AN AMERICAN NATIONAL STANDARD

Gages and Gaging for Metric M Screw Threads

ANSI/ASME B1.16M - 1984

(REVISION OF ANSI B1.16-1972)

SPONSORED AND PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center 345 East 47th Street New York, N.Y. 10017

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FOREWORD

(This Foreword is not part of ANSI/ASME B1.16M-1984.)

The first issue of ANSI B1.16 was approved and formally designated as an American National Standard on April 28, 1972. It was developed by Subcommittee 2 of the B1 Committee to serve as the American practice regarding the specifications and dimensions for gages applied to metric screw threads. As in the first issue, this Edition of ANSI B1.16M follows the American practice for the design and tolerances for gages of this type, except for the truncations of the HI/LO elements, which are more in line with the truncations specified in ISO 1502.

This new publication, designated ANSI/ASME B1.16M-1984, has had considerable new material added to cover the many options of gages and measuring equipment shown in ANSI B1.3M, Screw Thread Gaging Systems for Dimensional Acceptability. It has also retained HI and LO functional gages but has eliminated gages with pitch diameter outside product thread limits. It also includes tabulated values for the specifications of gage elements for the standard series of metric M screw thread sizes listed in ANSI B1.13M, Metric Screw Threads — M Profile.

ANSI/ASME B1.16M was approved by the ASME Standards Committee B1 on April 27, 1984. The proposed Standard was submitted by the ASME Board of Standardization to the American National Standards Institute. It was approved and formally designated an American National Standard on May 25, 1984.

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AN AMERICAN NATIONAL STANDARD

GAGES AND GAGING FOR METRIC M SCREW THREADS

1 INTRODUCTION

This Standard provides essential specifications and dimensions for the gages used on M series metric screw threads, and covers the specifications and dimensions for the thread gages and measuring equipment listed in Tables 1 and 2. The basic purpose and use of each gage are also described.

For easy reference, customary conversion of metric tables has been incorporated as part of Appendix D. Appendices A through D contain useful nonmandatory information that is supplementary to the required Sections of this Standard.

1.1 References

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

American National Standards

ANSI B1.2	Gages and Gaging for Unified Inch Screw Threads
ANSI B1.3M	Screw Thread Gaging Systems for Dimensional Acceptability
ANSI B1.7	Nomenclature, Definitions, and Letter Symbols for Screw Threads
ANSI B1.13M	Metric Screw Threads — M Profile
ANSI B46.1	Surface Texture
ANSI/ASME B47.1aM	Gage Blanks (Metric Translation of ANSI B47.1)
ANSI B89.1.6	Measurement of Qualified Plain Internal Diameters for Use as Master Rings and Ring Gages
ANSI B89.1.9	Precision Inch Gage Blocks for Length Measurement (Thru 20 Inches)
ANSI B89.3.1	Measurement of Out-of-Roundness

International Standard

ISO 1502-1978	General Purpose Metric Screw Threads — Gaging

1.2 Units of Measure

All dimensions in this Standard, including tables, are expressed in millimeters (mm) unless otherwise specified.

1.3 Classification

In this Standard, the terms H1 and LO are used to identify functional diameter thread gages, as per the practice of the previous B1.16 Standard. The terms apply to gages identified as NOT GO or minimum material (M/Mt), as described by their respective standards.

1.4 Federal Government Use

When this Standard is approved by the Department of Defense and federal agencies and is incorporated into FED-STD-H28/22, Screw Thread Standard for Federal Services, Section 22, the use of this Standard by the federal government will be subject to all requirements and limitations of FED-STD-H28/22.

2 BASIC PRINCIPLES

2.1 Accuracy in Gaging

Thread plug gages are controlled by direct measuring methods. Thread ring gages, thread snap limit gages, and indicating thread gages are controlled by reference to the appropriate setting gages or direct measuring methods or both.

TABLE 1 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREAD CHARACTERISTICS

Thread Gages and Measuring Equipment	Metric M							
	Maximum Material		LO Functional Diameter		Minimum Material			
	GO				Pitch Diam.		Thd. Groove Diam.	
	Func. Limit	Func. Size	Func. Limit	Func. Size	Limit	Size	Limit	Size
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2
1 Threaded Rings (ANSI/ASME B47.1aM): 1.1 GO	•							
1.2 LO			•					
2 Thread Snap Gages 2.1 GO segments	•							
2.2 LO segments			•					
2.3 GO rolls	•							
2.4 LO rolls			•					
2.5 Minimum material — pitch diameter type — cone and vee					•			
2.6 Minimum material — thread groove diameter type — cone only							•	
3 Plain Diameter Gages 3.1 Plain cylindrical rings for major diameter								
3.2 Major diameter snap type								
3.3 Minor diameter snap type								
3.4 Maximum and minimum major diameter snap type								
3.5 Maximum and minimum minor diameter snap type								
4 Indicating Thread Gages Having either two contacts at 180 deg. or three contacts at 120 deg. 4.1 GO segments	•	•	•	•				
4.3 GO rolls	•	•	•	•				
4.5 Minimum material — pitch diameter type — cone and vee					•	•		
4.6 Minimum material — thread groove diameter type — cone only							•	•

TABLE 1 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREAD CHARACTERISTICS (CONT'D)

Metric M

Roundness of Pitch Cylinder				Taper of Pitch Cylinder		Lead Incl. Helix Variation	Flank Angle Variation	Major Diameter		Minor Diameter		Root Rad.	Diam. Runout Major to Pitch	Surface Texture
Oval 180 deg.		Multilobe 120 deg.												
Limit	Size	Limit	Size	Limit	Size			Limit	Size	Limit	Size			
E_1	E_2	F_1	F_2	G_1	G_2	H	I	J_1	J_2	K_1	K_2	L	M	N
										(Note 1)				
•										(Note 1)				
•				•										
•										(Note 1)				
•				•										
•				•										
•				•										
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•	•	•	•							(Note 1)				
•	•	•	•							(Note 1)				
•	•	•	•	•	•									
•	•	•	•	•	•									

TABLE 1 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREAD CHARACTERISTICS (CONT'D)

Thread Gages and Measuring Equipment	Metric M							
	Maximum Material		LO Functional Diameter		Minimum Material			
	GO				Pitch Diam.		Thd. Groove Diam.	
	Func. Limit	Func. Size	Func. Limit	Func. Size	Limit	Size	Limit	Size
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2
4.7 Major diameter and pitch diameter runout gage								
4.8 Differential segment or roll (GO profile for one pitch in length) used in combination with a GO indicating gage to yield a diameter equivalent for variation in lead (including uniformity of helix), and a minimum-material indicating gage to yield a diameter equivalent for variation in flank angle.								
5 Indicating Plain Diameter Gages 5.1 Major diameter type								
5.2 Minor diameter type								
6 Pitch Micrometer With Standard Contacts (Approximately LO Profile) Cone and Vee			•	•				
7 Pitch Micrometer With Modified Contacts (Approximately Pitch Diameter Contact) Cone and Vee					•	•		
8 Thread-Measuring Wires With Suitable Measuring Means							•	•
9 Optical Comparator and Toolmaker's Microscope With Suitable Fixturing					•	•		
10 Profile Tracing Equipment With Suitable Fixturing								
11 Lead Measuring Machine With Suitable Fixturing								
12 Helical Path Attachment Used With GO Type Indicating Gage								
13 Helical Path Analyzer								
14 Plain Micrometer and Calipers — Modified As Required								
15 Surface Measuring Equipment								
16 Roundness Equipment								

TABLE 1 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREAD CHARACTERISTICS (CONT'D)

Metric M

Roundness of Pitch Cylinder				Taper of Pitch Cylinder		Lead Incl. Helix Variation	Flank Angle Variation	Major Diameter		Minor Diameter		Root Rad.	Diam. Runout Major to Pitch	Surface Texture
Oval 180 deg.		Multilobe 120 deg.												
Limit	Size	Limit	Size	Limit	Size			Limit	Size	Limit	Size			
E_1	E_2	F_1	F_2	G_1	G_2	H	I	J_1	J_2	K_1	K_2	L	M	N
													•	
•	•	•	•	•	•	•	•							
								•	•					
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							•					•		•
						•								
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														•
•	•	•	•											

NOTE:
(1) Maximum minor diameter limit is acceptable when product passes GO gage.

