–14NPT" to "1″–11½ NPT."

Page 152, table 87B, in right-hand view of plug, delete diameter D and show diameter K_1 at notch B located at length L_1 from end. Page 154, footnote 24, insert "of" after "dimensions."

TABLE 85A. *Limits of size of U. S. A. compressed gas cylinder valve outlet threads series NGO*

Symbol (designation of thread)	External thread					Internal thread				
	Major diameter		Pitch diameter		Minor diameter	Minor diameter		Pitch diameter		Major diameter
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	2	3	4	5	6	7	8	9	10	11
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*
.745″–14NGO$^{-RH}_{-LH}$-EXT	0.7450	0.7400	0.6986	0.6950	0.6574					
.750″–14NGO$^{-RH}_{-LH}$-INT						0.6727	0.6804	0.7036	0.7072	0.7500
.825″–14NGO$^{-RH}_{-LH}$-EXT	.8250	.8200	.7786	.7750	.7374					
.830″–14NGO$^{-RH}_{-LH}$-INT						.7527	.7604	.7836	.7872	.8300
.880″–14NGO-LH-EXT	.8800	.8750	.8336	.8300	.7924					
.885″–14NGO-LH-INT						.8077	.8154	.8386	.8422	.8850
.903″–14NGO-RH-EXT	.9030	.8980	.8566	.8530	.8154					
.908″–14NGO-RH-INT						.8307	.8384	.8616	.8652	.9080
.960″–14NGO$^{-RH}_{-LH}$-EXT	.9600	.9550	.9136	.9100	.8724					
.965″–14NGO$^{-RH}_{-LH}$-INT						.8877	.8954	.9186	.9222	.9650
1.030″–14NGO$^{-RH}_{-LH}$-EXT	1.0300	1.0250	.9836	.9796	.9424					
1.035″–14NGO$^{-RH}_{-LH}$-INT						.9577	.9654	9886	.9926	1 0350
1.034″–14NGO(C1)-RH-EXT	1.0340	1.0300	.9835	.9795	.9330					
1.035″–14NGO(C1)-RH-INT						.9400	.9530	.9845	.9885	1.0350

TABLE 85B. *Correlation of threads of valve and gases to show interchangeability*

Thread of valve	Number	Gas
0.825–14NGO–RH–EXT	2	Acetylene, alternate.
	12	Butane, No. 2 alternate.
	13	Carbon dioxide, standard.
	20	Ethyl chloride.
	37	Nitrous oxide, standard.
	40	Oxygen, medical.
	44	Propane, No. 2 alternate.
0.825–14NGO–LH–EXT	11	Butane, No. 1 alternate.
	19	Ethane.
	21	Ethylene, industrial and medical.
	24	Ethylene oxide, alternate.
	28	Helium, oil-pumped, alternate.
	29	Hydrogen.
	31	Isobutane, alternate.
	32	Methane.
	43	Propane, No. 1 alternate.
	46	Propylene, alternate.
0.885–14NGO–LH–INT	1	Acetylene, standard.
	9	Butadiene.
	10	Butane, standard.
	23	Ethylene oxide, standard.
	30	Isobutane, standard.
	42	Propane, standard.
	45	Propylene, standard.
0.903–14NGO–RH–EXT	39	Oxygen, industrial and medical.
0.965–14NGO–RH–INT	3	Air, water-pumped.
	7	Argon, water-pumped.
	25	Helium, water-pumped, standard.
	35	Nitrogen, water-pumped.
0.965–14NGO–LH–INT	4	Air, oil-pumped.
	8	Argon, oil-pumped.
	27	Helium, oil-pumped, standard.
	36	Nitrogen, oil-pumped.
1.030–14NGO–RH–EXT	15	Chlorine, standard.
	18	Dichlorodifluoro-methane.
	33	Methyl chloride, standard.
	47	Sulfur dioxide, standard.
1.034–14NGO(Cl)–RH–EXT	16	Chlorine, alternate.
⅜″–18NPT–RH–INT	5A	Ammonia, anhydrous, standard.
	6	Ammonia, anhydrous, alternate.
½″–14NPT–RH–EXT	34	Methyl chloride alternate.
	48	Sulfur dioxide, alternate.
½″–14NPT–RH–INT	5B	Ammonia, anhydrous, standard.
Standard medical gas flush outlet for yoke.	14	Carbon dioxide, medical.
	17	Cyclopropane.
	22	Ethylene, medical.
	26	Helium, medical.
	38	Nitrous oxide, medical.
	41	Oxygen, medical.

SECTION X. ACME THREADS

The American War Standard ASA B1.5–1945, "Acme Threads," of the American Standards Association, is being considered by the ASA Sectional Committee B1 for adoption as an American Standard. It is to be anticipated that there will be some revisions.

The following revisions and corrections to be made in this section are necessary to bring it into substantial agreement with the American War Standard as published, and with the specifications for gages in section III of this supplement:

Page 158, 2d col., at end of "1. GENERAL AND HISTORICAL," insert:

"While threads for valve operation may be made to this standard, the application is highly specialized and these data should not be used without consultation with the valve manufacturer."

Page 159, 2d col., 3d sentence under table, change to read: "It is suggested that screws and nuts of the same class be used together for either general purpose or centralizing assemblies."

Page 159, 2d col., last line: Delete remainder of paragraph and substitute: "Classes 5C and 6C screws and nuts can be used interchangeably, but if a class 5C nut is used with a class 6C screw, the available backlash is less than when used with a class 5C screw."

Page 160, 2d col., par. No. 4, line 6, change "column 8" to "column 4." (Same correction applies to ASA B1. 5–1945.)

Page 161, 2d col., line 7 from bottom, change "*BD*" to "*B*."

Page 174, table 98, column headed ⅜, change ".2731" to ".2730."

Pages 177–179, revise the text to read as follows:

7. GAGES FOR ACME THREADS

Gages representing both extreme product limits, or adequate gaging instruments for thread elements, are necessary for the proper inspection of Acme screw threads. The dimensions of "go" and "not go" gages should be in accordance with the principles: (a) that the maximum-metal limit, or "go", gage should check simultaneously as many elements as possible, and that a minimum-metal limit or "not go" thread gage can effectively check but one element; and (b) that permissible variations in the gages be kept within the extreme product limits.

(a) GAGE TOLERANCES

Tolerances for the thread elements of "go" and "not go" thread gages for Acme threads are given in tables 12, p. 39, and 100, p. 179, H28(1944).

1. TOLERANCES ON PITCH DIAMETER.—The pitch diameter tolerances for gages for class 2 screws and nuts are given in table 100, column 2, and for gages for classes 3, 4, 5, and 6 screws and nuts, in table 100, column 3.

2. TOLERANCES ON MAJOR AND MINOR DIAMETERS.—The major and minor diameter tolerances for Acme thread gages are given in table 100, column 4. These are applicable to all gages except the "go" and "not go" thread plug gages for major diameter of all classes of centralizing nuts, and for "go" and "not go" plain ring or snap gages for major diameter of centralizing screws. For these gages the tolerances are class Z, as given in table 12, p. 39, H28(1944).

3. TOLERANCES ON LEAD.—The variation in lead of all Acme thread gages for classes 3, 4, 5, and 6 product shall not exceed 0.0002 inch between any two threads not farther apart than one inch. However, the cumulative error in lead shall not exceed 0.0003 inch for gages with a length over 1

to 3 inches, inclusive; or 0.0004 inch for gages with a length over 3 to 5 inches, inclusive; or 0.0006 inch for gages with a length over 5 to 10 inches, inclusive. For gages for class 2 product, 0.0001 inch shall be added to the above values. For multiple threads, the cumulative tolerance for pitch and lead shall be multiplied by 1.5.

4. Tolerances on Angle of Thread.—The tolerances on angle of thread, as specified in table 100, column 5, for the various pitches are tolerances on one-half of the included angle. This insures that the bisector of the included angle will be perpendicular to the axis of the thread within proper limits. The equivalent deviation from the true thread form caused by such irregularities as convex or concave sides of thread, or slight projections on the thread form, should not exceed the tolerances permitted on angle of thread.

(b) GAGES FOR SCREW

1. "Go" Thread Ring or Thread Snap Gage.—(*a*) *Major diameter.*—The major diameter of the "go" thread ring or thread snap gage shall clear a diameter greater by 0.01 inch than the maximum major diameter of the screw.

(*b*) *Pitch diameter.*—The pitch diameter shall fit the maximum-metal limit thread setting plug gage.

(*c*) *Minor diameter.*—For general purpose screws, the minor diameter of the "go" thread ring gage shall be the same as the maximum minor diameter of the screw plus 0.005 inch for pitches finer than 10 threads per inch, and plus 0.010 inch for 10 threads per inch and coarser, to allow for possible errors in concentricity of the pitch and minor diameters of the product. The tolerance shall be minus.

For centralizing screws, the minor diameter of the "go" thread ring gage shall be less than the minimum minor diameter of the nut by the amount of the allowance on pitch diameter, table 94, columns 3 to 5. The tolerance (table 100, column 4) shall be minus.

(*d*) *Length.*—The length of the "go" thread ring or thread snap gage should approximate the length of engagement (see footnote to table 101) but should not exceed the length specified in table 101, col. 3.

2. Maximum-Metal Limit Thread Setting Plug for "Go" Thread Ring or Snap Gages.—(*a*). *Major diameter.*—The major diameter of the basic-form maximum-metal limit thread setting plug gage shall be the same as the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken plus. The major diameter of the truncated maximum-metal limit thread setting plug gage shall be smaller by one-third of the basic thread depth ($=p/6$) than the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken minus.

(*b*) *Pitch diameter.*—The pitch diameter of the maximum-metal limit thread setting plugs for all general purpose screws shall be the same as the maximum pitch diameter of the screw. For centralizing screws, if the product length of engagement exceeds the length of the ring gage, table 101, column 3, the pitch diameter of the maximum-metal limit thread setting plugs shall be less than the maximum pitch diameter of the screw by the amount stated in table 101, column 5. The gage tolerance (table 100, columns 2 and 3) shall be minus.

(*c*) *Minor diameter.*—The minor diameter shall be cleared below the minimum minor diameter of the "go" thread ring gage.

(*d*) *Length.*—The length of the maximum-metal limit thread setting plug gage should approximate the length of the "go" thread ring or thread snap gage.

3. "Go" Plain Ring or Snap Gage for Major Diameter.—The diameter of the "go" plain ring gage, or gaging dimension of the "go" plain snap gage, shall be the same as the maximum major diameter of the screw. The class Z tolerances given in table 12, p. 39, H28 (1944), shall be applicable to gages for centralizing threads. Tolerances given in table 100, column 4, shall be applicable to gages for general purpose threads. The tolerances shall be taken in the minus direction.

4. "Not Go" Thread Ring or Thread Snap Gage.—(*a*) *Major diameter.*—The major diameter of the "not go" thread ring or thread snap gage shall clear a diameter greater by 0.01 inch than the maximum major diameter of the screw. The clearance cut may have $0.435p$ maximum width between intersections with the flanks of the thread.

(*b*) *Pitch diameter.*—The pitch diameter shall fit the minimum-metal limit thread setting plug gage.

(*c*) *Minor diameter.*—The minor diameter shall be the basic minor diameter of the nut plus $p/4$, with the tolerance (table 100, column 4) taken plus.

(*d*) *Length.*—The length of the "not go" thread ring or thread snap gage should approximate 3 pitches (see footnote to table 101). When a multiple thread is involved, the "not go" thread ring or snap gage shall be of such length as to provide at least 1 full turn of thread.

5. Thread Setting Plug for "Not Go" Thread Ring or Thread Snap Gage.—(*a*) *Major diameter.*—The major diameter of the basic-form minimum-metal limit thread setting plug gage shall be the same as the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken plus. The major diameter of the truncated minimum-metal limit thread setting plug gage shall be truncated one-third basic thread depth ($=p/6$) smaller than the maximum major diameter of the screw. The gage

tolerance (table 100, column 4) shall be taken minus.

(*b*) *Pitch diameter.*—The pitch diameter shall be the same as the minimum pitch diameter of the screw, with the tolerance taken plus.

(*c*) *Minor diameter.*—The minor diameter shall be cleared below the minimum minor diameter of the "not go" thread ring gage.

(*d*) *Length.*—The length shall be at least equal to the length of the "not go" thread ring or thread snap gage.

6. "Not Go" Plain Snap Gage for Major Diameter.—The gaging dimension of the "not go" plain snap gage shall be the same as the minimum major diameter of the screw. Class Z tolerances given in table 12, p. 39, H28 (1944) shall be applicable to gages for centralizing threads. Tolerances given in table 100, column 4 shall be applicable to gages for general purpose threads. The gage tolerance shall be taken in the plus direction.

(c) GAGES FOR NUT

1. "Go" Thread Plug Gage, General Purpose Threads.—The major diameter of the "go" thread plug gage for general purpose threads shall be equal to the minimum major diameter of the nut minus 0.005 inch for pitches finer than 10 threads per inch, and minus 0.010 inch for 10 threads per inch and coarser, to allow for possible errors in concentricity of the pitch and major diameters of the product. The gage tolerance (table 100, column 4) shall be plus.

(*b*) *Pitch diameter.*—The pitch diameter shall be equal to the minimum (basic) pitch diameter of the nut, with the tolerance (table 100, columns 2 and 3) taken plus.

(*c*) *Minor diameter.*—The minor diameter shall clear a diameter less by 0.01 inch than the minimum minor diameter of the nut.

(*d*) *Length.*—The length of the "go" thread plug gage should approximate the length of engagement (see footnote to table 101) but shall not exceed twice the nominal major diameter unless specifically requested.

2. "Go" Thread Plug Gage for Centralizing Threads.—(*a*) *Major diameter.*—The major diameter of the "go" thread plug gage for centralizing threads shall be the same as the minimum major diameter of the nut with a plus tolerance, class Z (table 12, p. 39, H28 (1944). Both corners at the crest shall be chamfered equally at an angle of 45°, leaving a width of flat at crest of $0.28p+0.00, -0.02p$.

(*b*) *Pitch diameter, minor diameter, and length.*—The pitch diameter, minor diameter, and length of gage shall be the same as those given in 1 (b), 1 (c), and 1 (d) above.

3. "Not Go" Thread Plug Gage for Pitch Diameter of All Nuts.—(*a*) *Major diameter.*—The major diameter of the "not go" thread plug gage shall be equal to the maximum (basic) major diameter of the screw minus $p/4$, with the tolerance (table 100, column 4) taken minus.

(*b*) *Pitch diameter.*—The pitch diameter shall be the same as the maximum pitch diameter of the nut, with the tolerance (table 100, columns 2 and 3) taken minus.

(*c*) *Minor diameter.*—The minor diameter shall clear a diameter less by 0.01 inch than the minimum minor diameter of the nut. The clearance cut may have $0.435p$ maximum width between intersections with the flanks of the thread.

(*d*) *Length.*—The length of the "not go" thread plug gage should approximate 3 pitches (see footnote to table 101). When a multiple thread is involved, the "not go" thread plug gage shall be of such length as to provide at least 1 full turn of thread.

4. "Not Go" Thread Plug Gage for Major Diameter of Centralizing Nut.—The major diameter shall be equal to the maximum major diameter of the nut. The tolerance shall be class Z (table 12, p. 39, H28 (1944), taken minus. The included angle of the thread shall be 29°. The pitch diameter shall be the maximum pitch diameter of the class 4C centralizing *screw* (for centralizing nuts, classes 2C, 3C, and 4C) or the maximum pitch diameter of the class 6C centralizing *screw* (for centralizing nuts, classes 5C and 6C), with a minus tolerance of twice that given in table 100, column 3. The crest corners shall be chamfered 45° equally to leave a central crest flat not more than $0.24p$ wide. The approximate depth of chamfer is $0.07p$. The minor diameter shall clear a diameter less by 0.01 inch than the minimum minor diameter of the nut. The length should approximate 3 pitches (see footnote to table 101). When a multiple thread is involved, the "not go" gage shall be of such length as to provide at least 1 full turn of thread.

5. "Go" Plain Plug Gage for Minor Diameter of Nut.—The diameter of the "go" plain plug gage shall be the same as the minimum minor diameter of the nut. The gage tolerance shall be class Z (table 12, p. 39, H28 (1944)), taken plus. The gage length shall be in accordance with Commercial Standard CS8–41, Gage Blanks, or the latest revision thereof.

6. "Not Go" Plain Plug for Minor Diameter of Nut.—The diameter of the "not go" plain plug gage shall be the same as the maximum minor diameter of the nut. The gage tolerance shall be class Z (table 12, p. 39, H28 (1944)), taken minus. The gage length shall be in accordance with CS8–41 or the latest revision thereof.

(d) CONCENTRICITY

Methods of securing concentricity between major and pitch diameters of screw or nut must be determined for each individual application.

Page 180, revise note under table 101 to read as follows:

NOTE.—The above compensation is based on a length of engagement not exceeding two diameters and on a lead error in the product not exceeding the following values (in inch):

0.0003 in length of ½ inch or less.
.0004 in length over ½ to 1½ inches.
.0005 in length over 1½ to 3 inches.
.0007 in length over 3 to 6 inches.
.0010 in length over 6 to 10 inches.

The principles have been established in the foregoing requirements that "go" gages should approximate the length of engagement, and "not go" gages should be 3 pitches long. For reasons of economy or limitations in gage manufacture or use, it may be desirable to modify these principles to: (1) Take advantage of the economies of using standard blanks, as listed in CS8–41, wherever they may be utilized successfully. (2) Avoid too cumbersome ring gages as well as excessively expensive gages by limiting the length of "go" thread ring gages to maximum lengths given in column 3 above. (3) Avoid excessively cumbersome thread plug gages by limiting maximum length to 2 diameters wherever possible. (4) Take full advantage of modern equipment for producing and checking accurate leads, particularly where long engagements are involved, thus permitting the use of standard or moderate length thread plug, thread ring, or thread snap gages. Alternatively, of course, instruments might be used for checking diameters and angles independently.

Should a "go" gage shorter than the length of engagement be chosen, independent means should be used to measure lead error in product. The maximum metal condition must be reduced to assure free assembly of product, if the lead error in the length of engagement, δp, so determined, exceeds 0.259 G, where G is the product pitch diameter allowance. The required amount of change in pitch diameter, ΔE, of the product (minus on external thread, plus on internal thread) accordingly is

$$\Delta E=3.867\left(1-\frac{L_g}{L_e}\right)\delta p,$$

where L_g is the length of the gage, and L_e is the length of engagement. When instruments are used for checking diameter it is a simple matter to make this allowance. When thread plug and ring gages are used, the allowance is sometimes increased a fixed amount, as outlined in the above table. This arbitrarily reduces the tolerance on diameter.

SECTION XI. WRENCH-HEAD BOLTS AND NUTS, AND WRENCH OPENINGS

Page 181, footnote 26, add: "Stock production sizes (lengths, diameters, etc.) of regular square and hexagon head machine bolts and heavy, regular, and light nuts are given in Simplified Practice Recommendation R169–37, Machine, Carriage, and Lag Bolts (Steel) (Stock Production Sizes)."

Page 185, table 104, col. 2, change "1.2500" to "1.8750."

SECTION XII. ROUND UNSLOTTED HEAD BOLTS

Page 197, footnote 29, add: "Stock production sizes (lengths, diameters, etc.) of square neck carriage bolts, step bolts, and elevator bolts are given in Simplified Practice Recommendation R169–37, Machine, Carriage, and Lag Bolts (Steel) (Stock Production Sizes)."

SECTION XIII. MACHINE SCREWS, MACHINE-SCREW AND STOVE-BOLT NUTS, AND SET SCREWS

The data in this section relative to sloted machine, cap, and set screws are, for the present, superseded by the corresponding data in American Standard ASA B18.6–1947, Slotted and Recessed Head Screws. A complete revision of this section is deferred until a revision, now in progress, of Federal Specification FF–S–91, Screws, Machine; (Including Screws, Set) has been completed, in order that this section and the revised Federal specifications will be in complete agreement.

SECTION XIV. SOCKET SET SCREWS, SOCKET-HEAD CAP SCREWS, AND SOCKET-HEAD SHOULDER SCREWS

The data in this section are, for the present, superseded by American Standard ASA B18.3–1947, Socket Head Cap Screws and Socket Set Screws. A complete revision of this section is deferred until Federal Specifications covering these items, now in process of development, have been completed, in order that this section and the Federal Specifications will be in complete agreement.

APPENDIX 2. WIRE METHODS OF MEASUREMENT OF PITCH DIAMETER

Pages 228 to 233, subsections 4 to 8, inclusive, revise to read as follows:

4. GENERAL FORMULA FOR MEASUREMENT OF PITCH DIAMETER

The general formula for determining the pitch diameter of any thread whose sides are symmetrical with respect to a line drawn through the vertex and perpendicular to the axis of the thread, in which the slight effect of lead angle is taken into account, is

$$E=M_w+\frac{\cot\alpha}{2n}-w\left[1+(\operatorname{cosec}^2\alpha+\cot^2\alpha\tan^2\lambda')^{\frac{1}{2}}\right], \quad (1)$$

in which

E=pitch diameter
M_w=measurement over wires
α=half angle of thread
n=number of threads per inch=$1/p$
w=mean diameter of wires
λ'=angle between axis of wire and plane perpendicular to axis of thread.

This formula is a very close approximation, being based on certain assumptions regarding the positions of the points of contact between the wire and the thread.

Formula 1 can be converted to the following simplified form, which is particularly useful when measuring threads of large lead angle:

$$E=M_w+\frac{\cot\alpha}{2n}-w(1+\operatorname{cosec}\alpha'), \quad (2)$$

in which $\alpha' =$ the angle whose tangent $= \tan \alpha \cos \lambda'$.

When formula 1 is used, the usual practice is to expand the square root term as a series, retaining only the first and second terms, which gives the following:

$$E = M_w + \frac{\cot \alpha}{2n} - w\left(1 + \operatorname{cosec} \alpha + \frac{\tan^2 \lambda' \cos \alpha \cot \alpha}{2}\right). \tag{3}$$

For large lead angles it is necessary to measure the wire angle, λ', but for lead angles of 5° or less, if the "best-size" wire is used, this angle may be assumed to be equal to the lead angle of the thread at the pitch line, λ. The value of $\tan \lambda$, the tangent of the lead angle, is given by the formula

$$\tan \lambda = \frac{l}{3.1416E} = \frac{1}{3.1416NE},$$

in which

$l =$ lead
$N =$ number of turns per inch
$E =$ nominal pitch diameter, or an approximation of the measured pitch diameter.

5. MEASUREMENT OF PITCH DIAMETER OF AMERICAN NATIONAL STRAIGHT THREADS

For threads of the American National coarse, fine, extra-fine, 8-pitch, 12-pitch, and 16-pitch thread series, the term

$$\frac{w \tan^2 \lambda' \cos \alpha \cot \alpha}{2}$$

is neglected, as its value is small, being in all cases less than 0.00015 inch for standard fastening screws when the best-size wire is used, and the above formula 3 takes the simplified form

$$E = M_w + \frac{\cot \alpha}{2n} - w(1 + \operatorname{cosec} \alpha). \tag{4}$$

The practice is permissible provided that it is uniformly followed, and in order to maintain uniformity of practice, and thus avoid confusion, the National Bureau of Standards uses formula 4 for such threads. The Bureau also uses formula 4 for special 60° threads, except when the value of the term

$$\left(\frac{w \tan^2 \lambda' \cos \alpha \cot \alpha}{2}\right)$$

exceeds 0.00015 inch, as in the case of multiple threads, or other threads having exceptionally large lead angles. For 60° threads this term exceeds 0.00015 when $NE\sqrt{n}$ is less than 17.1.

For a 60° thread of correct angle and thread form the formula 4 simplifies to

$$E = M_w + \frac{0.86603}{n} - 3w. \tag{5}$$

For a given set of best-size wires

$$E = M_w - C$$

when

$$C = w(1 + \operatorname{cosec} \alpha) - \frac{\cot \alpha}{2n}.$$

The quantity C is a constant for a given thread angle, and, when the wires are used for measuring threads of the pitch and angle for which they are the best size, the pitch diameter is obtained by the simple operation of subtracting this constant from the measurement taken over the wires. In fact, when best-size wires are used, this constant is changed very little by a moderate variation or error in the angle of the thread. Consequently, the constants for the various sets of wires in use may be tabulated, thus saving a considerable amount of time in the inspection of gages. However, when wires of other than the best size are used, this constant changes appreciably with a variation in the angle of the thread.

It has been shown that, with the exception of coarse pitch screws, variation in angle from the basic size causes no appreciable change in the quantity C for the best-size wires. On the other hand, when a wire near the maximum or minimum allowable size is used, a considerable change occurs, and the values of the cotangent and cosecant of the actual measured half angle are to be used. It is apparent, therefore, that there is a great advantage in using wires very closely approximating the best size. For convenience in carrying out computations, the values of $(\cot \alpha)/2n$ for standard pitches are given in table 144, p. 225, H28 (1944).

6. MEASUREMENT OF PITCH DIAMETER OF TAPER THREADS

The pitch diameter of a taper thread plug gage is measured in much the same manner as that of a straight thread gage, except that a definite position at which the measurement is to be made must be located. A point at a known distance L from the reference end of the gage is located by means of a combination of precision gage blocks and the cone point furnished as an accessory with these blocks, as shown in the inset in figure 39. The gage is set vertically on a surface plate, the cone point is placed with its axis horizontal at the desired height, and the plug is turned until the point fits accurately into the thread. The position of this point is marked carefully with a pencil or a bit of prussian blue.

1. TWO-WIRE METHOD.—Assuming that the measurement is to be made with a horizontal comparator, the gage is set in the comparator with its axis vertical, that is, the line of measurement and the thread axis are perpendicular to each other. The measurement is made with two wires, as shown in figure 39, one of which is placed in the thread to make contact at the same axial section of the thread as was touched by the cone point. This wire is designated the fixed wire. The second wire is placed in the thread groove on the opposite side of the gage, which is next above the fixed wire, and the measurement over the wires is made. The second wire is then placed in the thread groove next below the fixed wire, and a second measurement is made. The average of these two measurements is M_w, the measurement over the wires at the position of the fixed wire.

The general formula for a taper thread, corresponding to formula 3 is

$$E = M_w + \frac{\cot \alpha - \tan^2 \beta \tan \alpha}{2n} - w\left(1 + \operatorname{cosec} \alpha + \frac{\tan^2 \lambda' \cos \alpha \cot \alpha}{2}\right), \tag{6}$$

in which

$E =$ pitch diameter
$M_w =$ measurement over wires
$\beta =$ half angle of taper of thread
$n =$ number of threads per inch $= 1/p$
$\alpha =$ half angle of thread
$w =$ mean diameter of wires
$\lambda' =$ wire angle.

The term $\dfrac{\cot \alpha - \tan^2 \beta \tan \alpha}{2n}$

is the exact value of the depth of the fundamental triangle of a taper thread, which is less than that of the same pitch thread cut on a cylinder. For steep-tapered thread gages, having an included taper larger than ¾ in. per foot this more accurate term should be applied. For such a thread, which has a small lead angle, formula 6 take the form

$$E=M_w+\frac{\cot\alpha-\tan^2\beta\tan\alpha}{2n}-w(1+\operatorname{cosec}\alpha) \qquad (7)$$

Otherwise, as for American National taper pipe threads having an included taper of ¾ in. per foot, the simplified formula 5

$$E=M_w+\frac{0.86603}{n}-3w$$

for 60° threads may be used. This simplified formula gives a value of E that is 0.00005 inch larger than that given by the above general formula 6 for the 2½″–8 American National taper pipe thread, the worst case in this thread series.

The pitch diameter at any other point along the thread, as at the gaging notch, is obtained by multiplying the distance parallel to the axis of the thread, between this point and the point at which the measurement was taken, by the taper per inch, then adding the product to or subtracting it from the measured pitch diameter according to the direction in which the second point is located with respect to the first.

2. Three Wire Method.—Depending on the measuring facilities available or other circumstances, it is sometimes more convenient to use three wires. In such cases measurement is made in the usual manner, but care must be taken that the measuring contacts touch all three wires, since the line of measurement is not perpendicular to the axis of the screw when there is proper contact. (See fig. 38.) On account of this inclination, the measured distance between the axes of the wires must be multiplied by the secant of the half angle of the taper of the thread. The formula for the pitch diameter of any taper thread plug gage, the threads of which are symmetrical with respect to a line perpendicular to the axis, then has the form corresponding to formula 4:

$$E=(M_w-w)\sec\beta+\frac{\cot\alpha}{2n}-w\operatorname{cosec}\alpha, \qquad (8)$$

in which β = half-angle of taper of thread. Thus the pitch diameter of an American National standard pipe-thread gage having correct angle (60°) and taper (¾ inch per foot) is then given by the formula

$$E=1.00049(M_w-w)+0.86603\,p-2w. \qquad (9)$$

An adaption of the three-wire method is frequently used to reduce the time required when the pitch diameter of a number of gages of the same size is to be measured. Only light gages, up to about 2 in., can be measured accurately by this method. The gage is supported on two wires placed several threads apart, which are in turn supported on a taper thread testing fixture. The third wire is placed in the threads at the top of the gage and measurement is made from the top of this wire to the bottom of the fixture with a vertical comparator having a flat anvil, using a gage block combination as the standard. The fixture consists of block, the upper surface of which is at an angle to the base plane equal to the nominal angle of taper of the thread, 2β. Thus the element of the cone at the top of the thread gage is made parallel to the base of the instrument. The direction of measurement is not perpendicular to the axis of the gage but at an angle, β, from perpendicularity. A stop is provided at the thick end of the block with respect to which the gage is positioned on the fixture. As the plane of the end of the gage may not be perpendicular to the axis, a roll approximately equal to the diameter of the gage should be inserted between the stop and the gage to assure contact at the axis of the gage. For a given fixture and roll, a constant is computed which, when subtracted from the measured distance from the top of the upper wire to the base plane, gives M corresponding to the pitch diameter E_0 at the small end of the gage. E_0 is then determined by applying formulas 8 or 9.

3. Four-Wire Method.—A four-wire method of measurement which yields measurements of the pitch diameter, E_0, at the small end of the gage, and the half-angle of taper, β, is also sometimes used. This method is illustrated in figure 39A, and requires four thread wires of equal diameter, a pair of gage blocks of equal thickness, and two pairs of rolls of different diameters, the rolls of each pair being equal in diameter. Two measurements, M_1 and M_2, are made over the rolls and formulas are applied as follows:

$$\cot\frac{90-\beta}{2}=\frac{M_2-M_1+d_1-d_2}{d_2-d_1}, \qquad (10)$$

$$M_w=M_2-d_2\left(1+\cot\frac{90°-\beta}{2}\right)-2g\sec\beta, \qquad (11)$$

in which

M_2 = measurement over larger rolls
M_1 = measurement over smaller rolls
d_2 = diameter of larger rolls
d_1 = diameter of smaller rolls
β = actual half-angle of taper of thread
g = thickness of each gage block.

To determine E_0, the pitch diameter at the small end of the gage, M_w, as determined from formula 11, is substituted in formulas 6 or 7.

The errors of measurement by this method may be slightly but not significantly larger than by the other methods described, on account of elastic deformations of the rolls and gage blocks under the measuring load, and differing conditions of loading of the thread wires.

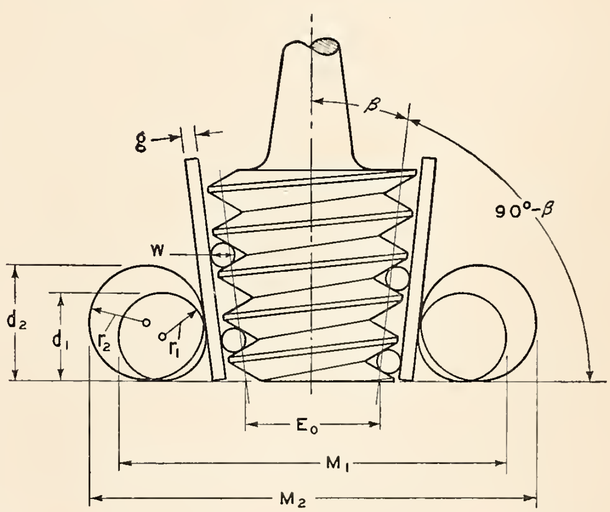


Figure 39A. *Measurement of pitch diameter of taper thread gage by the four-wire method.*

7. MEASUREMENT OF PITCH DIAMETER OF THREAD RING GAGES

The application of direct methods of measurement to determine the pitch diameter of thread ring gages presents serious difficulties, particularly in securing proper contact load when a high degree of precision is required. The usual practice is to fit the ring gage to a threaded setting plug. When the thread ring gage is of correct lead, angle, and thread form, within close limits, this method is satisfactory and represents standard American practice. It is the only method available for small sizes of threads. For the larger sizes, various more or less satisfactory methods have been devised, but none of these have found wide application.

8. WIRE METHODS OF MEASUREMENT OF ACME THREAD PLUG GAGES

For Acme (29°) threads, the three-wire method of measurement is used. Because the angle of the thread is small, and its cotangent large, it is always necessary to take the lead angle into account in deriving pitch diameter. The general formula, 2, given again here, has been found to be the most convenient to apply,

$$E=M_w+\frac{\cot\alpha}{2n}-w(1+\operatorname{cosec}\alpha'),\qquad (2)$$

in which

$\alpha'=\tan^{-1}(\tan\alpha\cos\lambda')$
λ' = measured wire angle.

For a half-angle of thread of 14° 30′, formula 2 takes the form

$$E=M_w+\frac{1.933357}{n}-w(1+\operatorname{cosec}\alpha')\qquad (12)$$

The diameter, w, of the wires used should be as close to the size which will contact the flanks of the thread at the pitch line as practicable, to avoid errors caused by deviation of the thread angle from nominal. The following formula, which takes into account the lead angle, yields a size of wire which touches the flanks of the thread close to the pitch line:

$$w_b=\frac{p}{2}\sec\alpha'=\frac{p}{2}\sec\tan^{-1}(\tan\alpha\cos\lambda).\qquad (13)$$

If best size wires are used, and the lead angle, λ, does not exceed 5°, it may be assumed that $\alpha'=14°30'$. The best wire sizes for the standard Acme thread series, resulting from this formula, are given in col. 4, table 147. The quantities, $1.933357/n$ are given in col. 5, table 147, H28 (1944).