TABLE 2 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREAD CHARACTERISTICS

Thread Gages and Measuring Equipment	Metric M							
	Maximum Material		HI Functional Diameter		Minimum Material			
	GO				Pitch Diam.		Thd. Groove Diam.	
	Func. Limit	Func. Size	Func. Limit	Func. Size	Limit	Size	Limit	Size
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2
1 Threaded Plugs (ANSI/ASME B47.1aM): 1.1 GO	•							
1.2 HI			•					
2 Thread Snap Gages 2.1 GO segments	•							
2.2 HI segments			•					
2.3 GO rolls	•							
2.4 HI rolls			•					
2.5 Minimum material — pitch diameter type — cone and vee					•			
2.6 Minimum material — thread groove diameter type — cone only							•	
3 Plain Diameter Gages 3.1 Plain cylindrical plugs for minor diameter								
3.2 Major diameter snap type								
3.3 Minor diameter snap type								
3.4 Maximum and minimum major diameter snap type								
3.5 Maximum and minimum minor diameter snap type								
4 Indicating Thread Gages Having either two contacts at 180 deg. or three contacts at 120 deg. 4.1 GO segments	•	•	•	•				
4.3 GO rolls	•	•	•	•				

TABLE 2 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREAD CHARACTERISTICS

Metric M

Roundness of Pitch Cylinder				Taper of Pitch Cylinder		Lead Incl. Helix Variation	Flank Angle Variation	Major Diameter		Minor Diameter		Root Rad.	Diam. Runout Minor to Pitch	Surface Texture
Oval 180 deg.		Multilobe 120 deg.												
Limit	Size	Limit	Size	Limit	Size			Limit	Size	Limit	Size			
E_1	E_2	F_1	F_2	G_1	G_2	H	I	J_1	J_2	K_1	K_2	L	M	N
								(Note 1)						
•								(Note 1)						
•				•										
•								(Note 1)						
•				•										
•				•										
•				•										
										•				
								•						
										•				
								•						
•	•	•	•					(Note 1)						
•	•	•	•					(Note 1)						

TABLE 2 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREAD CHARACTERISTICS (CONT'D)

Thread Gages and Measuring Equipment	Metric M							
	Maximum Material		HI Functional Diameter		Minimum Material			
	GO				Pitch Diam.		Thd. Groove Diam.	
	Func. Limit	Func. Size	Func. Limit	Func. Size	Limit	Size	Limit	Size
	A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2
4.5 Minimum material — pitch diameter type — cone and vee					•	•		
4.6 Minimum material — thread groove diameter type — cone only							•	•
4.7 Minor diameter and pitch diameter runout gage								
4.8 Differential segment or roll (GO profile for one pitch in length) used in combination with a GO indicating gage to yield a diameter equivalent for variation in lead (including uniformity of helix) and a minimum-material indicating gage to yield a diameter equivalent for variation in flank angle								
5 Indicating Plain Diameter Gages 5.1 Major diameter type								
5.2 Minor diameter type								
6 Pitch Micrometer With Standard Contacts (Approximately HI Profile) Cone and Vee			•	•				
7 Pitch Micrometer With Modified Contacts (Approximately Pitch Diameter Contact) Cone and Vee					•	•		
8 Thread-Measuring Balls With Suitable Measuring Means							•	•
9 Optical Comparator and Toolmaker's Microscope With Suitable Fixturing and Cast Replica					•	•		
10 Profile Tracing Equipment With Suitable Fixturing								
14 Surface Measuring Equipment								
15 Roundness Equipment								

TABLE 2 SCREW THREAD GAGES AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREAD CHARACTERISTICS (CONT'D)

Metric M

Roundness of Pitch Cylinder				Taper of Pitch Cylinder		Lead Incl. Helix Variation	Flank Angle Variation	Major Diameter		Minor Diameter		Root Rad.	Diam. Runout Minor to Pitch	Surface Texture
Oval 180 deg.		Multilobe 120 deg.												
Limit	Size	Limit	Size	Limit	Size			Limit	Size	Limit	Size			
E_1	E_2	F_1	F_2	G_1	G_2	H	I	J_1	J_2	K_1	K_2	L	M	N
•	•	•	•	•	•									
•	•	•	•	•	•									
													•	
•	•	•	•	•	•	•	•							
								•	•					
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•	•			•	•									
						•	•	•	•			•		
							•					•		•
														•
•	•	•	•											

NOTE:
(1) Minimum major diameter limit is acceptable when product passes GO gage.

2.2 Limitations of Gaging

2.2.1 Product threads accepted by a gage of one type may be verified by other types. It is possible, however, that parts which are near a limit may be accepted by one type and rejected by another. Also, it is possible for two individual limit gages of the same type to be at opposite extremes of the gage tolerances permitted, and borderline product threads accepted by one gage could be rejected by another. For these reasons, a product screw thread is considered acceptable when it passes a test by any of the permissible gages in ANSI B1.3M for the gaging system specified, provided the gages being used are within the tolerances specified in this Standard.

2.2.2 Gaging large product external and internal threads equal to or greater than 160 mm nominal size with plain and threaded plug and ring gages presents problems for technical and economic reasons. In these instances, verification may be based on use of modified snap or indicating gages or measurement of thread elements. Various types of gages or measuring devices in addition to those defined in this Standard are available and acceptable when properly correlated to this Standard. The producer and user should agree on the method and equipment used.

2.2.3 Indicating gages for internal threads smaller than 5 mm are not available.

2.3 Determining Size of Gages

2.3.1 Measuring Pitch Diameter. The three-wire method of determining pitch diameter size of thread plug gages is standard for gages in this Standard. Refer to Appendix B.

2.3.2 Size limit adjustments of thread ring and external thread snap gages are determined by their fit on their respective calibrated setting plugs. Indicating gages and thread gages for product external threads are controlled by reference to appropriate calibrated setting plugs.

2.3.3 Size limit adjustments of internal thread snap gages are determined by their fit on their respective calibrated setting rings. Indicating gages and other adjustable thread gages for product internal threads are controlled by reference to appropriate calibrated setting rings or by direct measuring methods.

2.4 Standard Temperature

2.4.1 A temperature of 20°C (68°F) is the standard temperature used internationally for linear measurements. Nominal dimensions of gages and product as specified and actual dimensions as measured shall be within specified limits at this temperature. For screw thread gaging, the acceptable tolerance on the standard temperature is ±1°C (±2°F).

2.4.2 As product threads are frequently checked at temperatures which are not controlled, it is desirable that the coefficient of the thermal expansion of gages be the same as that of the product on which they are used. Inasmuch as the majority of threaded product consists of iron or steel, and screw thread gages are ordinarily made of hardened steel, this condition is usually fulfilled without special attention, provided thread gages and product have stabilized to the same temperature. When the materials of the product thread and the gage are dissimilar, the differing thermal coefficients can cause serious complications and must be taken into account, unless both product and gage at the time of gaging are at a temperature of:

(*a*) 20°C ±2°C (68°F ±4°F) for 25 mm and smaller;

(*b*) 20°C ±1°C (68°F ±2°F) for sizes above 25 mm to 75 mm;

(*c*) 20°C ±0.5°C (68°F ±1°F) for sizes above 75 mm to 150 mm.

2.5 Rounding Procedure for Converting Metric Gage Values to Inch Gage Values

Determine metric gage dimensions from gage specifications. Calculate the inch gage size by dividing the metric gage size (given to three decimal places) by 25.4. Round to five decimal places by the following method: when the first digit discarded is less than 5, the last digit retained should not be changed. If the first discarded digit is greater than 5, or if it is a 5 followed by at least one digit other than 0, the last figure retained should be increased by one unit. If the first discarded digit is a 5 followed by only zeros, the last digit retained should be rounded upward if it is an odd number, but not changed if it is an even number. Metric dimensions are official values, and all inch tables shown in Appendix D are for reference only.

EXAMPLES OF ROUNDING:

6.437243782 is rounded to 6.43724
6.437246643 is rounded to 6.43725
6.437245001 is rounded to 6.43725
6.437255000 is rounded to 6.43726
6.437245000 is rounded to 6.43724

3 GENERAL PRACTICE

3.1 General Design

The design of gages is specified only to the extent that it affects the results obtained in the gaging of product threads. Moreover, to serve their intended purposes satisfactorily, thread gages should be produced by the latest and best manufacturing techniques. The type of steel or wear-resistant material selected, together with the heat-treating and stabilization processes, should provide wear life and dimensional stability. Thread gaging elements should be precisely manufactured to assure adequate refinement of surface texture, prevention or elimination of amorphous or smear metal, and uniformity of thread form over the entire length of the gaging member.

3.2 Types of Gages

GO thread gages check either the maximum-material limit or size to assure interchangeable assembly. HI and LO thread gages inspect the HI and LO functional diameter limit.

GO and NOT GO plain cylindrical plug or ring gages and snap or indicating gages check the limit or size of the minor diameter of product internal threads and the major diameter of product external threads, respectively.

3.3 Interpretation of Tolerances

Tolerances on lead, half-angle, and pitch diameter are variations which may be taken independently for each of these elements and may be taken to the extent allowed by respective tabulated dimensional limits. The tabulated tolerance on any one element shall not be exceeded, even though variations in the other two elements are smaller than the respective tabulated tolerances.

3.4 Direction of Tolerances on Gages

At the maximum-material limit (GO), the dimensions of all gages used for final conformance gaging are to be within the limits of size of the product thread. At the functional diameter limit, using HI and LO thread gages, the standard practice is to have the gage tolerance within the limits of size of the product thread. Specifications for gage limits are listed in Tables 4 and 5.

3.5 Standard Thread Gage Tolerances

Standard tolerances for thread-working gages, thread-setting plugs, and setting rings are as follows:

(*a*) W tolerances, shown in Table 7, represent the highest commercial grade of accuracy and workmanship and are specified for thread-setting gages;

(*b*) X tolerances, shown in Table 6, are larger than W tolerances and are used for product inspection gages.

Unless otherwise specified, all thread gages and gaging contacts that directly check the product thread shall be X tolerance.

3.6 Tolerance on Lead

Cumulative effect of progressive or erratic helix variation and thick or thin end thread variations is specified as an allowable variation between any two threads not farther apart than the length of the standard taperlock or trilock gage, shown in ANSI/ASME B47.1aM. In the case of setting plugs, the specified tolerance shall be applicable to the thread length in the mating ring gage or nine pitches, whichever is smaller. For setting rings, the tolerance applies to a thread length of three pitches. The tolerance on lead establishes the width of a zone, measured parallel to the axis of the thread, within which the actual helical path must lie for the specified length of the thread. Measurements will be taken from a fixed reference point located at the start of the first full thread to a sufficient number of positions along the entire helix to detect all types of lead variations. The amounts that these positions vary from their basic (theoretical) positions will be recorded with due respect to sign. The greatest variation in each direction [plus and minus (±)] will be selected and the sum of their values, *disregarding sign,* shall not exceed the specified tolerance. If the variations are all in one direction, the maximum value governs conformance. In the case of truncated setting plugs, the lead variations present on the full-form portion and the truncated portion of an individual gage shall not differ from each other by more than 0.003 mm over any portion equivalent to the length of the thread ring gage, or nine pitches,

whichever is less. (When linear lead and drunkenness are measured as individual elements and the sum of these does not exceed the tolerance specified, the gage is well within tolerance.)

3.7 Tolerances on Half-Angle

Tolerances are specified for the half-angles rather than the included angle to assure that the bisector of the included angle will be perpendicular to the axis of the thread within proper limits. The equivalent of the variation from the true thread form caused by such irregularities as convex, concave or wavy flanks, rounded crests, or slight projections on the thread form shall not exceed the tolerance permitted on half-angle.

3.8 Check of Effect of Lead and Flank Angle Variations on Product Thread

When this check is specified, there are two general methods available for the inspection procedures involved.

(*a*) *Direct Measurement of Lead and Half-Angle of Flanks.* The lead and flank angles of the product thread may be measured by means of available measuring equipment, such as, but not limited to, thread indicating gages, projection comparators, measuring microscopes, graduated cone points, lead measuring machines, helix variation measuring machines, and thread flank charting equipment. Diameter equivalents of such variations from nominal may be calculated: each 0.0025 mm variation in lead amounts to 0.0043 mm (1.732×0.0025) increase in functional pitch diameter on external threads or a decrease in functional pitch diameter on internal threads for 60 deg. screw threads. The tangent of half-angle variation times $1.5p$ equals the approximate maximum change in functional pitch diameter, based on a height of thread engagement of $0.625H$ and equal half-angle variations.

(*b*) *Differential Gaging Utilizing Indicating Thread Gages.* See Sections 4 and 5 for explanation and illustration of differential gaging for internal and external threads.

3.9 Calibration Requirements and Standards

Calibration requirements and standards for X tolerance thread gages, snap gages, and indicating gages, Z tolerance plain gages, and measuring instruments are given in Table 14 for external product threads, in Table 15 for internal product threads, and in Table 16 for setting gages. See Appendix A for methods of calibrating and inspecting gages.

4 TYPES OF GAGES FOR PRODUCT INTERNAL THREAD

4.1 GO Working Thread Plug Gages (Table 2 — Gage 1.1)

4.1.1 Purpose and Use. The GO thread plug gage inspects the maximum-material GO functional limit, A_1, of product internal thread. The GO thread gage represents the maximum-material GO functional limit of the product internal thread, and its purpose is to assure interchangeable assembly of maximum-material mating parts. GO thread plug gages must enter and pass through the full-threaded length of the product freely. The GO thread plug gage is a cumulative check of all thread elements except the minor diameter.

4.1.2 Basic Design. The maximum-material limit on GO thread plug gages is made to the prescribed maximum-material limit of the product internal thread, and the gaging length is equal to the length of the gaging plug.

4.1.3 Gage Blanks. For practical and economic reasons, the design and lengths of the gaging plug members have been standardized for various size ranges and pitches (see ANSI/ASME B47.1aM or Table C1).

4.1.4 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 1.

4.1.5 Thread Crests. The major diameter of the GO thread plug gage shall be the same as the minimum major diameter of the product internal thread with a plus gage tolerance. The thread crests shall be flat in an axial section and parallel to the axis.

4.1.6 Thread Roots. The minor diameter of the GO thread plug gage shall be cleared beyond a $p/8$ width of flat either by an extension of the sides of the thread toward a sharp vee or by an undercut no

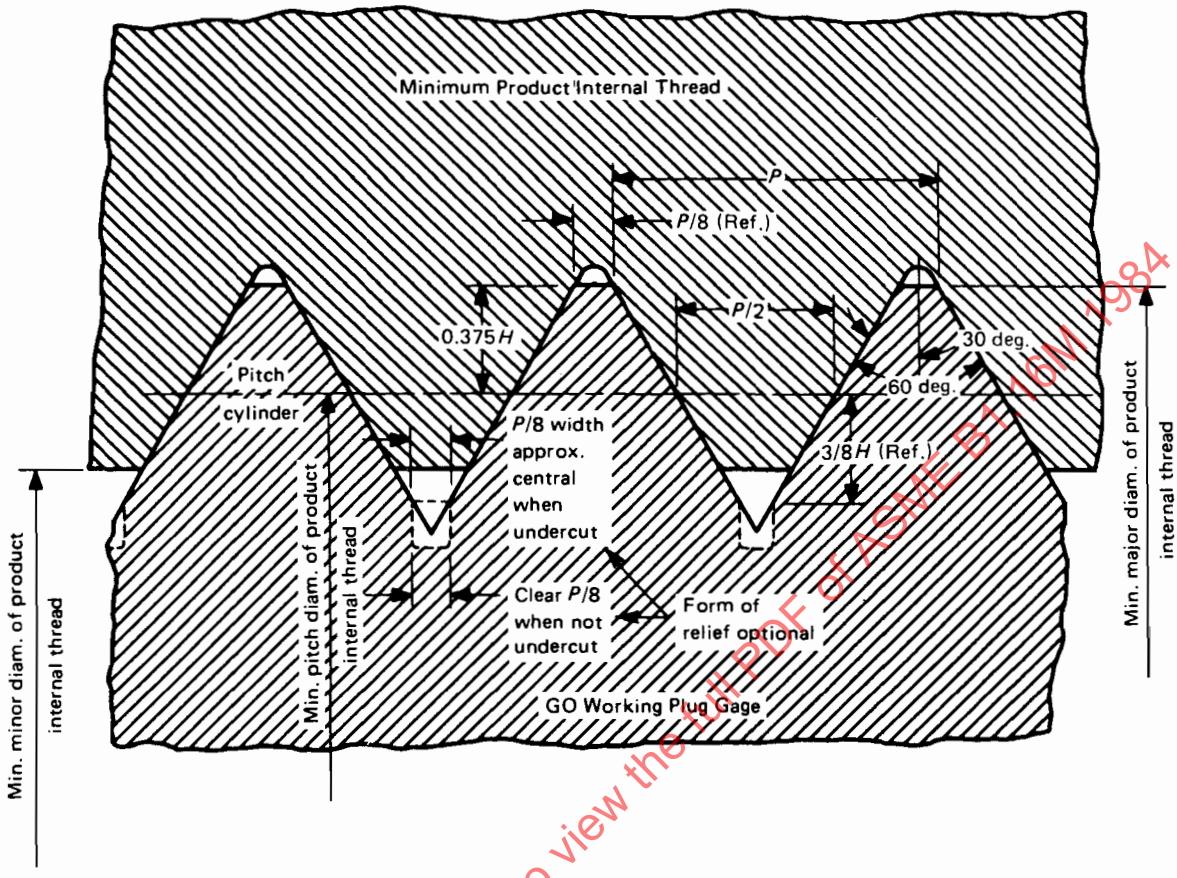


FIG. 1 MAXIMUM-MATERIAL GO FUNCTIONAL LIMIT

greater than $p/8$ maximum width and approximately central.