TABLE 147A. $(1+\operatorname{cosec}\alpha')$ *for* $\alpha=14°30'$ *and* wire angles from 0° to 28°

Wire angle		1+ cosec α′	Difference	Wire angle		1+ cosec α′	Difference	Wire angle		1+ cosec α′	Difference
deg.	*min.*			*deg.*	*min.*			*deg.*	*min.*		
0	0	4.9939		10	0	5.0517	20	20	0	5.2346	43
	30	41	1		10	37	20		10	5.2389	43
	40	42	1		20	57	20		20	5.2432	43
	50	43	2		30	77	21		30	5.2475	44
1	0	45	2		40	98	21		40	5.2519	44
	10	47	2		50	5.0619	21		50	5.2563	45
	20	49	3	11	0	40	22	21	0	5.2608	45
	30	52	3		10	62	22		10	5.2653	46
	40	55	3		20	84	23		20	5.2699	46
	50	58	4		30	5.0707	23		30	5.2745	47
2	0	62	4		40	30	23		40	5.2792	47
	10	66	4		50	53	23		50	5.2839	47
	20	70	5	12	0	76	24	22	0	5.2886	48
	30	75	5		10	5.0800	24		10	5.2934	48
	40	80	5		20	5.0824	25		20	5.2982	49
	50	85	5		30	5.0849	25		30	5.3031	49
3	0	90	6		40	5.0874	25		40	5.3080	50
	10	96	7		50	5.0899	26		50	5.3130	50
	20	5.0003	6	13	0	5.0925	26	23	0	5.3180	51
	30	9	7		10	5.0951	26		10	5.3231	51
	40	16	7		20	5.0977	27		20	5.3282	52
	50	23	8		30	5.1004	27		30	5.3334	52
4	0	31	8		40	5.1031	27		40	5.3386	53
	10	39	8		50	5.1058	28		50	5.3439	53
	20	47	8	14	0	5.1086	28	24	0	5.3492	53
	30	55	9		10	5.1114	29		10	5.3545	54
	40	64	9		20	5.1143	29		20	5.3599	55
	50	73	9		30	5.1172	29		30	5.3654	55
5	0	82	10		40	5.1201	30		40	5.3709	56
	10	92	10		50	5.1231	30		50	5.3765	56
	20	5.0102	10	15	0	5.1261	31	25	0	5.3821	56
	30	12	11		10	5.1292	31		10	5.3877	57
	40	23	11		20	5.1323	31		20	5.3934	58
	50	34	11		30	5.1354	31		30	5.3992	58
6	0	45	12		40	5.1385	32		40	5.4050	59
	10	57	12		50	5.1417	33		50	5.4109	59
	20	69	12	16	0	5.1450	33	26	0	5.4168	60
	30	81	13		10	5.1483	33		10	5.4228	60
	40	94	13		20	5.1516	33		20	5.4288	61
	50	5.0207	13		30	5.1549	34		30	5.4349	61
7	0	20	14		40	5.1583	34		40	5.4410	62
	10	34	14		50	5.1617	35		50	5.4472	62
	20	48	14	17	0	5.1652	35	27	0	5.4534	63
	30	62	15		10	5.1687	36		10	5.4597	64
	40	77	15		20	5.1723	36		20	5.4661	64
	50	92	15		30	5.1759	36		30	5.4725	65
8	0	5.0307	16		40	5.1795	37		40	5.4790	65
	10	23	16		50	5.1832	37		50	5.4855	66
	20	39	16	18	0	5.1869	37	28	0	5.4921	
	30	55	17		10	5.1906	38				
	40	72	17		20	5.1944	38				
	50	89	17		30	5.1982	39				
9	0	5.0406	18		40	5.2021	39				
	10	24	18		50	5.2060	40				
	20	42	18	19	0	5.2100	40				
	30	60	19		10	5.2140	40				
	40	79	19		20	5.2180	41				
	50	98	19		30	5.2221	41				
					40	5.2262	42				
					50	5.2304	42				

To measure the wire angle, if the wires are reasonably straight and have a length greater than the major diameter of the gage, the angle $2\lambda'$ between wires held in place in the thread on opposite sides of the gage can be measured in a projection comparator. Otherwise, λ' can be determined with a toolmakers' microscope.

The quantities $(1+\operatorname{cosec}\alpha')$ for wire angles, λ', from 0°0′ to 28°0′, inclusive, at 10′ intervals, are given in table 147A. The amount of $(1+\operatorname{cosec}\alpha')$ for an intermediate angle may be determined by interpolation, as shown by the following example for 7°33′:

$$\begin{aligned}(1+\operatorname{cosec}\alpha') \text{ for } \lambda' &= 5.0262\\ 0.0015\times 0.3 &= 0.00045\\ \hline (1+\operatorname{cosec}\alpha') \text{ for } \lambda' &= 5.02665\end{aligned}$$

9. MEASUREMENT OF PITCH DIAMETER OF BUTTRESS THREADS

This subsection will be prepared when the ASA standard for Buttress threads becomes available.)

APPENDIX 4. SCREW THREADS OF TRUNCATED WHITWORTH FORM (TO BE KNOWN AS AMERICAN TRUNCATED WHITWORTH THREADS)—American War Standard

This appendix is to be omitted in future editions of this Handbook. In revised form it will be printed as ASA B1.6 Screw Threads of Truncated Whitworth Form, which will be available only in a limited edition but not for sale

APPENDIX 5. MISCELLANEOUS STANDARD THREAD PROFILES

2 (a). 29 DEGREE STUB THREADS

4. BUTTRESS THREADS

Revised standards for these threads are in process of being developed by ASA Sectional Committee B1.

APPENDIX 6. DEFINITIONS OF SYMBOLS DESIGNATING THE DIMENSIONS OF TAPER THREAD ELEMENTS

There is presented below, as a substitute for this appendix, the draft of a "proposed American Standard for Nomenclature, Definitions, and Letter Symbols for Screw Threads," prepared by Subcommittee 8 of the ASA Sectional Committee on the Standardization and Unification of Screw Threads. This draft, if and when approved by Sectional Committee B1, will be considered by the Interdepartmental Screw Thread Committee for replacement of section II of Handbook H28 (1944).

APPENDIX 6. NOMENCLATURE, DEFINITIONS, AND LETTER SYMBOLS FOR SCREW THREADS

1. INTRODUCTORY

The purposes of this standard are to establish uniform practices with regard to: (1) Screw-thread nomenclature, and (2) letter symbols for designating dimensions of screw threads for use on drawings, in tables of dimensions which set forth dimensional standards, and in other records, and for expressing mathematical relationships.

The standard consists of a glossary of terms, two tables of screw-thread dimensional symbols, three illustrations showing the application of dimensional symbols, and two tables of identification symbols.

Typography.—In accordance with the usual practice in published text, letter symbols and letter subscripts, whether upper or lower case, should be printed in italic type. An exception is Greek letters; Greek capital letters are always vertical, and lower case always resembles italics. In manuscripts this is indicated by underlining each symbol to be italicized. Coefficients, numeral subscripts, and exponents should be printed in vertical Arabic numerals. Standard mathematical notation should be followed.

2. DEFINITIONS OF TERMS

The terms commonly applied to screw threads may be classified in four general groups, namely: (1) Those relating to types of screw threads; (2) those relating to size of mechanical parts in general; (3) those relating to elements of both straight and taper screw threads; and (4) those relating only to taper screw threads.

(*a*) Terms Relating to Types of Screw Threads.—Screw threads and the terms generally applied to designate the types of screw threads are defined as follows:

1. *Screw thread.*—A screw thread, (henceforth referred to as a thread), is a ridge of uniform section in the form of a helix on the external or internal surface of a cylinder, or in the form of a conical spiral on the external or internal surface of a cone or frustum of a cone. A thread formed on a cylinder is known as a "straight" or "parallel" thread, to distinguish it from a "taper" thread which is formed on a cone or frustum of a cone.
2. *External thread.*—An external thread is a thread on the outside of a part.
3. *Internal thread.*—An internal thread is a thread on the inside of a part.
4. *Right-hand thread.*—A thread is a right-hand thread if, when viewed axially, it winds in a clockwise and receding direction
5. *Left-hand thread.*—A thread is a left-hand thread if, when viewed axially, it winds in a counterclockwise and receding direction.
6. *Single thread.*—A single (single-start) thread is one having lead equal to the pitch. (See (c) 14 and (c) 15.)
7. *Multiple thread.*—A multiple (multiple-start) thread is one in which the lead is an integral multiple of the pitch. (See (c) 14 and (c) 15.)
8. *Symmetrical threads.*—Symmetrical threads are those having equal flank angles.
9. *Asymmetrical threads.*—Asymmetrical threads are those having unequal flank angles.

(*b*) Terms Relating to Size of Parts.—Terms relating to the size of parts, which are generally applicable to mechanical parts, including threads, are defined as follows:

1. *Dimension.*—A dimension is a geometrical characteristic such as a diameter, length, angle, circumference, or center distance.
2. *Size.*—Size is a designation of magnitude.
3. *Nominal size.*—The nominal size is the designation which is used for the purpose of general identification.
4. *Basic size.*—The basic size of a dimension is the theoretical size from which the limits of size for that dimension are derived by the application of the allowance and tolerances.
5. *Actual size.*—The actual size of a dimension is the measured size of that dimension on an individual part.
6. *Limits of size.*—These limits are the maximum and minimum sizes permissible for a specific dimension.
7. *Tolerance.*—The tolerance on a dimension is the total permissible variation in its size. The tolerance is the difference between the limits of size.
8. *Allowance.*—An allowance is an intentional difference in correlated dimensions of mating parts. It is the minimum clearance (positive allowance) or maximum interference (negative allowance) between such parts.
9. *Fit.*—The fit between two mating parts is the relationship existing between them with respect to the amount of clearance or interference which is present when they are assembled.

(*c*) Terms Relating to Elements of Screw Threads.—Terms relating to dimensions and other elements of both straight and taper threads are defined as follows:

1. *Axis.*—The axis of a thread is the axis of the cylinder, cone, or frustum of a cone on which the thread is formed.

2. *Form.*—The form of thread is its profile in an axial plane for a length of one pitch.

3. *Basic form.*—The basic form of thread is that form in which the size of each dimension is basic.

4. *Flank or side.*—The flank or side of a thread is either surface connecting the crest with the root, the intersection of which, with an axial plane, is a straight line.

5. *Crest.*—The crest is that surface of the thread which joins the sides of the thread and is farthest from the cylinder, cone, or frustum of a cone from which the thread projects.

6. *Root.*—The root is that surface of the thread which joins the sides of adjacent threads and is identical with or immediately adjacent to the cylinder, cone, or frustum of a cone from which the thread projects.

7. *Base.*—The base of a thread is that section of the thread which coincides with the cylinder, cone, or frustum of a cone from which the thread projects.

8. *Sharp crest.*—The sharp crest is the intersection of the flanks or sides of a thread when extended, if necessary, beyond the crest.

9. *Sharp root.*—The sharp root is the intersection of the flanks or sides of adjacent threads when extended, if necessary, beyond the root.

10. *Leading flank.*—The leading flank or side of a thread is the one which, when the thread is about to be assembled with a mating thread, faces the mating thread.

11. *Following flank.*—The following flank or side of a thread is the one which is opposite to the leading flank or side.

12. *Crest truncation.*—The crest truncation of a thread is the distance, measured perpendicular to the axis, between the sharp crest and the cylinder or cone which bounds the crest.

13. *Root truncation.*—The root truncation of a thread is the distance, measured perpendicular to the axis, between the sharp root and the cylinder or cone which bounds the root.

14. *Pitch.*—The pitch of a thread is the distance, measured parallel to its axis, between corresponding points on adjacent threads in the same axial plane.

15. *Lead.*—The lead is the distance a thread moves axially, with respect to a fixed mating thread, in one complete rotation.

16. *Included angle.*—The included angle of a thread is the angle between the flanks or sides of the thread measured in an axial plane.

17. *Flank angle.*—The flank angles are the angles between the individual sides and the perpendicular to the axis of the thread, measured in an axial plane. A flank angle of a symmetrical thread is commonly termed the "half-angle of thread."

18. *Lead angle.*—On a straight thread the lead angle is the angle made by the helix of the thread at the pitch line with a plane perpendicular to the axis. On a taper thread, the lead angle at a given axial position is the angle made by the conical spiral of the thread at the pitch line with the plane perpendicular to the axis at that position.

19. *Thickness.*—The thickness of thread is the distance between the flanks or sides of the thread measured at a specified diameter and parallel to the axis.

20. *Number of threads.*—The number of threads denotes the number per unit of length (per inch), and is the reciprocal of the pitch. (See (c)14.)

21. *Number of turns.*—The number of turns per unit of length (per inch) is the number of rotations required to advance a screw axially that unit of length, with respect to a fixed mating thread. It is the reciprocal of the lead. (See (c) 15.)

22. *Height of fundamental triangle.*—The height of the fundamental triangle of a thread, or the height of a sharp-V thread, is the distance measured perpendicular to the axis between the sharp major and minor cylinders or cones, respectively. (See (d) 3 and (d) 5.)

23. *Height or depth.*—The height or depth of thread is the distance between the major and minor cylinders or cones, respectively. (See (d) 2 and (d) 4.)

24. *Addendum.*—The addendum of an external thread is the distance, measured perpendicular to the axis, between the major and pitch cylinders or cones, respectively. The addendum of an internal thread is the distance, measured perpendicular to the axis, between the minor and pitch cylinders or cones, respectively.

25. *Dedendum.*—The dedendum of an external thread is the distance, measured perpendicular to the axis, between the pitch and minor cylinders or cones, respectively. The dedendum of an internal thread is the distance, measured perpendicular to the axis, between the major and pitch cylinders or cones, respectively.

26. *Depth of thread engagement.*—The depth of thread engagement between two mating threads is the distance, measured perpendicular to the axis, by which their thread forms overlap each other. One-hundred-percent depth of thread engagement is the distance, measured perpendicular to the axis, between the basic major and basic minor diameters.

27. *Length of thread engagement.*—The length of thread engagement of two mating threads is the distance between the extreme points of contact on the pitch cylinders or cones, measured parallel to the axis.

28. *Major diameter.*—On a straight thread, the major diameter is the diameter of the imaginary coaxial cylinder which bounds the crest of an external thread or the root of an internal thread.

On a taper thread, the major diameter, at a given position on the thread axis, is the diameter of the major cone at that position. (See (d) 2.)

29. *Minor diameter.*—On a straight thread, the minor diameter is the diameter of the imaginary coaxial cylinder which bounds the root of an external thread or the crest of an internal thread.

On a taper thread, the minor diameter, at a given position on the thread axis, is the diameter of the minor cone at that position. (See (d) 4.)

30. *Pitch diameter.*—On a straight thread, the pitch diameter is the diameter of the imaginary coaxial cylinder, the surface of which would pass through the threads at such points as to make the width of the threads equal to the width of the spaces cut by the surface of the cylinder.

On a taper thread, the pitch diameter at a given position on the thread axis is the diameter of the pitch cone at that position. (See (d) 1.)

In British nomenclature this dimension is called the "effective diameter."

31. *Pitch line.*—The pitch line is an element of the imaginary cylinder or cone specified in the definition of pitch diameter.

32. *Vanish cone.*—The vanish cone is an imaginary cone, the surface of which would pass through the roots of incomplete threads formed by the lead or chamfer of the threading tool. These threads are referred to as "vanish threads" or "washout threads."

33. *Vanish point.*—The vanish point of an external thread is the intersection of an element of the vanish cone with an element of the cylinder of the largest major diameter of the thread.

34. *Crest clearance.*—The crest clearance in a thread assembly is the distance between the crest of a thread and the root of its mating thread.

35. *Higbee cut.*—"Higbee cut" designates the removal of the partial thread at the entering end of thread, creating a blunt start. This is a feature of threaded parts which are repeatedly assembled by hand, such as hose couplings and thread plug gages, to prevent cutting of the hands and crossing of threads. (See fig. 55B.)

36. *Stress area.*—The stress area is the assumed area of

an externally threaded part which is used for the purpose of computing the tensile strength.

(d) Terms Relating Only to Taper Screw Threads.—Terms relating only to taper threads are defined as follows:

1. *Pitch cone.*—The pitch cone is an imaginary cone, the surface of which would pass through the thread at such points as to make the widths between the sides of the thread equal to the spaces between the sides of adjacent threads.

2. *Major cone.*—The major cone is an imaginary cone having an apex angle equal to that of the pitch cone, the surface of which bounds the crest of an external thread or the root of an internal thread.

3. *Sharp major cone.*—The sharp major cone is an imaginary cone having an apex angle equal to that of the pitch cone, the surface of which would pass through the sharp crest of an external thread or the sharp root of an internal thread.