4.1.7 Runout of Pitch and Major Cylinders. On thread plug gages an eccentric condition produces an oversize effective major diameter having a width of flat less than $p/8$, which may encroach on the minimum permissible limit for the root profile of the product internal thread. The permissible maximum effective major diameter, as determined by adding measurement of runout (full-indicator movement) with respect to the pitch cylinder to the measured major diameter, shall not exceed the maximum major diameter specified.

4.1.8 Pitch Cylinder. The pitch cylinder shall be round and straight within the gage pitch diameter limits specified.

4.1.9 Lead and Half-Angle Variations. Lead and half-angle variations shall be within the limits specified. See Table 6.

4.1.10 Incomplete Thread. The feather edge at both ends of the threaded section of the gaging member shall be removed. On pitches coarser than 0.8 mm, not more than one complete turn of the end threads shall be removed to obtain a full-thread form blunt start. See Fig. 2. On pitches 0.8 mm and finer, a 60 deg. chamfer from the axis of the gage is acceptable in lieu of the blunt start.

4.1.11 Chip Grooves. Each GO thread plug gage, except in sizes M4 and smaller, shall be provided with a chip groove at the entering end. On reversible gages, a chip groove shall be provided at each end. Chip grooves that are in accordance with

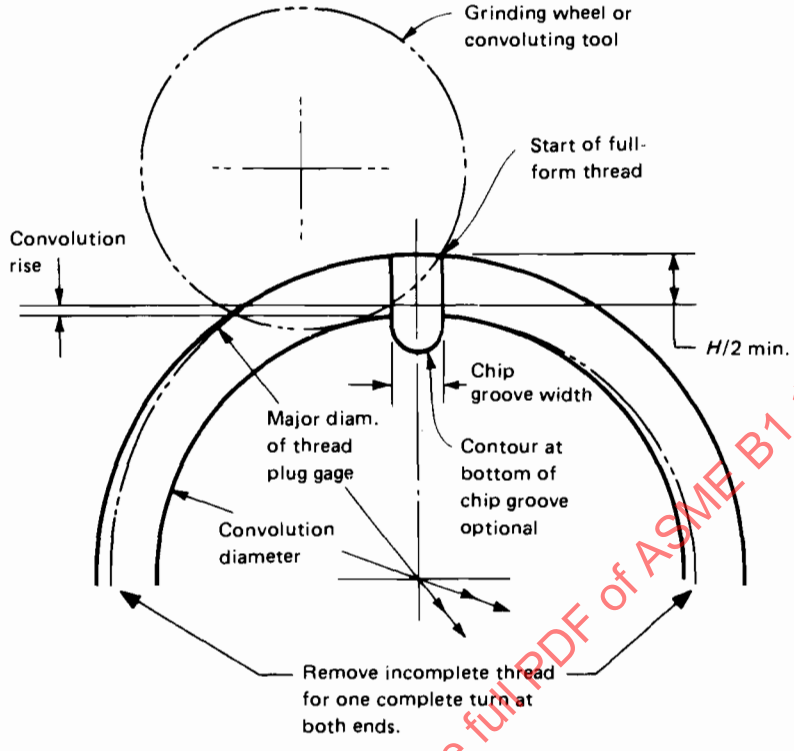


FIG. 2 PARTIAL END THREADS AND CHIP GROOVES

commercial practice are acceptable, such as a groove cut at an angle with the axis or a longitudinal groove cut parallel with the axis and extending the complete length of the gaging member. The groove shall be located circumferentially at the start of the full thread, and in all cases the depth shall extend below the root of the first full thread. The distance from the major diameter of the thread plug to the crest of the convolution rise in front of the chip groove, due to the radius of the convoluting tool, shall be a minimum of $H/2$ as shown in Fig. 2. The beginning of the first thread shall be full form. The recommended widths for chip grooves are as shown in Table 3.

TABLE 3 RECOMMENDED WIDTHS FOR CHIP GROOVES

Nominal Diameter, mm	Chip Groove Width, A, mm	
	Max.	Min.
M4 and smaller	No chip groove required	
Over M4 to M5, incl.	0.91	0.66
Over M5 to M10, incl.	1.32	1.07
Over M10 to M12, incl.	1.70	1.45
Over M12 to M24, incl.	2.11	1.70
Over M24 to M39, incl.	3.30	1.70
Over M39	4.90	1.70

4.1.12 Identification. The GO thread plugs should be marked by the metric nominal size, pitch-tolerance class, GO, PD, and pitch diameter in millimeters (if PD is basic size, tolerance class may be eliminated).

EXAMPLE:
M8 × 1-6H GO PD7.350

4.2 HI Thread Plug Gages (Table 2 — Gage 1.2)

4.2.1 Purpose and Use. The HI thread plug gage inspects the HI functional diameter limit, B_1, of product internal thread. The HI thread plug gage represents the HI functional diameter limit of the product internal thread.

TABLE 4 SPECIFICATIONS AND FORMAT FOR TABLES 10 AND 12 — LIMITS OF SIZE OF THREADED AND PLAIN GAGES FOR METRIC M EXTERNAL AND INTERNAL THREADS

Nominal Size and Pitch				1	(To be specified)
Tolerance Class				2	Of external thread to be checked
Gages for External Threads	Thread gages	GO	Pitch diameter	3	Max. pitch diameter of external thread; gage tolerance minus
			Minor diameter	4	Max. pitch diameter of external thread; minus $H/2$; gage tolerance minus
		LO	Pitch diameter	5	Min. pitch diameter of external thread; gage tolerance plus
			Minor diameter	6	Min. pitch diameter of external thread minus $0.2p$; gage tolerance plus
	Plain gages for major diameter	GO		7	Max. major diameter of external thread; gage tolerance minus
		NOT GO		8	Min. major diameter of external thread; gage tolerance plus
Gages for Internal Threads	Thread gages	GO	Major diameter	9	Min. major diameter of internal thread; gage tolerance plus
			Pitch diameter	10	Min. pitch diameter of internal thread; gage tolerance plus
		HI	Major diameter	11	Max. pitch diameter of internal thread plus $0.2p$; gage tolerance minus
			Pitch diameter	12	Max. pitch diameter of internal thread; gage tolerance minus
	Plain gages for minor diameter	GO		13	Min. minor diameter of internal thread; gage tolerance plus
		NOT GO		14	Max. minor diameter of internal thread; gage tolerance minus
Tolerance Class				15	Of internal thread to be checked

Thread plug gages when applied to the product internal thread may engage only the end threads (which may not be representative of the complete thread). Entering threads on product are incomplete and permit gage to start. Starting threads on HI plugs are subject to greater wear than the remaining threads. Such wear in combination with the incomplete product threads permits further entry of the gage. HI functional diameter is acceptable when the HI thread plug gage is applied to the product internal thread it does not enter, or if all complete product threads can be entered, provided that a definite drag from contact with the product material results on or before the second turn of entry. The gage should not be forced after the drag is definite. Special requirements such as, but not limited to, an exceptionally thin or ductile material, or a small number of threads, may necessitate modification of this practice.

4.2.2 Basic Design. To better check the maximum functional diameter limit, the flank contact is reduced by truncating the major diameter, and the length of the gaging element, where practical, is less than that of the GO gage.