4. *Minor cone.*—The minor cone is an imaginary cone having an apex angle equal to that of the pitch cone, the surface of which bounds the root of an external thread or the crest of an internal thread.

5. *Sharp minor cone.*—The sharp minor cone is an imaginary cone having an apex angle equal to that of the pitch cone, the surface of which would pass through the sharp root of an external thread or the sharp crest of an internal thread.

6. *Standoff.*—The standoff is the axial distance between specified reference points on external and internal taper threaded members or gages, when assembled with a specified torque or under other specified conditions.

3. LETTER SYMBOLS AND ABBREVIATIONS

Symbols associated with screw threads are of two kinds: (1) Letter symbols for designating dimensions of screw threads and threaded products; and (2) abbreviations used as identification symbols for designating various standard thread forms and thread series.

(a) Dimensional Symbols.—Standard letter symbols to designate the dimensions of screw threads are given in tables 162A and 162B. General symbols are given in table 162A and pipe thread symbols, in 162B. The application of general symbols are illustrated in figures 55A and 55B and pipe thread symbols in figure 55C.

(b) Identification Symbols.—Identification symbols are capital letter abbreviations of names used to designate various forms of thread and thread series, and commonly consist of combinations of such abbreviations. There are assembled in table 162C the names and abbreviations which are now in use, together with references to standards in which they occur. The names of various standard threads, and their corresponding identification symbols, consisting of certain combinations of abbreviations, together with references, are compiled in table 162D.

The method of designating a screw thread by means of symbols is by the use of the initial letters of the thread series, preceded by the diameter in inches (or the screw number) and number of threads per inch, all in Arabic characters, and followed by the classification of fit in Arabic numerals. For example, a threaded part of the American National coarse thread series, ½ inch in diameter, 13 threads per inch, class 3 fit, is designated ½″–13NC–3. The identification symbol applicable to each thread series is stated in the section where such series is presented. If the thread is left hand, the symbol "LH" shall follow the class of fit. No symbol is used to distinguish right hand threads. The number of threads per inch shall be indicated in all cases, irrespective of whether it is the standard number of threads for that particular size of threaded part, or special. Tools and gages for standard thread diameters and pitches shall bear standard identification symbols, and special marking of such items shall be avoided.

For screw threads of American National form but of special diameters, pitches, and lengths of engagement, the symbol "NS" shall be used. It is occasionally desirable to modify a standard thread by the inclusion of some nonstandard feature. Thus, it might be necessary to limit the maximum major diameter of a ½″–13NC–3 screw to 0.4800 inch in order to provide clearance for a shoulder. The word "modified" should be added to the designation with an asterisk (*), and the nonstandard feature or dimension of the thread should be enclosed in brackets and likewise marked with an asterisk (*).

Multiple threads shall be designated by showing both the pitch and the lead in accordance with examples given on p. 162, H28 (1944).

Table 162A. *General symbols (see figs. 55A and 55B)*

Symbols	Dimensions	Remarks
D	Major diameter	*Exception:* B is used for basic major diameter when this differs from the nominal major diameter. Subscripts s or n, indicating external or internal thread, may be used if necessary.
E	Pitch diameter	Subscripts s or n, indicating external or internal thread, may be used if necessary.
K	Minor diameter	
p	Pitch	Equals $1/n$.
l	Lead	Equals $1/N$.
n	Number of threads per unit of length (per inch).	
N	Number of turns per unit of length (per inch).	
H	Height of fundamental triangle	
h	Height of thread	Subscripts s or n, indicating external or internal thread, may be used if necessary.
h_a	Addendum.	
h_d	Dedendum.	
h_b	Equals $2h_a$ of basic external thread.	
h_e	Depth of thread engagement.	
α (alpha)	Half-angle of symmetrical thread.	
α_1	Angle between leading flank of thread and normal to axis of thread.	
α_2	Angle between following flank of thread and normal to axis of thread.	
λ (lambda)	Lead angle	$\tan \lambda = \frac{l}{\pi E}$.
r	Radius of rounding at crest, or radius of rounding at root.	Subscripts c or r indicating crest or root, and s or n indicating external or internal thread may be used if necessary.
	Depth from apex of fundamental triangle to adjacent root or crest of thread:	
s	(1) If rounded.	
f	(2) If flat.	
	Depth from apex of fundamental triangle to:	
f_{cs}	(1) Flat at crest of external thread.	
f_{rs}	(2) Flat at root of external thread.	
f_{cn}	(3) Flat at crest of internal thread.	
f_{rn}	(4) Flat at root of internal thread.	
	Width of:	
F	(1) Flat (general).	
F_{cs}	(2) Flat at crest of external thread.	
F_{rs}	(3) Flat at root of external thread.	
F_{cn}	(4) Flat at crest of internal thread.	
F_{rn}	(5) Flat at root of internal thread.	
L	Length of bolt or screw.	
L_t	Length of full thread	Subscripts s or n, indicating external or internal thread, may be used if necessary.
L_e	Length of thread engagement.	
w	Diameter of measuring wires.	
M_w	Measurement over wires.	
T	Measurement under wires.	

TABLE 162A. *General symbols (see figs. 55A and 55B)*—Continued

Symbols	Dimensions	Remarks
C	Correction to measurement over wires to give pitch diameter.	$E=M_w-C-c$. $C=w(1+\operatorname{cosec}\alpha)-(\cot\alpha)/2n$.
P	Correction to measurement under wires to give pitch diameter.	$E=T+P-c$. $P=1/2p\cot\alpha-(\operatorname{cosec}\alpha-1)w$.
λ'	Wire angle	See NPL "Notes on Screw Gages", August 1944, p. 23, or NBS Handbook H28 (1944), p. 228.
c	Wire angle correction	
Prefix symbol with δ (delta).	Error in any dimension	*Examples:* Error in pitch, δp; error in half-angle, $\delta\alpha_1$ or $\delta\alpha_2$.
ΔE_α (delta E_α).	Pitch-diameter equivalent of errors in flank angles.	
ΔE_p (delta E_p).	Pitch-diameter equivalent of error in pitch.	
G	Allowance at pitch diameter.	
U	Basic truncation of crest from basic Whitworth form.	(1) U=Height of segment of B. S. Whitworth crest. (2) These symbols apply only to Truncated Whitworth threads.
k	Height of truncated Whitworth thread.	

TABLE 162B. *Pipe-thread symbols (see fig. 55c)*

Symbols	Dimensions	Remarks
D	Outside diameter of pipe	Subscript 4 is used for dimensions in plane of vanish point when these differ from D, d, or t, respectively.
d	Inside diameter of pipe	
t	Wall thickness of pipe	
D_x	Major diameter	Subscript x denotes plane containing the diameter. For axial positions of planes see foot of table 162B. Subscripts s or n designating screw or nut may also be used if necessary.
E_x	Pitch diameter	
K_x	Minor diameter	
L_x	Length of thread from plane of pipe end to plane containing basic diameter D_x, E_x, or K_x.	For axial position of plane containing basic diameter, see foot of table 162B.
V	Length of washout (vanish cone) threads.	
β (beta)	Half apex angle of pitch cone of taper thread.	
γ (gamma)	Angle of chamfer at end of pipe measured from a plane normal to the axis.	
A	Hand tight standoff of face of coupling from plane containing vanish point on pipe.	
M	Length from plane of hand tight engagement to the face of coupling on internally threaded member.	

TABLE 162B. *Pipe-thread symbols (see fig. 55c)*—Con.

Symbols	Dimensions	Remarks
S	Distance of gaging step of plug gage from face of ring gage for hand tight engagement.	
L_n	Length from center line of coupling, face of flange, or bottom of internal thread chamber to face of fitting.	
b	Width of bearing face on coupling.	
τ (tau)	Angle of chamfer at bottom of recess or counterbore measured from the axis.	
ϵ (epsilon)	Half apex angle of vanish cone	
J	Length from center line of coupling, face of flange, or bottom of internal thread chamber to end of pipe, wrenched engagement.	
L_t	(1) Length of straight full thread (see table 162A). (2) Length from plane of handtight engagement to small end of full internal taper thread.	
Q	Diameter of recess or counterbore in fitting.	
q	Depth of recess or counterbore in fitting.	
W	Outside diameter of coupling or hub of fitting.	
DEFINITION OF PLANES DENOTED BY SUBSCRIPT x		
$x=0$	Plane of pipe end	
$x=1$	Gage plane, or plane at mouth of coupling (excluding recess, if present).	
$x=2$	Plane at which washout threads on pipe commence.	
$x=3$	Plane in coupling reached by end of pipe in wrenched condition. NOTE.—L_3 is measured from plane containing pipe end in position of handtight engagement.	
$x=4$	Plane containing vanish point of thread on pipe.	
$x=5$	Plane at which major diameter cone of thread intersects outside diameter of pipe.	

NOTE.—Additional special subscripts are as follows: Plane $x=6$ is the plane of the pipe end for railing joints. Plane $x=7$ is the plane of the API gage point at a specified length from the plane of vanish point. Plane $x=8$ is the plane of the large end of the "L_8 thread ring gage" for the compressed-gas cylinder valve connection thread. Plane $x=9$ is the plane of the small end of the "L_9 thread plug gage" for the compressed-gas cylinder neck thread.

TABLE 162D.—*Identification symbols* [1]

Symbol	Thread series	References: ASA Standards	References: Handbook H28 (1944), section No.
Acme–C	American Standard Acme threads, centralizing	B1.5–1945	X.
Acme–G	American Standard Acme threads, general purpose	B1.5–1945	X.
Stub Acme	American Standard Stub Acme thread	B1.11	
Butt	American Standard buttress thread	Under development	Appendix 5.
NC	American National coarse thread series	B1.1–1935	IV.
NF	American National fine thread series	B1.1–1935	IV.
NEF	American National extra-fine thread series		IV.
8N	American National 8-pitch thread series	B1.1–1935	IV.
12N	American Natilnal 12-pitch thread series	B1.1–1935	IV.
16N	American National 16-pitch thread series	B1.1–1935	IV.
NH	American National hose coupling and fire hose coupling threads		VII.
NGO	American National gas outlet threads		VIII (revised).
NS	Special threads of American National form		V.
NPT	American Standard taper pipe threads	B2.1–1945	VI.
NPSC	American Standard straight pipe thread in couplings	B2.1–1945	VI.
NPTF	American Standard taper pipe thread (dryseal)	B2.1–1945	VI.
NPSF	American Standard straight pipe thread (dryseal)	B2.1–1945	VI.
NPSI	American Standard intermediate straight pipe thread (dryseal)	B2.1–1945, App. E	
NPSM	American Standard straight pipe thread for mechanical joints	B2.1–1945	VI.
NPSL	American Standard straight pipe thread for locknuts and locknut pipe threads	B2.1–1945	VI.
NPSH	American Standard straight pipe thread for hose couplings and nipples	B2.1–1945	VI.
NPTR	American Standard taper pipe thread for railing fittings	B2.1–1945	VI.
BSW–T	British Standard Whitworth truncated	B1.6	
BSF–T	British Standard fine truncated	B1.6	
BSPP–T	British Standard pipe (parallel) truncated	B1.6	

[1] Methods of designating multiple threads are shown in ASA B1.5–1945, American War Standard for Acme Threads, and section X of Handbook H28 (1944).

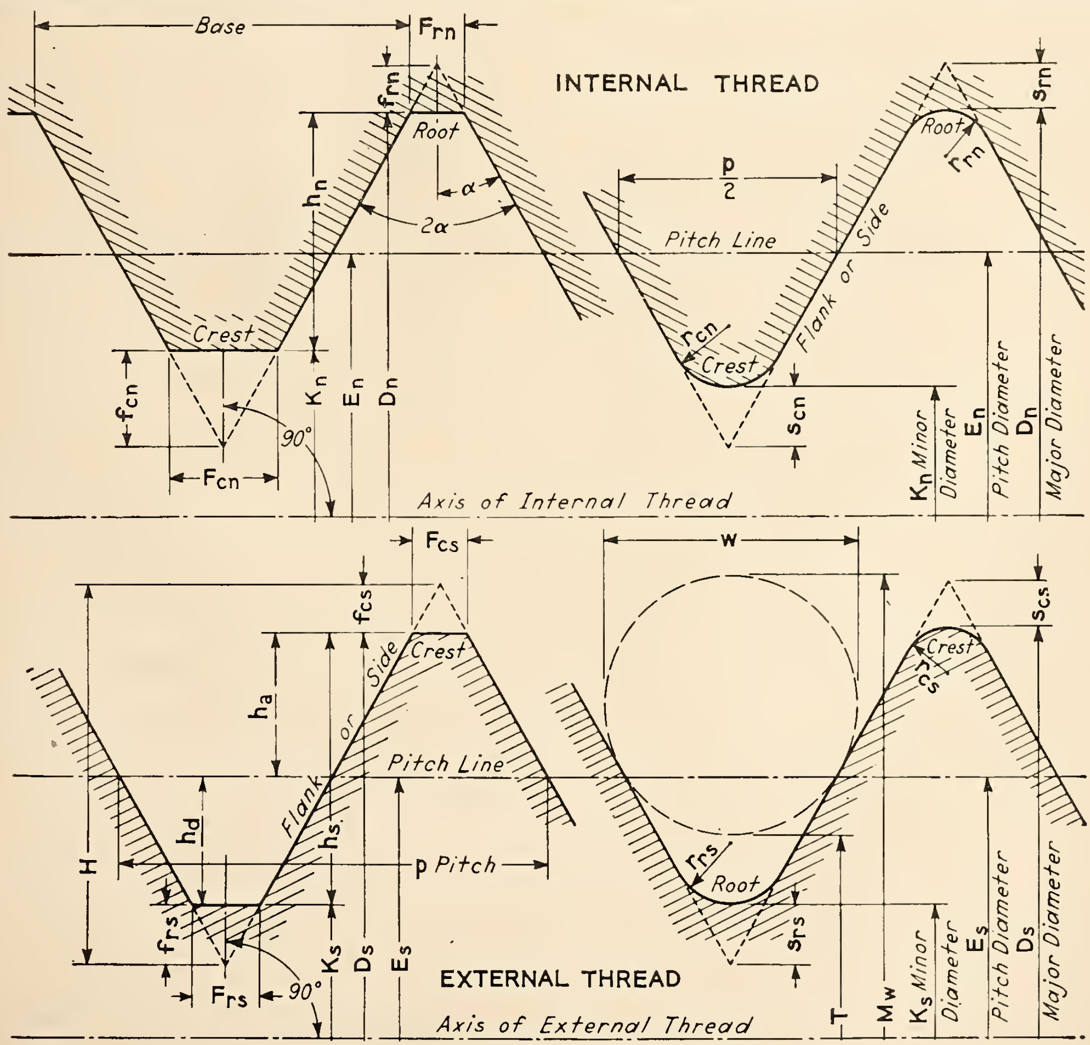
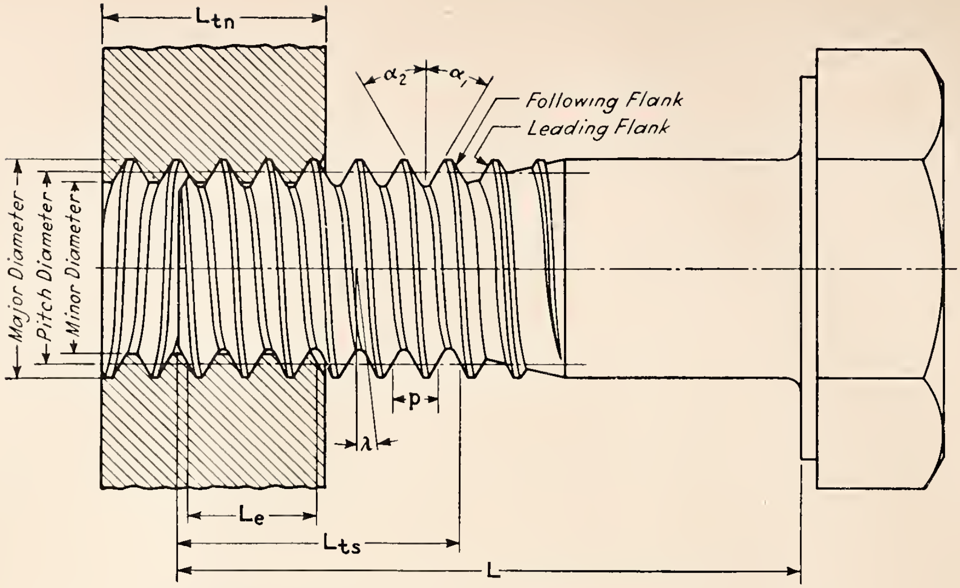
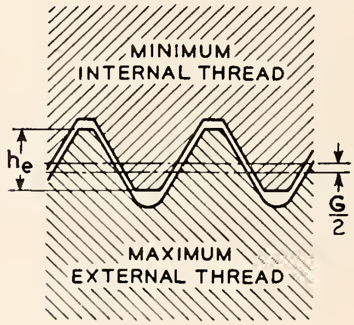
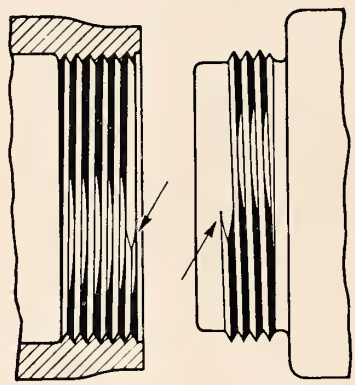


FIGURE 55A. *General screw thread symbols.*





Depth of thread engagement where an allowance is provided.