4.2.3 Gage Blanks. For practical and economic reasons, the designs and lengths of the gaging elements have been standardized for various size

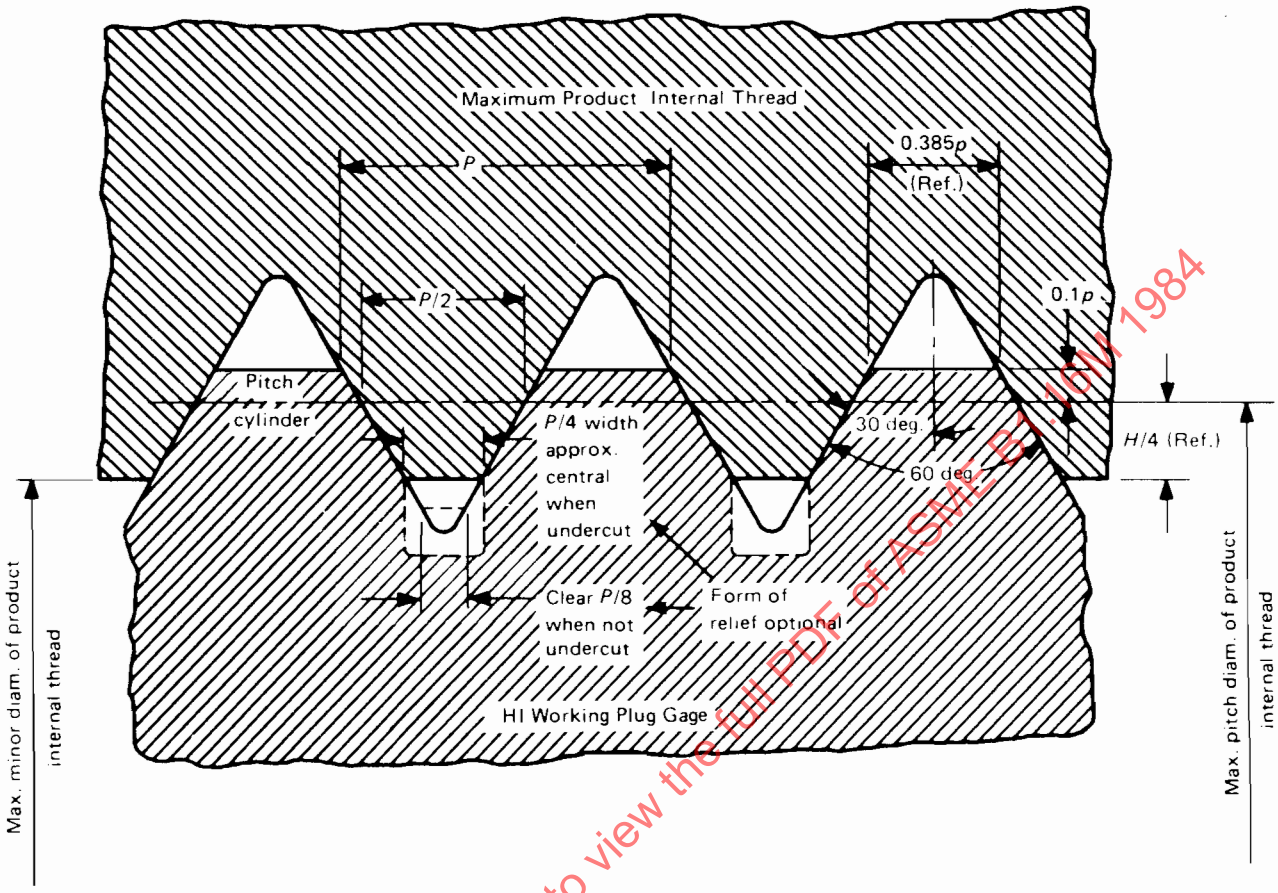


FIG. 3 H1 FUNCTIONAL DIAMETER LIMIT

ranges and pitches (see ANSI/ASME B47.1aM or Table C1).

4.2.4 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 3.

4.2.5 Thread Crests. The maximum major diameter of the H1 thread plug gage shall be equal to the maximum pitch diameter of the product internal thread plus $0.2p$ with the gage tolerance minus. This corresponds to a width of flat at the crest of the gage equal to $0.385p$. See Table 4.

4.2.6 Thread Roots. The minor diameter of the H1 thread plug gage shall be cleared beyond a $p/8$ width of flat by an extension toward a sharp vee of the sides of the thread from the position corresponding to this approximate width; or by an undercut to any dimension no wider than the width resulting from $p/8$ maximum width, either side of and approximately central with the center line of the thread groove.

4.2.7 Runout of Pitch and Major Cylinders. The permissible maximum effective diameter, as determined by adding measurements of runout (full-indicator movement) with respect to the pitch cylinder to the measured major diameter, shall not exceed the maximum major diameter specified.

4.2.8 Pitch Cylinder. The pitch cylinder shall be round and straight within the gage pitch diameter limits specified.

4.2.9 Lead and Half-Angle Variations. Lead and half-angle variations shall be within the limits specified. See Table 6.

4.2.10 Incomplete Thread. The feather edge at both ends of the threaded section of the gaging member shall be removed. On pitches coarser than 0.8 mm, not more than one complete turn of the end threads shall be removed to obtain a full-thread blunt start. See Fig. 2. On pitches 0.8 mm and finer, a 60 deg. chamfer from the axis of the gage is acceptable in lieu of the blunt start.

4.2.11 Identification. The HI thread plug gage should be marked with the metric nominal size, pitch-tolerance class, HI, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H HI PD7.500

4.3 Thread Snap Gages — GO Segments or Rolls (Table 2 — Gages 2.1 and 2.3)

4.3.1 Purpose and Use. The thread snap gage with two GO threaded segments or two GO zero lead rolls inspects the maximum-material GO functional limit, A_1, of product internal thread. The setting of the GO segments or rolls represents the maximum-material GO functional limit of the product internal thread, and its purpose is to assure interchangeable assembly of maximum-material mating parts. The segments or rolls theoretically engage over the full-threaded length of the product. The segments or rolls have a cumulative check of all thread elements except the minor diameter.

Internal thread snap gages by design must have an outside diameter of gaging elements below minor diameter of internal thread in order to enter. The gage checks all thread elements by sensing the resistance of contact after being set to a master.

The GO thread snap gage can also indicate out-of-roundness of pitch cylinder for 180 deg. ovality by using the gage at different internal diametral locations on the product thread.

4.3.2 Basic Design. The GO segments and rolls assembled into gage frames are the design of the individual gage manufacturer. The lengths of the two threaded segments and the two thread rolls spaced 180 deg. apart are equivalent to the standard plug gage blank lengths for practical and economic reasons. See Table C1 and Fig. 4. Internal product threads less than 5 mm in diameter are not practical to check with snap gages. GO thread segments shall engage 25% or more of the product circumference. The product shall be checked around circumference of thread at sufficient axial positions to check the full-thread length. Thread rolls shall be applied axially at several locations (three if possible) over the full-thread length of product. The circumference shall be checked at each position.

4.3.3 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 4.

4.3.4 Thread Crests. The outside diameter of the threaded portion of the GO segments or rolls has the equivalent of a $p/8$ flat on the thread with a plus gage tolerance. The thread crest shall be flat in an axial section and parallel to the axis of the gaging member.

4.3.5 Thread Roots. The minor diameter of the threaded portion of the GO segments or rolls shall be cleared beyond a $p/8$ flat either by an extension of the flanks of the thread toward a sharp vee or by an undercut no greater than $p/8$ maximum width and approximately central.

4.3.6 Runout. The pitch and major cylinders of the threaded portion of the GO segments or rolls shall not exceed the runout as determined by measurements of runout (full-indicator movement) on each gaging member, with respect to the pitch cylinder. Runout shall not exceed one-half the X gage major diameter tolerance.

4.3.7 Pitch Cylinder. The pitch cylinder of the threaded portion of the GO segments or rolls shall be straight and round within the X gage pitch diameter limits specified.

4.3.8 Lead, Pitch, and Half-Angle Variations. Lead, pitch, and half-angle variations shall be within the limits specified. See Table 6.

4.3.9 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, GO, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H GO PD7.350

4.4 Thread Snap Gages — HI Segments or Rolls (Table 2 — Gages 2.2 and 2.4)

4.4.1 Purpose and Use. The thread snap gage with two HI segments or two HI rolls inspects the HI functional diameter limit, B_1, of product internal thread. The setting of the HI segments or rolls represents the maximum functional diameter limit of

TABLE 5 SPECIFICATIONS AND FORMAT FOR TABLES 11 AND 13 — LIMITS OF SIZE OF THREAD-SETTING GAGES FOR METRIC M THREAD WORKING GAGES

Nominal Size and Pitch				1	(To be specified)
Tolerance Class				2	Of external thread to be checked by gage set with plug
Full-Form and Truncated Setting Plugs	Plug for GO	Major diameter	Truncated*	3	Max. pitch diam. of external thread plus 0.2*P*; gage tolerance minus
			Full-form	4	Max. major diameter of external thread; gage tolerance plus
		Pitch diameter		5	Max. pitch diameter of external thread; gage tolerance minus
	Plug for LO	Major diameter	Truncated* (Note 1)	6	Min. pitch diameter of external thread plus 0.2*P*; gage tolerance minus
			Full-form	7	Max. major diameter of external thread provided that major diameter crest width shall not be less than 0.0254 mm (0.022 mm truncation). Apply W tolerance plus. Exception: if minimum major diameter crest width is less than 0.0254 mm (0.022 mm truncation), set nominal crest width to 0.0254 mm and apply gage tolerance minus. For the 0.0254 mm crest, major diameter is equal to the maximum major diameter of the external thread plus 0.216506*p* minus the sum of the external thread pitch diameter tolerance and 0.0440 mm.
		Pitch diameter		8	Min. pitch diameter of external thread; gage tolerance plus
Solid Thread-Setting Rings for Snap and Indicating Gages		Ring for GO	Pitch diameter (Note 2)	9	Min. pitch diameter of internal thread; W gage tolerance plus
			Minor diameter	10	Min. minor diameter of internal thread; W gage tolerance minus
		Ring for HI	Pitch diameter (Note 2)	11	Max. pitch diameter of internal thread; W gage tolerance minus
			Minor diameter	12	Max. minor diameter of internal thread; W gage tolerance minus
Tolerance Class				13	Of internal thread to be checked by gage set with ring

*Indicated rows apply to truncated setting plugs only.

NOTES:

(1) Truncated portion is required when optional sharp root profile in Figs. 19 and 21 is used.

(2) Tolerances greater than W tolerance for pitch diameter are acceptable when setting internal indicating or snap gages that are capable of compensating and when agreed upon by the supplier and user.

TABLE 6 X GAGE TOLERANCES FOR THREAD GAGES

Pitch, mm	Tolerance on Lead, mm (Notes 1, 3)	Tolerance on Half-Angle of Thread, deg. ± min.	Tolerance on Major or Minor Diameters (Note 4)		Tolerance on Pitch Diameter (Notes 2, 4)			
			To and Including 100 mm	Above 100 mm	To and Including 39 mm	Above 39 mm to 100 mm	Above 100 mm to 200 mm	Above 200 mm to 300 mm
1	2	3	4	5	6	7	8	9
0.2	0.005	0 40	0.008	. . .	0.005	. . .	. . .	. . .
0.25	.005	0 40	.008	. . .	.005	. . .	. . .	. . .
0.3	.005	0 30	.008	. . .	.005	. . .	. . .	. . .
0.35	.005	0 30	.008	. . .	.005	. . .	. . .	. . .
0.4	.005	0 30	.010	. . .	.005	. . .	. . .	. . .
0.45	.005	0 30	.010	. . .	.005	0.008	. . .	. . .
0.5	.005	0 30	.010	. . .	.005	.008	. . .	. . .
0.55	.005	0 30	.010	. . .	.005	.008	. . .	. . .
0.6	.005	0 20	.010	. . .	.005	.008	. . .	. . .
0.65	.005	0 20	.010	. . .	.005	.008	. . .	. . .
0.7	.005	0 20	.010	. . .	.005	.008	. . .	. . .
0.75	.005	0 20	.010	. . .	.005	.008	. . .	. . .
0.8	.008	0 15	.013	0.018	.008	.010	0.013	0.015
1.	.008	0 15	.013	.018	.008	.010	.013	.015
1.25	.008	0 15	.013	.018	.008	.010	.013	.015
1.5	.008	0 10	.015	.023	.008	.010	.015	.018
1.75	.008	0 10	.015	.023	.008	.010	.015	.018
2.	.008	0 10	.015	.023	.008	.010	.015	.018
2.5	.008	0 10	.015	.023	.008	.010	.015	.018
3.	.008	0 10	.018	.028	.010	.013	.015	.018
3.5	.010	0 5	.018	.028	.010	.013	.015	.018
4.	.010	0 5	.018	.033	.010	.013	.015	.018
4.5	.010	0 5	.020	.033	.010	.013	.015	.020
5.	.010	0 5	.020	.033	.010	.013	.015	.020
5.5	.010	0 5	.020	.033	.010	.013	.015	.020
6.	.010	0 5	.023	.038	.010	.013	.015	.020
8.	.010	0 5	.023	.038	.010	.013	.015	.020

NOTES:
(1) Allowable variation in lead between any two threads shall not be farther apart than the lengths of the standard gages that are shown in ANSI/ASME B47.1aM.
(2) Above M300, the tolerance is directly proportional to the tolerance in col. 9, in the ratio of the diameter to 300 mm.
(3) See 5.13.9.
(4) Tolerances apply to designated size of thread. Apply tolerances in accordance with Table 4.

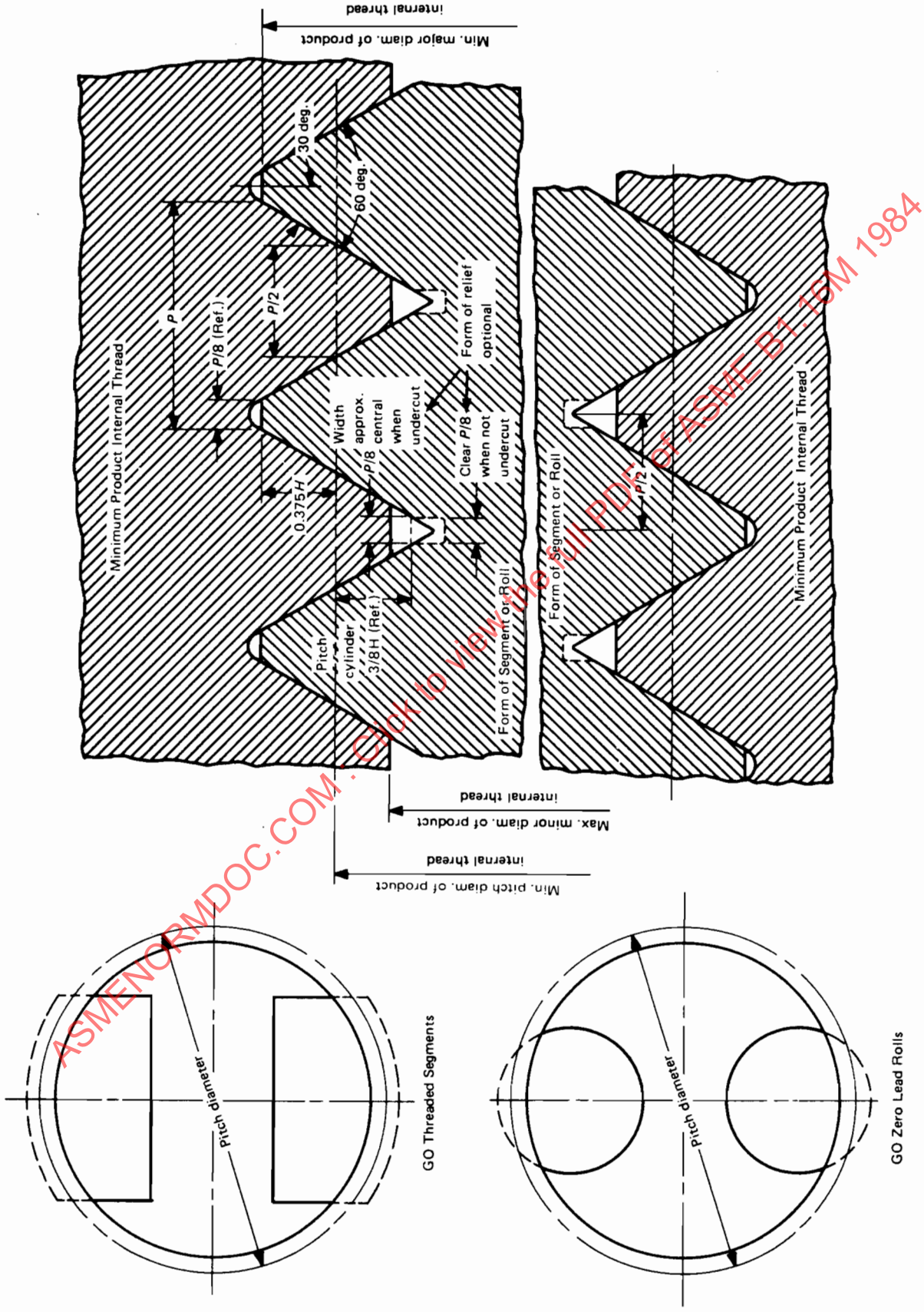


FIG. 4 THREAD SNAP GAGES — MAXIMUM-MATERIAL GO FUNCTIONAL LIMIT

the product internal thread. In applying the thread snap limit gage, the HI functional diameter is acceptable when gaging elements do not pass the product thread.