Higbee cut.

FIGURE 55B. *General screw thread symbols.*

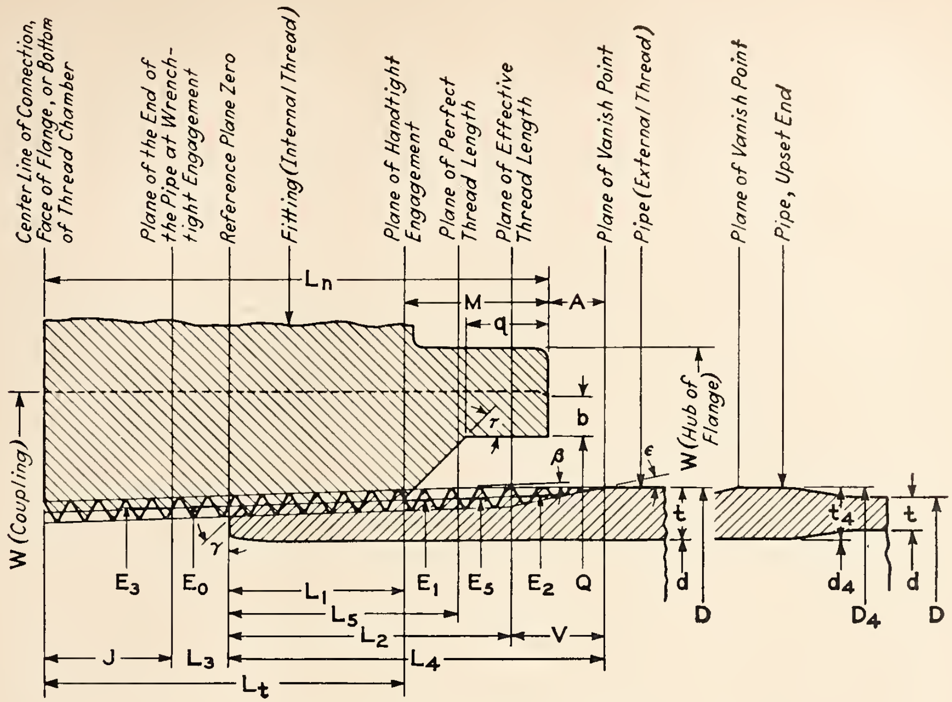


FIGURE 55C. *Pipe thread symbols.*

APPENDIX 8. ENDORSEMENTS

The following insertions and revisions are to be made on p. 271, second column of text: after line 16, insert: "WW-C-571. Conduit; Steel, Rigid, Enameled," amended August 22, 1945. WW-C-581a. "Conduit; Steel, Rigid, Zinc-Coated."

Near bottom of second column, change price of Nos. 5-A and 7-B to $1.00; change price of 5-F to 75 cents. Change No. 11-A to read: No. 11-A API Specifications for Oil Well Pumps ($1.25).

APPENDIX 9. UNIFIED SCREW THREADS

1. FOREWORD

On November 18, 1948, the Declaration of Accord with respect to the Unification of Screw Threads shown on the opposite page was signed by representatives of government and industry of Canada, the United Kingdom, and the United States. The publication of the Interdepartmental Screw Thread Committee, which was referred to in the Accord, was entitled, "Unified Screw Threads as Recommended by the Interdepartmental Screw Thread Committee."

The proposed Unified standards for thread form, for the coarse thread series in sizes from ¼ inch to 4 inches, inclusive, and for the fine thread series in sizes from ¼ inch to 1½ inches, inclusive, here presented, are in agreement with those in the above mentioned publication except that they have been modified in the following respects: (1) The allowance for class 1A is 0.300 instead of 0.450 times the class 2A pitch diameter tolerance, and (2) the minor diameter tolerances of internal threads have been modified slightly to place them on a consistent basis. These proposed standards, together with additional standards for threads of special diameters and pitches which are not now in final form, *have heretofore not been submitted but will be submitted*, in accordance with the usual procedure, *for approval* of each of the Departments represented on the Committee.

E. U. CONDON, *Chairman*.

MARCH 1949.

Declaration of Accord

with respect to the

Unification of Screw Threads

It is hereby declared that the undersigned, representatives of their Government and Industry Bodies, charged with the development of standards for screw threads, Agree that the standards for the Unified Screw Threads given in the publications of the Committees of the British Standards Institution, Canadian Standards Association, American Standards Association and of the Interdepartmental Screw Thread Committee fulfill all of the basic requirements for general interchangeability of threaded products made in accordance with any of these standards.

The Bodies noted above will maintain continuous cooperation in the further development and extension of these standards.

Signed in Washington, D. C., this 18th day of November, 1948, at the National Bureau of Standards of the United States.

C. D. Howe.	Ministry of Trade and Commerce, Dominion of Canada
J. G. Morrow	Canadian Standards Association
T. R. B. Sanders.	Ministry of Supply, United Kingdom
Percy Good	British Standards Institution
Ewart Smith	Representative of British Industry
E. U. Condon	National Bureau of Standards U. S. Department of Commerce Interdepartmental Screw Thread Committee
Fred P. [illegible]	American Standards Association The American Society of Mechanical Engineers Society of Automotive Engineers
William L. Batt	Sponsors Council of United States and United Kingdom on the Unification of Screw Threads

2. THE UNIFIED FORM OF THREAD

1. Angle of Thread.—The basic angle of thread between the flanks of the thread, measured in an axial plane, is 60°. The line bisecting this 60° angle is perpendicular to the axis of the screw thread.

2. Form of Crest.—The form of the crest may be either flat or rounded. The crest of the basic thread form of the external thread shall be truncated from the sharp crest an amount equal to $1/8 \times H$, where H is the depth of the fundamental triangle.

3. Clearance at Minor Diameter.—A clearance is provided at the minor diameter of the internal thread by truncating from the sharp crest an amount equal to $1/4 \times H$.

4. Clearance at Major Diameter.—A clearance is provided at the major diameter of the internal thread by making the thread form at the root such that its width is less than $1/8 \times p$.

5. Illustration.—Figure 1 shows the design forms (maximum metal condition) of the external and internal threads of the Unified form of thread.

6. Basic Thread Data.—The basic thread data for all standard pitches of the Unified form of thread are given in table 1.

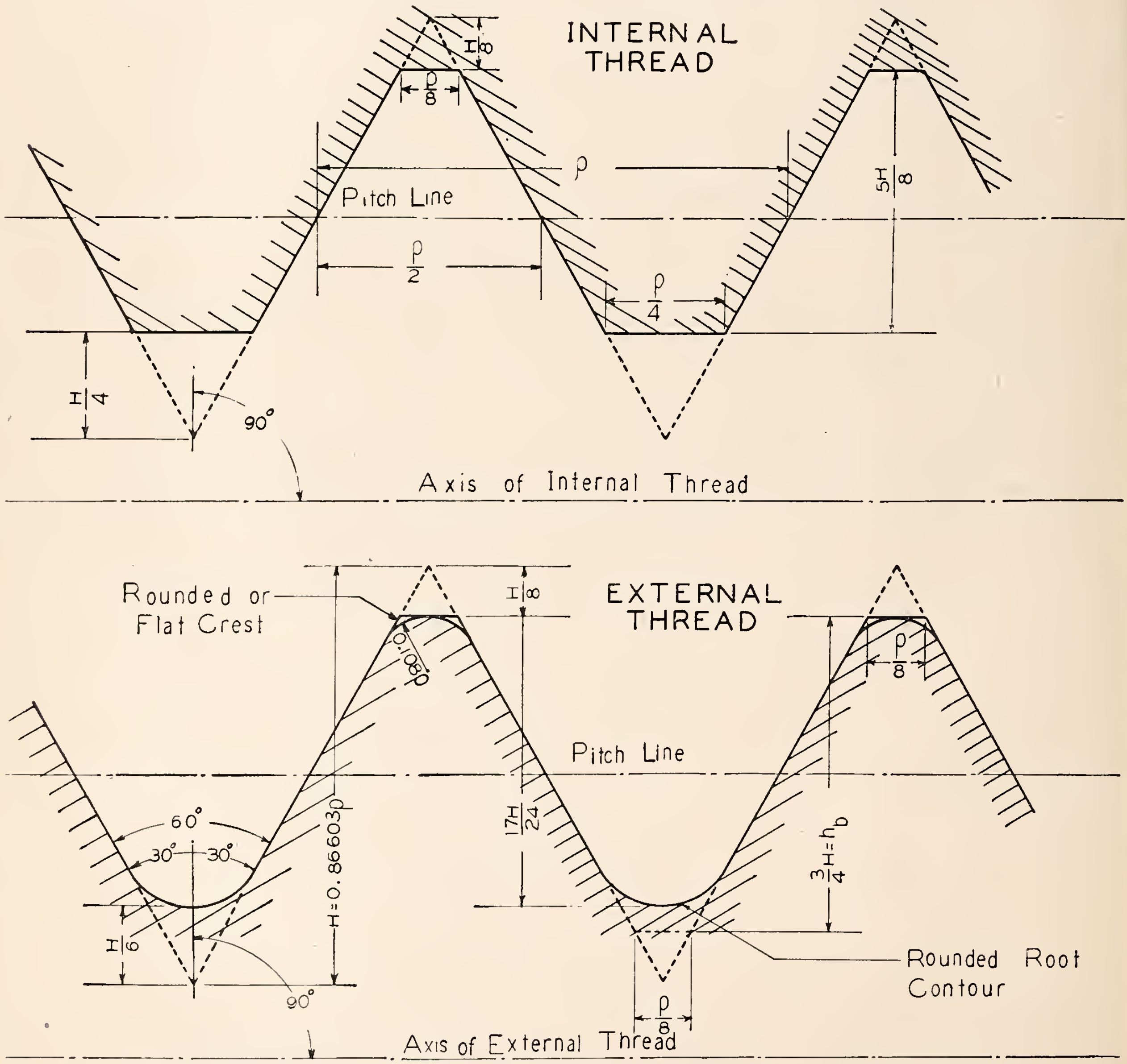


Figure 1.—*Unified internal and external screw thread design forms (maximum metal condition).*

3. THREAD SERIES AND SUGGESTED APPLICATIONS

1. Coarse Thread Series.—The diameter-pitch combinations and the basic dimensions of the Unified coarse thread series are given in table 2. The limits of size for the three classes of fit are given in tables 4 and 6. The coarse thread series is recommended for general use in engineering work, in machine construction where conditions are favorable to the use of bolts, screws, and other threaded components where quick and easy assembly of the parts is desired, and for all work where conditions do not require the use of fine-pitch threads.

2. Fine Thread Series.—The diameter-pitch combinations and the basic dimensions of the Unified fine-thread series are given in table 3. The limits of size for the three classes of fit are given in tables 5 and 7. The fine thread series is recommended for general use in automotive and aircraft work, and where special conditions require a fine thread.

4. CLASSIFICATION AND TOLERANCES

There are established for general use three distinct classes of screw-thread tolerances and allowances as specified in the following brief outline. These three classes, together with the accompanying specifications, are for the purpose of insuring the interchangeable manufacture of screw-thread parts. This standard includes classes 1A, 2A, and 3A, applied to external threads only, and classes 1B, 2B, and 3B applied to internal threads only. The requirements for a screw-thread fit for specific applications can be met by specifying the proper combination of classes for the components. For example, an external thread made to class 2A limits can be used with tapped holes made to classes 1B, 2B, or 3B limits for specific applications.

It is not the purpose of this standard to limit applications of the various standard classes. However, classes 2A and 2B were designed for the normal production of screws, bolts, and nuts, and so far as practicable such production should be limited to these classes. They are also suitable for a wide variety of other applications.

(a) GENERAL

The following general specifications apply to all classes specified for applications of the Unified form of thread.

1. Uniform Minimum Internal Thread.—The minimum major, pitch, and minor diameters of the internal thread are respectively the same for classes 1B, 2B, and 3B.

2. Direction and Scope of Tolerances.—

(*a*) The tolerance on the internal thread is plus, and is applied from the basic size to above basic size.

(*b*) The tolerance on the external thread is minus, and is applied from the maximum (or design) size to below the maximum size.

(*c*) The tolerances specified represent the extreme variations permitted on the product.

3. Basic Formula for Allowances and Tolerances.—The basic formula, from which allowances on all diameters and tolerances on pitch diameter are derived, is:

$$\text{Tolerance (or allowance)} = C(0.0015\sqrt[3]{D} + 0.0015\sqrt{L_e} + 0.015\sqrt[3]{p^2}),$$

where

C = a factor which differs for each allowance or tolerance for each class
D = basic major diameter
L_e = length of engagement
p = pitch.

This formula is based on the accuracy of present day threading practice, and is applicable to all reasonable combinations of diameter, pitch, and length of engagement. Numerical values of the increments in the formula for standard diameters, pitches, and lengths of engagement are given in table 8.

4. Allowances.—Allowances are applied only to external threads. The values of the factor C (par. 3 above) for allowances are as follows:

Class	Factor C
1A	0. 300
2A	. 300
3A	. 000

5. Pitch Diameter Tolerances.—(*a*) *Values of factor C.*—The values of the factor C (par. 3 above) for pitch diameter tolerances are as follows:

Class	Factor C
1A	1. 500
1B	1. 950
2A	1. 000
2B	1. 300
3A	. 750
3B	. 975

It will be noted that the factor C is 30 percent greater for internal than for external threads of a given class number on account of the relative difficulties of manufacture.

(*b*) *Tolerances cumulative.*—The tolerances on pitch diameter are cumulative, that is, they include the variations of lead and angle. Therefore,

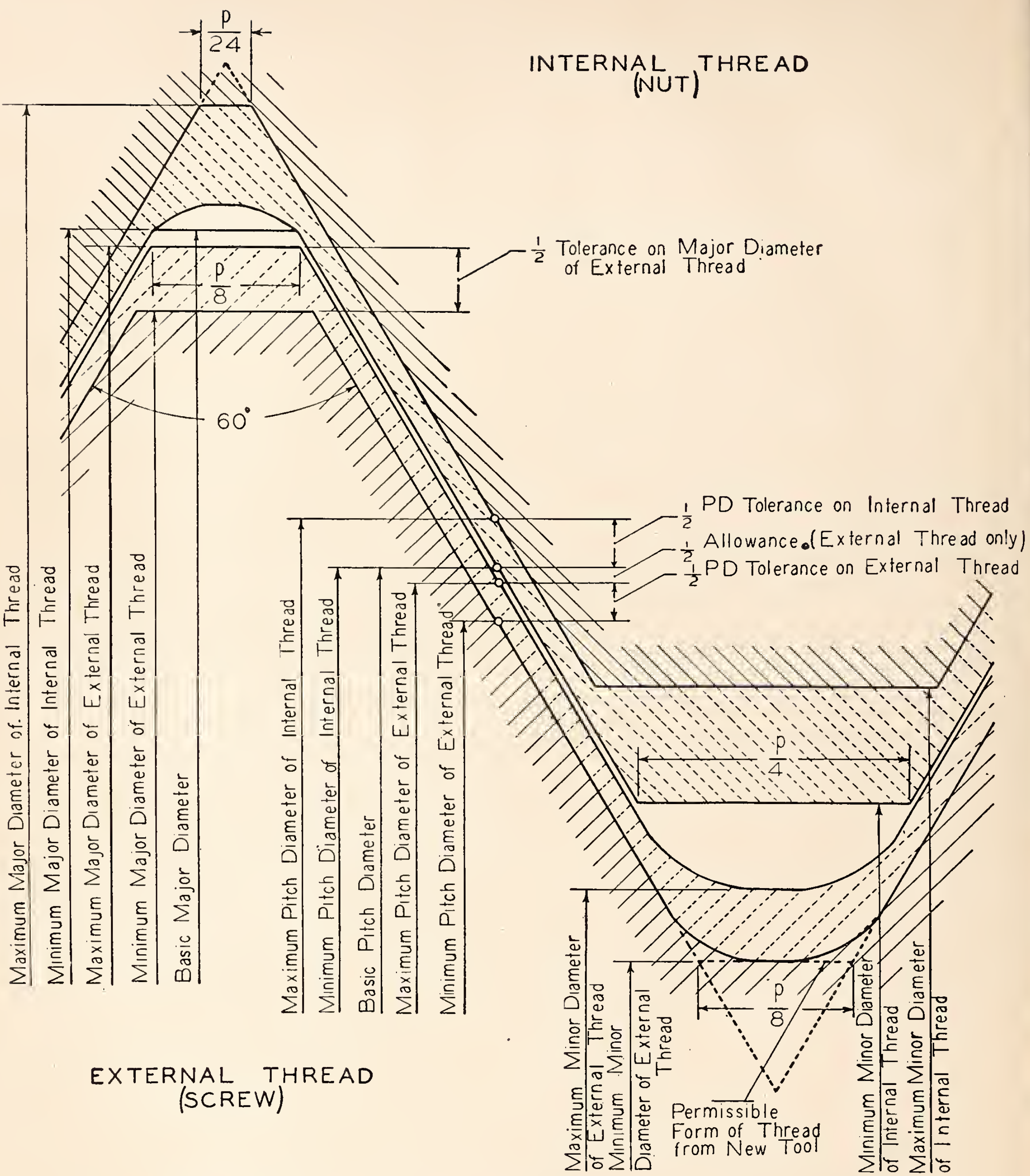


FIGURE 2.—*Disposition of tolerances, allowance, and crest clearances for classes 1A, 2A, 1B, and 2B.*

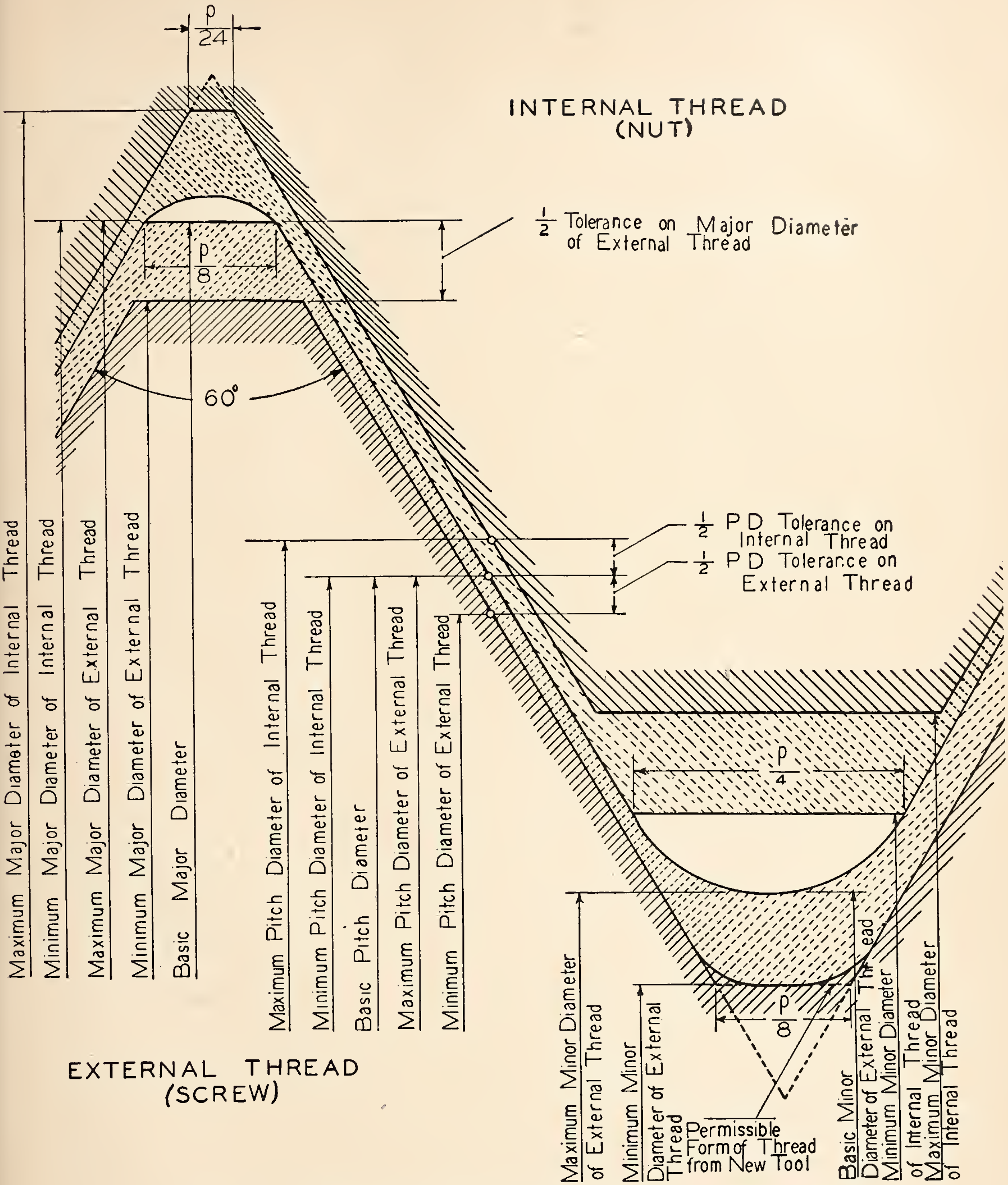


FIGURE 3.—*Disposition of tolerances and crest clearances for classes 3A and 3B.*

the full tolerance is not available for pitch diameter unless the lead and angle of the thread are perfect.

(*c*) *Length of engagement.*—The tolerances on pitch diameter for the coarse and fine thread series are based on a length of engagement equal to the basic major diameter.

6. Major Diameter Tolerances.—(*a*) *External threads.*—The tolerance on major diameter for class 1A is equal to $0.09\sqrt[3]{p^2}$ and for classes 2A and 3A is equal to $0.06\sqrt[3]{p^2}$. Tolerances equal to $0.09\sqrt[3]{p^2}$ are provided for class 2A products of unfinished, hot-rolled material.

(*b*) *Internal threads.*—No tolerance is specified, as the maximum major diameter is established by the crest of an unworn tool. See footnote 2, tables 5 and 7.

7. Minor Diameter Tolerances.—(*a*) *External threads.*—No tolerance is specified, as the minimum minor diameter is established by the crest of an unworn tool. See footnote 2, tables 4 and 6.

(*b*) *Internal threads.*—The tolerance on minor diameter for a given size and pitch of thread is the same for all classes.

For all Unified coarse and fine series threads 1 inch and larger in size, the tolerance is equal to $0.120p$. For sizes less than 1 inch in size, most tolerances are larger than $0.120p$ to minimize tapping difficulties (in accordance with formulas to be published in connection with special diameter-pitch combinations).

(b) SCREW-THREAD CLASSES

1. Classes 1A and 1B.—(*a*) *Definition.*—The combination of classes 1A and 1B is intended to cover the manufacture of threaded parts where quick and easy assembly is necessary, and where an allowance is required to permit ready assembly, even when the threads are slightly bruised or dirty.

(*b*) *Allowances and tolerances.*—Allowances and tolerances for the respective thread series are specified in tables 4, 5, 6, and 7 and their application is shown in figure 2.

2. Classes 2A and 2B.—(*a*) *Definition.*—Class 2A for external threads and 2B for internal threads are standards designed for screws, bolts, and nuts. They are also suitable for a wide variety of other applications. A moderate allowance is provided which minimizes galling and seizure encountered in assembly and use; it also accommodates platings, finishes, or coatings. The maximum dimensions of threads which are electroplated or have coatings of similar thickness are increased by the amount of the allowance.

(*b*) *Allowances and tolerances.*—Allowances and tolerances for the respective thread series are specified in tables 4, 5, 6, and 7, and their application is shown in figure 2.

3. Classes 3A and 3B.—(*a*) *Definition.*—Class 3A for external threads and class 3B for internal threads provides a class of fit for such applications where closeness of fit and accuracy of lead and angle of thread are important. They are obtainable consistently only by the use of high quality production equipment supported by a very efficient system of gaging and inspection. No allowance is provided, but since the tolerances on "go" gages are within the limits of size of the product, the gages will assure a slight clearance between product made to the maximum-metal limits.

(*b*) *Allowances and tolerances.*—Allowances and tolerances for the respective thread series are specified in tables 4, 5, 6, and 7 and their application is shown in figure 3.

5. GAGES

The specifications for gages beginning on page 3 of the Supplement to Handbook H28(1944) and beginning on page 29 of Handbook H28(1944) are applicable to Unified screw threads.

TABLE 1.—*Thread data, Unified thread form*

Threads per inch, n	Pitch, p	Height of sharp V-thread, $H=$ 0.86603p	Height of external thread, $h_s=$ 17/24$H=$ 0.61343p	Height of internal thread, $h_n=$ 5/8$H=$ 0.54127p	Depth of thread engagement, $h_e=$ 5/8$H=$ 0.54127p	Flat at external thread crest, $F_{cs}=$ p/8= 0.125p	Truncation of external thread crest, $f_{cs}=$ H/8= 0.10825p	Truncation of external thread root, $s_{rs}=$ H/6= 0.14434p	Flat at internal thread crest, $F_{cn}=$ p/4= 0.25p	Truncation of internal thread crest, $f_{cn}=$ H/4= 0.21651p	Flat at internal thread root, $F_{rn}=$ p/8= 0.125p	Truncation of internal thread root, $f_{rn}=$ H/8= 0.10825p	Addendum of external thread, $h_a=$ 3/8$H=$ 0.32476p	Twice the external thread addendum,[1] $h_b=2h_a=$ 3/4$H=$ 0.64952p
	in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
80	0. 01250	0. 01083	0. 00767	0. 00677	0. 00677	0. 00156	0. 00135	0. 00180	0. 00312	0. 00271	0. 00156	0. 00135	0. 00406	0. 00812
72	. 01389	. 01203	. 00852	. 00752	. 00752	. 00174	. 00150	. 00200	. 00347	. 00301	. 00174	. 00150	. 00451	. 00902
64	. 01563	. 01353	. 00958	. 00846	. 00846	. 00195	. 00169	. 00226	. 00391	. 00338	. 00195	. 00169	. 00507	. 01015
56	. 01786	. 01546	. 01095	. 00967	. 00967	. 00223	. 00193	. 00258	. 00446	. 00387	. 00223	. 00193	. 00580	. 01160
48	. 02083	. 01804	. 01278	. 01128	. 01128	. 00260	. 00226	. 00301	. 00521	. 00451	. 00260	. 00226	. 00677	. 01353
44	. 02273	. 01968	. 01394	. 01230	. 01230	. 00284	. 00246	. 00328	. 00568	. 00492	. 00284	. 00246	. 00738	. 01476
40	. 02500	. 02165	. 01534	. 01353	. 01353	. 00312	. 00271	. 00361	. 00625	. 00541	. 00312	. 00271	. 00812	. 01624
36	. 02778	. 02406	. 01704	. 01504	. 01504	. 00347	. 00301	. 00401	. 00694	. 00601	. 00347	. 00301	. 00902	. 01804
32	. 03125	. 02706	. 01917	. 01691	. 01691	. 00391	. 00338	. 00451	. 00781	. 00677	. 00391	. 00338	. 01015	. 02030
28	. 03571	. 03093	. 02191	. 01933	. 01933	. 00446	. 00387	. 00515	. 00893	. 00773	. 00446	. 00387	. 01160	. 02320
24	. 04167	. 03608	. 02556	. 02255	. 02255	. 00521	. 00451	. 00601	. 01042	. 00902	. 00521	. 00451	. 01353	. 02706
20	. 05000	. 04330	. 03067	. 02706	. 02706	. 00625	. 00541	. 00722	. 01250	. 01083	. 00625	. 00541	. 01624	. 03248
18	. 05556	. 04811	. 03408	. 03007	. 03007	. 00694	. 00601	. 00802	. 01389	. 01203	. 00694	. 00601	. 01804	. 03608
16	. 06250	. 05413	. 03834	. 03383	. 03383	. 00781	. 00677	. 00902	. 01562	. 01353	. 00781	. 00677	. 02030	. 04059
14	. 07143	. 06186	. 04382	. 03866	. 03866	. 00893	. 00773	. 01031	. 01786	. 01546	. 00893	. 00773	. 02320	. 04639
13	. 07692	. 06662	. 04719	. 04164	. 04164	. 00962	. 00833	. 01110	. 01923	. 01665	. 00962	. 00833	. 02498	. 04996
12	. 08333	. 07217	. 05112	. 04511	. 04511	. 01042	. 00902	. 01203	. 02083	. 01804	. 01042	. 00902	. 02706	. 05413
11½	. 08696	. 07531	. 05334	. 04707	. 04707	. 01087	. 00941	. 01255	. 02174	. 01883	. 01087	. 00941	. 02824	. 05648
11	. 09091	. 07873	. 05577	. 04921	. 04921	. 01136	. 00984	. 01312	. 02273	. 01968	. 01136	. 00984	. 02952	. 05905
10	. 10000	. 08660	. 06134	. 05413	. 05413	. 01250	. 01083	. 01443	. 02500	. 02165	. 01250	. 01083	. 03248	. 06495
9	. 11111	. 09623	. 06816	. 06014	. 06014	. 01389	. 01203	. 01604	. 02778	. 02406	. 01389	. 01203	. 03608	. 07217
8	. 12500	. 10825	. 07668	. 06766	. 06766	. 01562	. 01353	. 01804	. 03125	. 02706	. 01562	. 01353	. 04059	. 08119
7	. 14286	. 12372	. 08763	. 07732	. 07732	. 01786	. 01546	. 02062	. 03571	. 03093	. 01786	. 01546	. 04639	. 09279
6	. 16667	. 14434	. 10224	. 09021	. 09021	. 02083	. 01804	. 02406	. 04167	. 03608	. 02083	. 01804	. 05413	. 10825
5	. 20000	. 17321	. 12269	. 10825	. 10825	. 02500	. 02165	. 02887	. 05000	. 04330	. 02500	. 02165	. 06495	. 12990
4½	. 22222	. 19245	. 13632	. 12028	. 12028	. 02778	. 02406	. 03208	. 05556	. 04811	. 02778	. 02406	. 07217	. 14434
4	. 25000	. 21651	. 15336	. 13532	. 13532	. 03125	. 02706	. 03608	. 06250	. 05413	. 03125	. 02706	. 08119	. 16238

[1] Equivalent to the "basic height" h of the original American National form.

Table 2.—*Coarse-thread series, basic dimensions*

Sizes	Basic major diameter, D	Threads per inch, n	Basic pitch diameter,[1] E	Minor diameter, external threads, K_s	Minor diameter, internal threads, K_n	Lead angle at basic pitch diameter, λ		Section at minor diameter at $D-2h_b$	Stress area [2]
	in.		*in.*	*in.*	*in.*	*deg.*	*min*	*sq in.*	*sq in.*
1/4	0. 2500	20	0. 2175	0. 1887	0. 1959	4	11	0. 0269	0. 0317
5/16	. 3125	18	. 2764	. 2443	. 2524	3	40	. 0454	. 0522
3/8	. 3750	16	. 3344	. 2983	. 3073	3	24	. 0678	. 0773
7/16	. 4375	14	. 3911	. 3499	. 3602	3	20	. 0933	. 1060
1/2	. 5000	12	. 4459	. 3978	. 4098	3	24	. 1205	. 1374
9/16	. 5625	12	. 5084	. 4603	. 4723	2	59	. 1620	. 1816
5/8	. 6250	11	. 5660	. 5135	. 5266	2	56	. 2018	. 2256
3/4	. 7500	10	. 6850	. 6273	. 6417	2	40	. 3020	. 3340
7/8	. 8750	9	. 8028	. 7387	. 7547	2	31	. 4193	. 4612
1	1. 0000	8	. 9188	. 8466	. 8647	2	29	. 5510	. 6051
1 1/8	1. 1250	7	1. 0322	. 9497	. 9704	2	31	. 6931	. 7627
1 1/4	1. 2500	7	1. 1572	1. 0747	1. 0954	2	15	. 8898	. 9684
1 3/8	1. 3750	6	1. 2667	1. 1705	1. 1946	2	24	1. 0541	1. 1538
1 1/2	1. 5000	6	1. 3917	1. 2955	1. 3196	2	11	1. 2938	1. 4041
1 3/4	1. 7500	5	1. 6201	1. 5046	1. 5335	2	15	1. 7441	1. 8983
2	2. 0000	4 1/2	1. 8557	1. 7274	1. 7594	2	11	2. 3001	2. 4971
2 1/4	2. 2500	4 1/2	2. 1057	1. 9774	2. 0094	1	55	3. 0212	3. 2464
2 1/2	2. 5000	4	2. 3376	2. 1933	2. 2294	1	57	3. 7161	3. 9976
2 3/4	2. 7500	4	2. 5876	2. 4433	2. 4794	1	46	4. 6194	4. 9326
3	3. 0000	4	2. 8376	2. 6933	2. 7294	1	36	5. 6209	5. 9659
3 1/4	3. 2500	4	3. 0876	2. 9433	2. 9794	1	29	6. 7205	7. 0992
3 1/2	3. 5000	4	3. 3376	3. 1933	3. 2294	1	22	7. 9183	8. 3268
3 3/4	3. 7500	4	3. 5876	3. 4433	3. 4794	1	16	9. 2143	9. 6546
4	4. 0000	4	3. 8376	3. 6933	3. 7294	1	11	10. 6084	11. 0805

[1] British: Effective diameter.
[2] Based on the average of the mean pitch and minor diameters of the external thread.