Internal thread snap gages by design must have an outside diameter of gaging elements below minor diameter of internal thread in order to enter. The gage checks the HI functional diameter limit by sensing the resistance to contact after being set to master.

The HI thread snap gage will also indicate out-of-roundness of the pitch cylinder for 180 deg. ovality by using the gage at different diametral locations on internal thread. The HI thread snap gage will also check for taper of pitch cylinder by using the gage at different locations axially on internal thread.

4.4.2 Basic Design. In order that the HI thread snap gage may effectively check the HI functional diameter limit, the flank contact is reduced by truncating the thread on segments and rolls. As the design of the segments and rolls is different with each gage manufacturer, the number of threads engaged in product thread will vary. Usually, the number of pitches engaged is approximately two. Internal product threads less than 5 mm in diameter are not practical to check with snap gages.

4.4.3 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 5.

4.4.4 Thread Crests. The maximum major diameter of the HI segments and rolls shall be equal to the pitch diameter of segment or roll plus $0.2p$ with the gage tolerance minus. This corresponds to a width of flat at the crest equal to $0.385p$. See Table 4.

4.4.5 Thread Roots. The minor diameter of the HI segments and rolls shall be cleared beyond a $p/8$ width of flat by an extension toward a sharp vee of the sides of the thread or by an undercut to any dimension no wider than $p/4$. Undercut is to be approximately central with the center line of the thread groove. See Fig. 5.

4.4.6 Runout. The pitch and major cylinders of the threaded portion of the HI segments or rolls shall not exceed the runout as determined by measurements of runout (full-indicator movement) on each gaging member, with respect to the pitch cylinder. Runout shall not exceed one-half of the X gage major diameter tolerance.

4.4.7 Pitch Cylinder. The pitch cylinder of the threaded portion of the HI segments or rolls shall be round within the X gage pitch diameter limits specified.

4.4.8 Lead, Pitch, and Half-Angle Variations. Lead, pitch, and half-angle variations shall be within the limits specified. See Table 6.

4.4.9 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, HI, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H HI PD7.500

4.5 Thread Snap Gages — Minimum Material: Pitch Diameter Cone and Vee (Table 2 — Gage 2.5)

4.5.1 Purpose and Use. The thread snap gage with two segments or two rolls, both made to cone and vee design as shown in Fig. 6, inspects the minimum-material limit pitch diameter, C_1, of the product internal thread.

Internal thread snap gages by design must have an outside diameter of gaging elements below minor diameter of internal thread in order to enter. The gage checks the minimum-material pitch diameter limit by sensing the resistance of contact after being set to master.

The cone and vee snap gage can check roundness of pitch cylinder for 180 deg. ovality by using the gage at different diametral locations on internal thread.

The cone and vee snap gage can check taper of pitch cylinder by using the gage at different locations axially on internal thread.

4.5.2 Basic Design. The segments are usually made having a surface contact slightly above the pitch line near the center of the flank. The rolls are made with a point or line contact approximately at the pitch line, depending upon the angle variations of the thread flanks. See Fig. 6 for details. Internal product threads less than 5 mm in diameter are not practical to check with snap gages.