Table 3.—*Fine thread series, basic dimensions*

Sizes	Basic major diameter, D	Threads per inch, n	Basic pitch diameter,[1] E	Minor diameter, external threads, K_s	Minor diameter, internal threads, K_n	Lead angle at basic pitch diameter, λ		Section at minor diameter at $D-2h_b$	Stress area [2]
	in.		*in.*	*in.*	*in.*	*deg.*	*min*	*sq in.*	*sq in.*
1/4	0. 2500	28	0. 2268	0. 2062	0. 2113	2	52	0. 0326	0. 0362
5/16	. 3125	24	. 2854	. 2614	. 2674	2	40	. 0524	. 0579
3/8	. 3750	24	. 3479	. 3239	. 3299	2	11	. 0809	. 0876
7/16	. 4375	20	. 4050	. 3762	. 3834	2	15	. 1090	. 1185
1/2	. 5000	20	. 4675	. 4387	. 4459	1	57	. 1486	. 1597
9/16	. 5625	18	. 5264	. 4943	. 5024	1	55	. 1888	. 2026
5/8	. 6250	18	. 5889	. 5568	. 5649	1	43	. 2400	. 2555
3/4	. 7500	16	. 7094	. 6733	. 6823	1	36	. 3513	. 3724
7/8	. 8750	14	. 8286	. 7874	. 7977	1	34	. 4805	. 5088
1	1. 0000	12	. 9459	. 8978	. 9098	1	36	. 6245	. 6624
1 1/8	1. 1250	12	1. 0709	1. 0228	1. 0348	1	25	. 8118	. 8549
1 1/4	1. 2500	12	1. 1959	1. 1478	1. 1598	1	16	1. 0237	1. 0721
1 3/8	1. 3750	12	1. 3209	1. 2728	1. 2848	1	9	1. 2602	1. 3137
1 1/2	1. 5000	12	1. 4459	1. 3978	1. 4098	1	3	1. 5212	1. 5799

[1] British: Effective diameter.
[2] Based on the average of the mean pitch and minor diameters of the external thread.

TABLE 4.—*Limits of size, Unified coarse thread series, external threads, classes 1A, 2A, and 3A*

Designation			External thread limits of size [1]							
				Major diameter			Pitch diameter			
				Limits			Limits			
Size	Threads per inch	Thread symbol	Allowance	Max	Min	Tolerance	Max	Min	Tolerance	Minor diameter, max [2]
			in.	in.	in.	in.	in.	in.	in.	in.
¼	20	UNC–1A	0. 0011	0. 2489	0. 2367	0. 0122	0. 2164	0. 2108	0. 0056	0. 1876
"	"	" –2A	"	"	. 2408	. 0081	"	. 2127	. 0037	"
"	"	" –3A	0	. 2500	. 2419	"	. 2175	. 2147	. 0028	. 1887
5/16	18	UNC–1A	. 0012	. 3113	. 2982	. 0131	. 2752	. 2691	. 0061	. 2431
"	"	" –2A	"	"	. 3026	. 0087	"	. 2712	. 0040	"
"	"	" –3A	0	. 3125	. 3038	"	. 2764	. 2734	. 0030	. 2443
⅜	16	UNC–1A	. 0013	. 3737	. 3595	. 0142	. 3331	. 3266	. 0065	. 2970
"	"	" –2A	"	"	. 3643	. 0094	"	. 3287	. 0044	"
"	"	" –3A	0	. 3750	. 3656	"	. 3344	. 3311	. 0033	. 2983
7/16	14	UNC–1A	. 0014	. 4361	. 4206	. 0155	. 3897	. 3826	. 0071	. 3485
"	"	" –2A	"	"	. 4258	. 0103	"	. 3850	. 0047	"
"	"	" –3A	0	. 4375	. 4272	"	. 3911	. 3876	. 0035	. 3499
½	12	UNC–1A	. 0015	. 4985	. 4813	. 0172	. 4444	. 4367	. 0077	. 3963
"	"	" –2A	"	"	. 4871	. 0114	"	. 4393	. 0051	"
"	"	" –3A	0	. 5000	. 4886	"	. 4459	. 4421	. 0038	. 3978
9/16	12	UNC–1A	. 0016	. 5609	. 5437	. 0172	. 5068	. 4990	. 0078	. 4587
"	"	" –2A	"	"	. 5495	. 0114	"	. 5016	. 0052	"
"	"	" –3A	0	. 5625	. 5511	"	. 5084	. 5045	. 0039	. 4603
⅝	11	UNC–1A	. 0016	. 6234	. 6052	. 0182	. 5644	. 5561	. 0083	. 5119
"	"	" –2A	"	"	. 6113	. 0121	"	. 5589	. 0055	"
"	"	" –3A	0	. 6250	. 6129	"	. 5660	. 5619	. 0041	. 5135
¾	10	UNC–1A	. 0018	. 7482	. 7288	. 0194	. 6832	. 6744	. 0088	. 6255
"	"	" –2A	"	"	. 7353	. 0129	"	. 6773	. 0059	"
"	"	" –3A	0	. 7500	. 7371	"	. 6850	. 6806	. 0044	. 6273
⅞	9	UNC–1A	. 0019	. 8731	. 8523	. 0208	. 8009	. 7914	. 0095	. 7368
"	"	" –2A	"	"	. 8592	. 0139	"	. 7946	. 0063	"
"	"	" –3A	0	. 8750	. 8611	"	. 8028	. 7981	. 0047	. 7387
1	8	UNC–1A	. 0020	. 9980	. 9755	. 0225	. 9168	. 9067	. 0101	. 8446
"	"	" –2A	"	"	. 9830	. 0150	"	. 9100	. 0068	"
"	"	" –3A	0	1. 0000	. 9850	"	. 9188	. 9137	. 0051	. 8466
1⅛	7	UNC–1A	. 0022	1. 1228	1. 0982	. 0246	1. 0300	1. 0191	. 0109	. 9475
"	"	" –2A	"	"	1. 1064	. 0164	"	1. 0228	. 0072	"
"	"	" –3A	0	1. 1250	1. 1086	"	1. 0322	1. 0268	. 0054	. 9497
1¼	7	UNC–1A	. 0022	1. 2478	1. 2232	. 0246	1. 1550	1. 1439	. 0111	1. 0725
"	"	" –2A	"	"	1. 2314	. 0164	"	1. 1476	. 0074	"
"	"	" –3A	0	1. 2500	1. 2336	"	1. 1572	1. 1517	. 0055	1. 0747
1⅜	6	UNC–1A	. 0024	1. 3726	1. 3453	. 0273	1. 2643	1. 2523	. 0120	1. 1681
"	"	" –2A	"	"	1. 3544	. 0182	"	1. 2563	. 0080	"
"	"	" –3A	0	1. 3750	1. 3568	"	1. 2667	1. 2607	. 0060	1. 1705
1½	6	UNC–1A	. 0024	1. 4976	1. 4703	. 0273	1. 3893	1. 3772	. 0121	1. 2931
"	"	" –2A	"	"	1. 4794	. 0182	"	1. 3812	. 0081	"
"	"	" –3A	0	1. 5000	1. 4818	"	1. 3917	1. 3856	. 0061	1. 2955
1¾	5	UNC–1A	. 0027	1. 7473	1. 7165	. 0308	1. 6174	1. 6040	. 0134	1. 5019
"	"	" –2A	"	"	1. 7268	. 0205	"	1. 6805	. 0089	"
"	"	" –3A	0	1. 7500	1. 7295	"	1. 6201	1. 6134	. 0067	1. 5046
2	4½	UNC–1A	. 0029	1. 9971	1. 9641	. 0330	1. 8528	1. 8385	. 0143	1. 7245
"	"	" 2A	"	"	1. 9751	. 0220	"	1. 8433	. 0095	"
"	"	" 3A	0	2. 0000	1. 9780	"	1. 8557	1. 8486	. 0071	1. 7274

See footnotes at end of table.

TABLE 4.—*Limits of size, Unified coarse thread series, external threads, classes 1A, 2A, and 3A*—Continued

Designation			External thread limits of size [1]							
Size	Threads per inch	Thread symbol	Allowance	Major diameter			Pitch diameter			Minor diameter, max [2]
				Limits		Tolerance	Limits		Tolerance	
				Max	Min		Max	Min		
			in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
2¼	4½	UNC–1A	0. 0029	2. 2471	2. 2141	0. 0330	2. 1028	2. 0882	0. 0146	1. 9745
"	"	" –2A	"	"	2. 2251	. 0220	"	2. 0931	. 0097	"
"	"	" –3A	0	2. 2500	2. 2280	"	2. 1057	2. 0984	. 0073	1. 9774
2½	4	UNC–1A	. 0031	2. 4969	2. 4612	. 0357	2. 3345	2. 3190	. 0155	2. 1902
"	"	" –2A	"	"	2. 4731	. 0238	"	2. 3241	. 0104	"
"	"	" –3A	0	2. 5000	2. 4762	"	2. 3376	2. 3298	. 0078	2. 1933
2¾	4	UNC–1A	. 0032	2. 7468	2. 7111	. 0357	2. 5844	2. 5686	. 0158	2. 4401
"	"	" –2A	"	"	2. 7230	. 0238	"	2. 5739	. 0105	"
"	"	" –3A	0	2. 7500	2. 7262	"	2. 5876	2. 5797	. 0079	2. 4433
3	4	UNC–1A	. 0032	2. 9968	2. 9611	. 0357	2. 8344	2. 8183	. 0161	2. 6901
"	"	" –2A	"	"	2. 9730	. 0238	"	2. 8237	. 0107	"
"	"	" –3A	0	3. 0000	2. 9762	"	2. 8376	2. 8296	. 0080	2. 6933
3¼	4	UNC–1A	. 0033	3. 2467	3. 2110	. 0357	3. 0843	3. 0680	. 0163	2. 9400
"	"	" –2A	"	"	3. 2229	. 0238	"	3. 0734	. 0109	"
"	"	" –3A	0	3. 2500	3. 2262	"	3. 0876	3. 0794	. 0082	2. 9433
3½	4	UNC–1A	. 0033	3. 4967	3. 4610	. 0357	3. 3343	3. 3177	. 0166	3. 1900
"	"	" –2A	"	"	3. 4729	. 0238	"	3. 3233	. 0110	"
"	"	" –3A	0	3. 5000	3. 4762	"	3. 3376	3. 3293	. 0083	3. 1933
3¾	4	UNC–1A	. 0034	3. 7466	3. 7109	. 0357	3. 5842	3. 5674	. 0168	3. 4399
"	"	" –2A	"	"	3. 7228	. 0238	"	3. 5730	. 0112	"
"	"	" –3A	0	3. 7500	3. 7262	"	3. 5876	3. 5792	. 0084	3. 4433
4	4	UNC–1A	. 0034	3. 9966	3. 9609	. 0357	3. 8342	3. 8172	. 0170	3. 6899
"	"	" –2A	"	"	3. 9728	. 0238	"	3. 8229	. 0113	"
"	"	" –3A	0	4. 0000	3. 9762	"	3. 8376	3. 8291	. 0085	3. 6933

[1] The values in this table are based on a length of engagement equal to the nominal diameter.
[2] The minimum minor diameter of the external thread may be determined by subtracting $0.6495p(=h_b)$ from the minimum pitch diameter of the external thread. This minimum diameter is not controlled by gages but by the form of the threading tools.

TABLE 5.—*Limits of size, Unified fine thread series, external threads, classes 1A, 2A, and 3A*

Designation			External thread limits of size [1]							
				Major diameter			Pitch diameter			
Size	Threads per inch	Thread symbol	Allowance	Limits		Tolerance	Limits		Tolerance	Minor diameter max [2]
				Max	Min		Max	Min		
			in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
¼	28	UNF–1A	0. 0010	0. 2490	0. 2392	0. 0098	0. 2258	0. 2208	0. 0050	0. 2052
"	"	" –2A	"	"	. 2425	. 0065	"	. 2225	. 0033	"
"	"	" –3A	0	. 2500	. 2435	"	. 2268	. 2243	. 0025	. 2062
5/16	24	UNF–1A	. 0011	. 3114	. 3006	. 0108	. 2843	. 2788	. 0055	. 2603
"	"	" –2A	"	"	. 3042	. 0072	"	. 2806	. 0037	"
"	"	" –3A	0	. 3125	. 3053	"	. 2854	. 2827	. 0027	. 2614
⅜	24	UNF–1A	. 0011	. 3739	. 3631	. 0108	. 3468	. 3411	. 0057	. 3228
"	"	" –2A	"	"	. 3667	. 0072	"	. 3430	. 0038	"
"	"	" –3A	0	. 3750	. 3678	"	. 3479	. 3450	. 0029	. 3239
7/16	20	UNF–1A	. 0013	. 4362	. 4240	. 0122	. 4037	. 3975	. 0062	. 3749
"	"	" –2A	"	"	. 4281	. 0081	"	. 3995	. 0042	"
"	"	" –3A	0	. 4375	. 4294	"	. 4050	. 4019	. 0031	. 3762
½	20	UNF–1A	. 0013	. 4987	. 4865	. 0122	. 4662	. 4598	. 0064	. 4374
"	"	" –2A	"	"	. 4906	. 0081	"	. 4619	. 0043	"
"	"	" –3A	0	. 5000	. 4919	"	. 4675	. 4643	. 0032	. 4387
9/16	18	UNF–1A	. 0014	. 5611	. 5480	. 0131	. 5250	. 5182	. 0068	. 4929
"	"	" –2A	"	"	. 5524	. 0087	"	. 5205	. 0045	"
"	"	" –3A	0	. 5625	. 5538	"	. 5264	. 5230	. 0034	. 4943
⅝	18	UNF–1A	. 0014	. 6236	. 6105	. 0131	. 5875	. 5805	. 0070	. 5554
"	"	" –2A	"	"	. 6149	. 0087	"	. 5828	. 0047	"
"	"	" –3A	0	. 6250	. 6163	"	. 5889	. 5854	. 0035	. 5568
¾	16	UNF–1A	. 0015	. 7485	. 7343	. 0142	. 7079	. 7004	. 0075	. 6718
"	"	" –2A	"	"	. 7391	. 0094	"	. 7029	. 0050	"
"	"	" –3A	0	. 7500	. 7406	"	. 7094	. 7056	. 0038	. 6733
⅞	14	UNF–1A	. 0016	. 8734	. 8579	. 0155	. 8270	. 8189	. 0081	. 7858
"	"	" –2A	"	"	. 8631	. 0103	"	. 8216	. 0054	"
"	"	" –3A	0	. 8750	. 8647	"	. 8286	. 8245	. 0041	. 7874
1	12	UNF–1A	. 0018	. 9982	. 9810	. 0172	. 9441	. 9353	. 0088	. 8960
"	"	" –2A	"	"	. 9868	. 0114	"	. 9382	. 0059	"
"	"	" –3A	0	1. 0000	. 9886	"	. 9459	. 9415	. 0044	. 8978
1⅛	12	UNF–1A	. 0018	1. 1232	1. 1060	. 0172	1. 0691	1. 0601	. 0090	1. 0210
"	"	" –2A	"	"	1. 1118	. 0114	"	1. 0631	. 0060	"
"	"	" –3A	0	1. 1250	1. 1136	"	1. 0709	1. 0664	. 0045	1. 0228
1¼	12	UNF–1A	. 0018	1. 2482	1. 2310	. 0172	1. 1941	1. 1849	. 0092	1. 1460
"	"	" –2A	"	"	1. 2368	. 0114	"	1. 1879	. 0062	"
"	"	" –3A	0	1. 2500	1. 2386	"	1. 1959	1. 1913	. 0046	1. 1478
1⅜	12	UNF–1A	. 0019	1. 3731	1. 3559	. 0172	1. 3190	1. 3096	. 0094	1. 2709
"	"	" –2A	"	"	1. 3617	. 0114	"	1. 3127	. 0063	"
"	"	" –3A	0	1. 3750	1. 3636	"	1. 3209	1. 3162	. 0047	1. 2728
1½	12	UNF–1A	. 0019	1. 4981	1. 4809	. 0172	1. 4440	1. 4344	. 0096	1. 3959
"	"	" –2A	"	"	1. 4867	. 0114	"	1. 4376	. 0064	"
"	"	" –3A	0	1. 5000	1. 4886	"	1. 4459	1. 4411	. 0048	1. 3978

[1] The values in this table are based on a length of engagement equal to the nominal diameter.
[2] The minimum minor diameter of the external thread may be determined by subtracting $0.6495p(=h_b)$ from the minimum pitch diameter of the external thread. This minimum diameter is not controlled by gages but by the form of the threading tools.

TABLE 6.—*Limits of size, Unified coarse thread series, internal threads, classes 1B, 2B, and 3B*

Designation			Internal thread limits of size [1]						
			Minor diameter			Pitch diameter			
			Limits		Tolerance	Limits		Tolerance	
Size	Threads per inch	Thread symbol	Min	Max		Min	Max		Major diameter Min [2]
			in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
1/4	20	UNC–1B	0. 1959	0. 2067	0. 0108	0. 2175	0. 2248	0. 0073	0. 2500
"	"	" –2B	"	"	"	"	. 2223	. 0048	"
"	"	" –3B	"	"	"	"	. 2211	. 0036	"
5/16	18	UNC–1B	. 2524	. 2630	. 0106	. 2764	. 2843	. 0079	. 3125
"	"	" –2B	"	"	"	"	. 2817	. 0053	"
"	"	" –3B	"	"	"	"	. 2803	. 0039	"
3/8	16	UNC–1B	. 3073	. 3182	. 0109	. 3344	. 3429	. 0085	. 3750
"	"	" –2B	"	"	"	"	. 3401	. 0057	"
"	"	" –3B	"	"	"	"	. 3387	. 0043	"
7/16	14	UNC–1B	. 3602	. 3717	. 0115	. 3911	. 4003	. 0092	. 4375
"	"	" –2B	"	"	"	"	. 3972	. 0061	"
"	"	" –3B	"	"	"	"	. 3957	. 0046	"
1/2	12	UNC–1B	. 4098	. 4223	. 0125	. 4459	. 4559	. 0100	. 5000
"	"	" –2B	"	"	"	"	. 4525	. 0066	"
"	"	" –3B	"	"	"	"	. 4509	. 0050	"
9/16	12	UNC–1B	. 4723	. 4843	. 0120	. 5084	. 5186	. 0102	. 5625
"	"	" –2B	"	"	"	"	. 5152	. 0068	"
"	"	" –3B	"	"	"	"	. 5135	. 0051	"
5/8	11	UNC–1B	. 5266	. 5391	. 0125	. 5660	. 5767	. 0107	. 6250
"	"	" –2B	"	"	"	"	. 5732	. 0072	"
"	"	" –3B	"	"	"	"	. 5714	. 0054	"
3/4	10	UNC–1B	. 6417	. 6545	. 0128	. 6850	. 6965	. 0115	. 7500
"	"	" –2B	"	"	"	"	. 6927	. 0077	"
"	"	" –3B	"	"	"	"	. 6907	. 0057	"
7/8	9	UNC–1B	. 7547	. 7681	. 0134	. 8028	. 8151	. 0123	. 8750
"	"	" –2B	"	"	"	"	. 8110	. 0082	"
"	"	" –3B	"	"	"	"	. 8089	. 0061	"
1	8	UNC–1B	. 8647	. 8797	. 0150	. 9188	. 9320	. 0132	1. 0000
"	"	" –2B	"	"	"	"	. 9276	. 0088	"
"	"	" –3B	"	"	"	"	. 9254	. 0066	"
1 1/8	7	UNC–1B	. 9704	. 9875	. 0171	1. 0322	1. 0463	. 0141	1. 1250
"	"	" –2B	"	"	"	"	1. 0416	. 0094	"
"	"	" –3B	"	"	"	"	1. 0393	. 0071	"
1 1/4	7	UNC–1B	1. 0954	1. 1125	. 0171	1. 1572	1. 1716	. 0144	1. 2500
"	"	" –2B	"	"	"	"	1. 1668	. 0096	"
"	"	" –3B	"	"	"	"	1. 1644	. 0072	"
1 3/8	6	UNC–1B	1. 1946	1. 2146	. 0200	1. 2667	1. 2822	. 0155	1. 3750
"	"	" –2B	"	"	"	"	1. 2771	. 0104	"
"	"	" –3B	"	"	"	"	1. 2745	. 0078	"
1 1/2	6	UNC–1B	1. 3196	1. 3396	. 0200	1. 3917	1. 4075	. 0158	1. 5000
"	"	" –2B	"	"	"	"	1. 4022	. 0105	"
"	"	" –3B	"	"	"	"	1. 3996	. 0079	"
1 3/4	5	UNC–1B	1. 5335	1. 5575	. 0240	1. 6201	1. 6375	. 0174	1. 7500
"	"	" –2B	"	"	"	"	1. 6317	. 0116	"
"	"	" –3B	"	"	"	"	1. 6288	. 0087	"
2	4 1/2	UNC–1B	1. 7594	1. 7861	. 0267	1. 8557	1. 8743	. 0186	2. 0000
"	"	" –2B	"	"	"	"	1. 8681	. 0124	"
"	"	" –3B	"	"	"	"	1. 8650	. 0093	"

Footnotes at end of table.

TABLE 6.—*Limits of size, Unified coarse thread series, internal threads, classes 1B, 2B, and 3B*—Continued

Designation			Internal thread limits of size [1]						
			Minor diameter			Pitch diameter			
Size	Threads per inch	Thread symbol	Limits		Tolerance	Limits		Tolerance	Major diameter Min [2]
			Min	Max		Min	Max		
			in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
2¼	4½	UNC–1B	2. 0094	2. 0361	0. 0267	2. 1057	2. 1247	0. 0190	2. 2500
"	"	" –2B	"	"	"	"	2. 1183	. 0126	"
"	"	" –3B	"	"	"	"	2. 1152	. 0095	"
2½	4	UNC–1B	2. 2294	2. 2594	. 0300	2. 3376	2. 3578	. 0202	2. 5000
"	"	" 2B	"	"	"	"	2. 3511	. 0135	"
"	"	" 3B	"	"	"	"	2. 3477	. 0101	"
2¾	4	UNC–1B	2. 4794	2. 5094	. 0300	2. 5876	2. 6082	. 0206	2. 7500
"	"	" 2B	"	"	"	"	2. 6013	. 0137	"
"	"	" 3B	"	"	"	"	2. 5979	. 0103	"
3	4	UNC–1B	2. 7294	2. 7594	. 0300	2. 8376	2. 8585	. 0209	3. 0000
"	"	" 2B	"	"	"	"	2. 8515	. 0139	"
"	"	" 3B	"	"	"	"	2. 8480	. 0104	"
3¼	4	UNC–1B	2. 9794	3. 0094	. 0300	3. 0876	3. 1088	. 0212	3. 2500
"	"	" 2B	"	"	"	"	3. 1017	. 0141	"
"	"	" 3B	"	"	"	"	3. 0982	. 0106	"
3½	4	UNC–1B	3. 2294	3. 2594	. 0300	3. 3376	3. 3591	. 0215	3. 5000
"	"	" 2B	"	"	"	"	3. 3519	. 0143	"
"	"	" 3B	"	"	"	"	3. 3484	. 0108	"
3¾	4	UNC–1B	3. 4794	3. 5094	. 0300	3. 5876	3. 6094	. 0218	3. 7500
"	"	" 2B	"	"	"	"	3. 6021	. 0145	"
"	"	" 3B	"	"	"	"	3. 5985	. 0109	"
4	4	UNC–1B	3. 7294	3. 7594	. 0300	3. 8376	3. 8597	. 0221	4. 0000
"	"	" 2B	"	"	"	"	3. 8523	. 0147	"
"	"	" 3B	"	"	"	"	3. 8487	. 0111	"

[1] Tbe values in this table are basd on a length of engagement equal to the nominal diameter.
[2] Tbe maximum major diameter of the internal thread may be determined by adding $0.7939p(=1\frac{2}{6}\times h_b)$ to the maximum pitcb diameter of the internal thread. Tbis maximum diameter is not controlled by gages but by the form of the threading tools.

TABLE 7.—*Limits of size, Unified fine thread series, internal threads, classes 1B, 2B, and 3B*

Designation			Internal thread limits of size [1]						
			Minor diameter			Pitch diameter			Major diameter Min [2]
			Limits		Tolerance	Limits		Tolerance	
Size	Threads per inch	Thread symbol	Min	Max		Min	Max		
			in.	in.	in.	in.	in.	in.	in.
1/4	28	UNF–1B	0.2113	0.2190	0.0077	0.2268	0.2333	0.0065	0.2500
"	"	" –2B	"	"	"	"	.2311	.0043	"
"	"	" –3B	"	"	"	"	.2300	.0032	"
5/16	24	UNF–1B	.2674	.2754	.0080	.2854	.2925	.0071	.3125
"	"	" –2B	"	"	"	"	.2902	.0048	"
"	"	" –3B	"	"	"	"	.2890	.0036	"
3/8	24	UNF–1B	.3299	.3372	.0073	.3479	.3553	.0074	.3750
"	"	" –2B	"	"	"	"	.3528	.0049	"
"	"	" –3B	"	"	"	"	.3516	.0037	"
7/16	20	UNF–1B	.3834	.3916	.0082	.4050	.4131	.0081	.4375
"	"	" –2B	"	"	"	"	.4104	.0054	"
"	"	" –3B	"	"	"	"	.4091	.0041	"
1/2	20	UNF–1B	.4459	.4537	.0078	.4675	.4759	.0084	.5000
"	"	" –2B	"	"	"	"	.4731	.0056	"
"	"	" –3B	"	"	"	"	.4717	.0042	"
9/16	18	UNF–1B	.5024	.5106	.0082	.5264	.5353	.0089	.5625
"	"	" –2B	"	"	"	"	.5323	.0059	"
"	"	" –3B	"	"	"	"	.5308	.0044	"
5/8	18	UNF–1B	.5649	.5730	.0081	.5889	.5980	.0091	.6250
"	"	" –2B	"	"	"	"	.5949	.0060	"
"	"	" –3B	"	"	"	"	.5934	.0045	"
3/4	16	UNF–1B	.6823	.6908	.0085	.7094	.7192	.0098	.7500
"	"	" –2B	"	"	"	"	.7159	.0065	"
"	"	" –3B	"	"	"	"	.7143	.0049	"
7/8	14	UNF–1B	.7977	.8068	.0091	.8286	.8392	.0106	.8750
"	"	" –2B	"	"	"	"	.8356	.0070	"
"	"	" –3B	"	"	"	"	.8339	.0053	"
1	12	UNF–1B	.9098	.9198	.0100	.9459	.9573	.0114	1.0000
"	"	" –2B	"	"	"	"	.9535	.0076	"
"	"	" –3B	"	"	"	"	.9516	.0057	"
1 1/8	12	UNF–1B	1.0348	1.0448	.0100	1.0709	1.0826	.0117	1.1250
"	"	" –2B	"	"	"	"	1.0787	.0078	"
"	"	" –3B	"	"	"	"	1.0768	.0059	"
1 1/4	12	UNF–1B	1.1598	1.1698	.0100	1.1959	1.2079	.0120	1.2500
"	"	" –2B	"	"	"	"	1.2039	.0080	"
"	"	" –3B	"	"	"	"	1.2019	.0060	"
1 3/8	12	UNF–1B	1.2848	1.2948	.0100	1.3209	1.3332	.0123	1.3750
"	"	" –2B	"	"	"	"	1.3291	.0082	"
"	"	" –3B	"	"	"	"	1.3270	.0061	"
1 1/2	12	UNF–1B	1.4098	1.4198	.0100	1.4459	1.4584	.0125	1.5000
"	"	" –2B	"	"	"	"	1.4542	.0083	"
"	"	" –3B	"	"	"	"	1.4522	.0063	"

[1] Tbe values in this table are based on a length of engagement equal to the nominal diameter.

[2] The maximu major diameter of the internal tread may be determined by adding $0.7939p(=1\ 2/9 \times h_b)$ to the maximum pitcb diameter of the internal thread. This maximum diameter is not controlled by gages but by the form of the threading tools.

TABLE 8.—*Increments in pitch-diameter tolerance formula*

(PD tolerance $=C(0.0015\sqrt[3]{D}+0.0015\sqrt{L_e}+0.015\sqrt[3]{p^2})$)

Diameter						Length of engagement								Pitch	
D	$0.0015\sqrt[3]{D}$	D	$0.0015\sqrt[3]{D}$	D	$0.0015\sqrt[3]{D}$	L_e	$0.0015\sqrt{L_e}$	L_e	$0.0015\sqrt{L_e}$	L_e	$0.0015\sqrt{L_e}$	L_e	$0.0015\sqrt{L_e}$	Threads per inch	$0.015\sqrt[3]{p^2}$
in.	*in.*	*in.*	*in*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*		*in.*
0. 0600	0. 000587	1. 3125	0. 001642	3. 8750	. 002356	. 0600	. 000367	0. 3214	0. 000850	1. 2500	0. 001677	4. 2500	0. 003092	80	0. 000808
. 0625	. 000595	1. 3750	. 001668	4. 0000	. 002381	. 0625	. 000375	. 3281	. 000859	1. 2857	. 001701	4. 3750	. 003137	72	. 000867
. 0730	. 000627	1. 4375	. 001693	4. 2500	. 002430	. 0730	. 000405	. 3438	. 000880	1. 3125	. 001718	4. 5000	. 003182	64	. 000938
. 0860	. 000662	1. 5000	. 001717	4. 5000	. 002476	. 0781	. 000419	. 3571	. 000896	1. 3750	. 001759	4. 6250	. 003226	56	. 001025
. 0938	. 000682	1. 5625	. 001741	4. 7500	. 002521	. 0860	. 000440	. 3594	. 000899	1. 4286	. 001793	4. 7500	. 003269	48	. 001136
. 0990	. 000694	1. 6250	. 001764	5. 0000	. 002565	. 0938	. 000459	. 3750	. 000919	1. 4375	. 001798	4. 8750	. 003312	44	. 001204
. 1120	. 000723	1. 6875	. 001786	5. 2500	. 002607	. 0990	. 000472	. 3906	. 000937	1. 5000	. 001837	5. 0000	. 003354	40	. 001282
. 1250	. 000750	1. 7500	. 001808	5. 5000	. 002648	. 1094	. 000496	. 4063	. 000956	1. 6250	. 001912	5. 1250	. 003396	36	. 001376
. 1380	. 000775	1. 8125	. 001829	5. 7500	. 002687	. 1120	. 000502	. 4167	. 000968	1. 6667	. 001936	5. 2500	. 003437	32	. 001488
. 1640	. 000821	1. 8750	. 001850	6. 0000	. 002726	. 1125	. 000503	. 4219	. 000974	1. 7500	. 001984	5. 3750	. 003478	28	. 001627
. 1875	. 000859	1. 9375	. 001870	7. 0000	. 002869	. 1250	. 000530	. 4375	. 000992	1. 8750	. 002054	5. 5000	. 003518	24	. 001803
. 1900	. 000862	2. 0000	. 001890	8. 0000	. 003000	. 1380	. 000557	. 4500	. 001006	2. 0000	. 002121	5. 6250	. 003558	20	. 002036
. 2160	. 000900	2. 0625	. 001909	9. 0000	. 003120	. 1406	. 000562	. 5000	. 001061	2. 1250	. 002187	5. 7500	. 003597	18	. 002184
. 2500	. 000945	2. 1250	. 001928	10. 0000	. 003232	. 1563	. 000593	. 5556	. 001118	2. 2500	. 002250	5. 8750	. 003636	16	. 002362
. 3125	. 001018	2. 1875	. 001947	12. 0000	. 003434	. 1607	. 000601	. 5625	. 001125	2. 3750	. 002312	6. 0000	. 003674	14	. 002582
. 3750	. 001082	2. 2500	. 001966	14. 0000	. 003615	. 1640	. 000607	. 6250	. 001186	2. 5000	. 002372	6. 5000	. 003824	13	. 002713
. 4375	. 001139	2. 3125	. 001984	16. 0000	. 003780	. 1719	. 000622	. 6429	. 001203	2. 6250	. 002430	7. 0000	. 003969	12	. 002862
. 5000	. 001191	2. 3750	. 002001	18. 0000	. 003931	. 1875	. 000650	. 6875	. 001244	2. 7500	. 002487	7. 5000	. 004108	11	. 003033
. 5625	. 001238	2. 4375	. 002019	20. 0000	. 004072	. 1900	. 000654	. 7143	. 001268	2. 8750	. 002543	8. 0000	. 004243	10	. 003232
. 6250	. 001282	2. 5000	. 002036	24. 0000	. 004327	. 2031	. 000676	. 7500	. 001299	3. 0000	. 002598	8. 5000	. 004373	9	. 003467
. 6875	. 001324	2. 6250	. 002069			. 2160	. 000697	. 8125	. 001352	3. 1250	. 002652	9. 0000	. 004500	8	. 003750
. 7500	. 001363	2. 7500	. 002102			. 2188	. 000702	. 8333	. 001369	3. 2500	. 002704	9. 5000	. 004623	7	. 004099
. 8125	. 001400	2. 8750	. 002133			. 2250	. 000712	. 8750	. 001403	3. 3333	. 002739	10. 0000	. 004743	6	. 004543
. 8750	. 001435	3. 0000	. 002163			. 2344	. 000726	. 9000	. 001423	3. 3750	. 002756	10. 5000	. 004861	5	. 005130
. 9375	. 001468	3. 1250	. 002193			. 2500	. 000750	. 9375	. 001452	3. 5000	. 002806	11. 0000	. 004975	4½	. 005503
1. 0000	. 001500	3. 2500	. 002222			. 2656	. 000773	1. 0000	. 001500	3. 6250	. 002856	11. 5000	. 005087	4	. 005953
1. 0625	. 001531	3. 3750	. 002250			. 2778	. 000791	1. 0625	. 001546	3. 7500	. 002905	12. 0000	. 005196		
1. 1250	. 001560	3. 5000	. 002277			. 2813	. 000796	1. 1111	. 001581	3. 8750	. 002953				
1. 1875	. 001588	3. 6250	. 002304			. 2969	. 000817	1. 1250	. 001591	4. 0000	. 003000				
1. 2500	. 001616	3. 7500	. 002330			. 3125	. 000839	1. 1875	. 001635	4. 1250	. 003047				