4.5.3 Thread Form. The specifications for thread form, thread crests, and thread roots are summarized in Fig. 6.

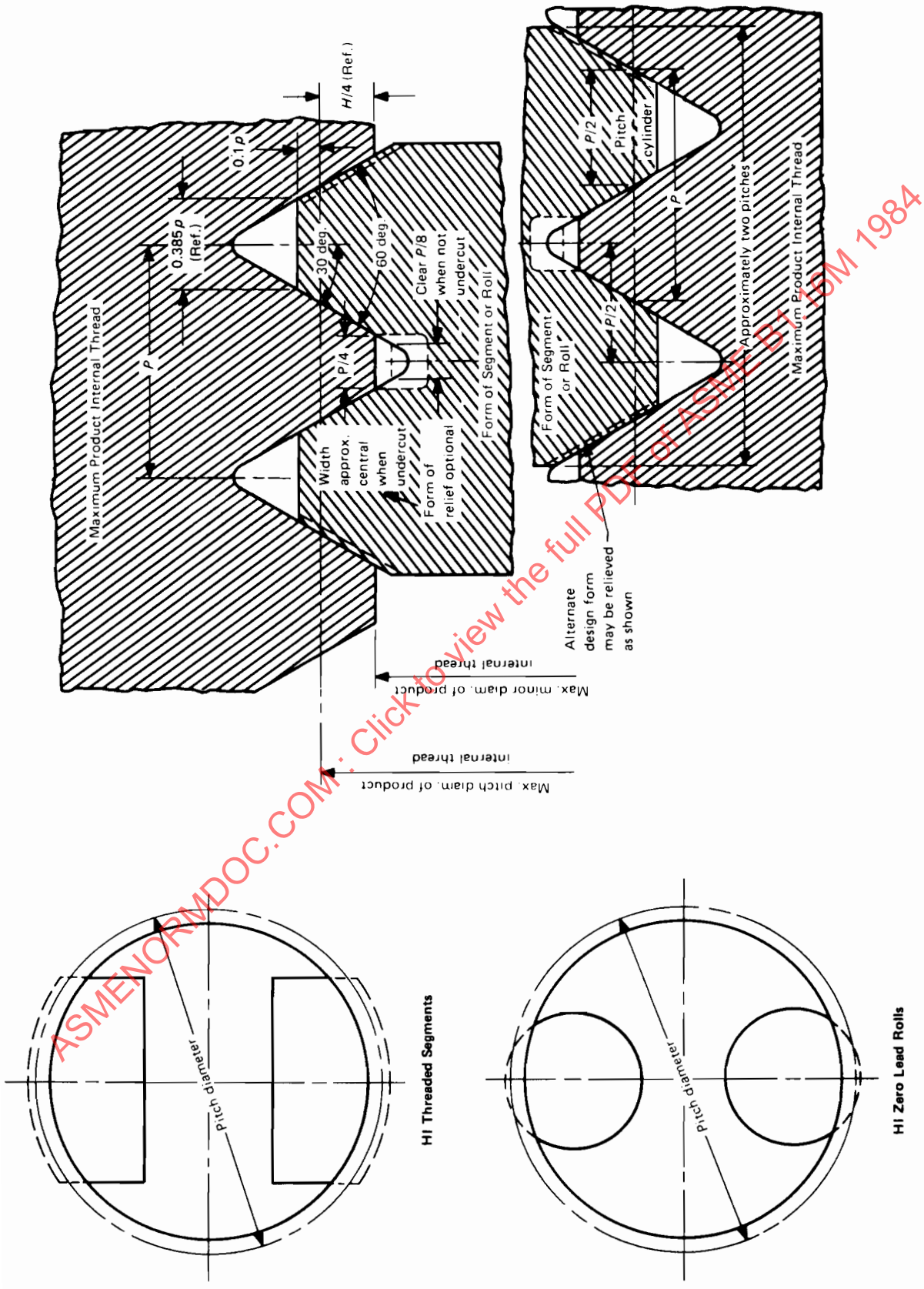


FIG. 5 THREAD SNAP GAGES — HI FUNCTIONAL DIAMETER LIMIT

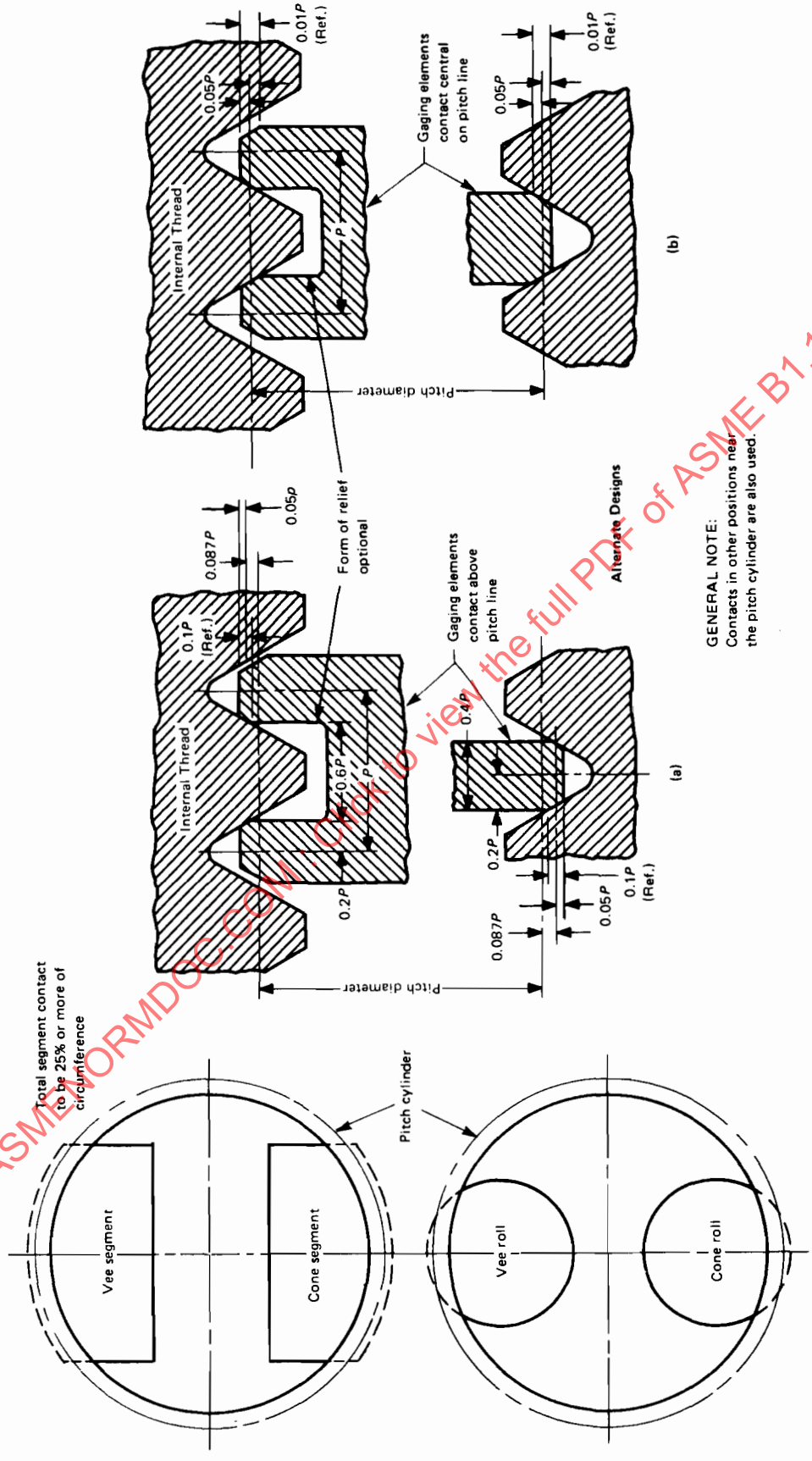


FIG. 6 THREAD SNAP GAGES — MINIMUM-MATERIAL PITCH DIAMETER LIMIT — CONE AND VEE

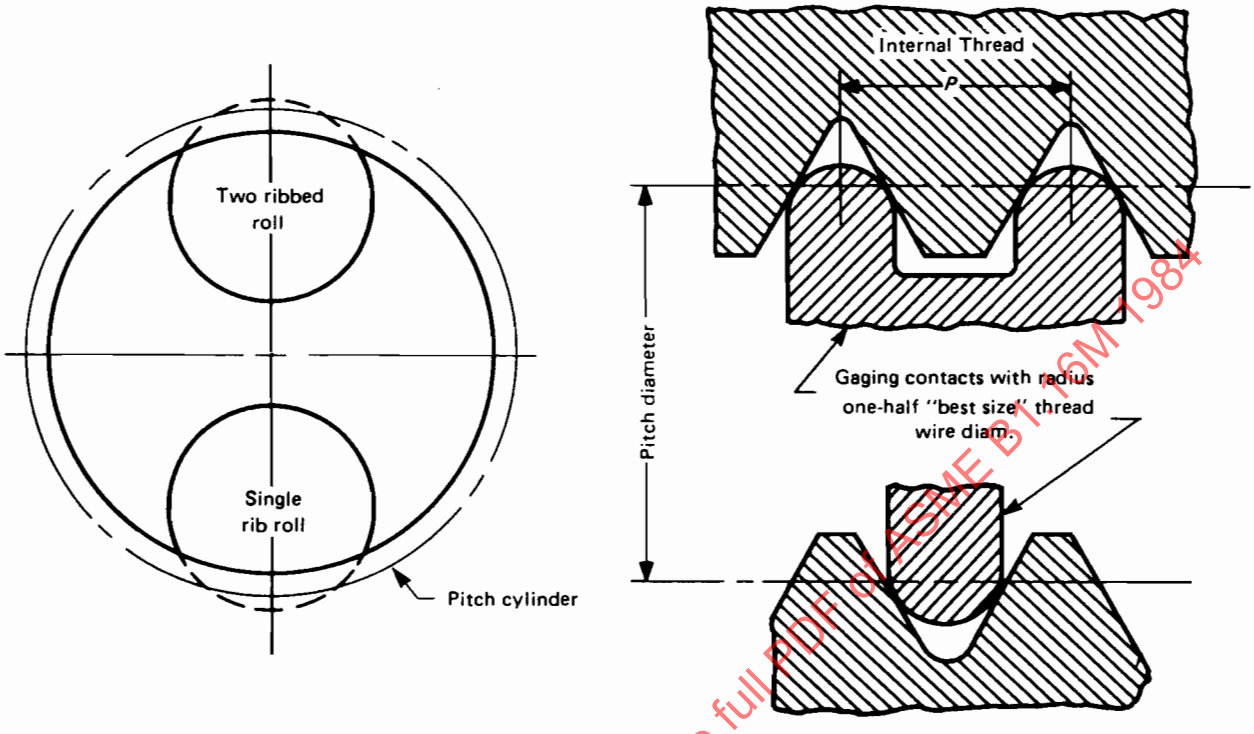


FIG. 7 THREAD SNAP GAGES — MINIMUM-MATERIAL THREAD GROOVE DIAMETER LIMIT

4.5.4 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H PD7.500

4.6 Thread Snap Gages — Minimum Material Thread Groove Diameter Type (Table 2 — Gage 2.6)

4.6.1 Purpose and Use. The thread snap gage with two rolls with "best size" thread wire radius contacts inspects the minimum-material limit pitch diameter, D_1, of the product internal thread.

Internal thread snap gages by design must have an outside diameter of gaging elements below minor diameter of internal thread in order to enter. The gage checks the minimum-material pitch diameter limit by sensing the resistance of contact after being set to master.

The roll thread snap gage will check roundness of the pitch cylinder for 180 deg. ovality by using the gage at different diametral locations.

Also, the roll thread snap gage will check taper of the pitch cylinder by using the gage at different locations axially.

4.6.2 Basic Design. The "best size" thread wire radius contacts on the rolls check the threads at the pitch cylinder. Ribs on roll contacts are made one pitch apart. Internal product threads less than 5 mm in diameter are not practical to check with snap gages.

4.6.3 Thread Form. The specifications for the form on gage rolls are summarized in Fig. 7.

4.6.4 Identification. The assembled gage with rolls should be marked with the metric nominal size, pitch-tolerance class, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H PD7.500

4.7 Thread-Setting Solid Ring Gages

4.7.1 Purpose and Use. Thread-setting ring gages are used for setting internal thread indicating and snap gages. GO thread-setting ring gages are made to the maximum-material limit of the internal thread specification and HI thread-setting rings to the minimum-material limit. Setting rings under 5 mm diameter are too small to be practical.

4.7.2 Gage Blanks. GO and HI solid thread ring gage blanks have been standardized for various size ranges and pitches (see ANSI/ASME B47.1aM). Length of gage thread is a minimum of four pitches.

4.7.3 The GO and HI thread-setting gage threads are stated in detail below and are summarized in Tables 5, 7, 11, and 13, and Fig. 8.

4.7.4 Thread Crests

4.7.4.1 The minor diameter of the GO setting ring gage is equal to the minimum minor diameter of the internal thread.

4.7.4.2 The minor diameter of the HI setting ring gage is equal to the maximum minor diameter of the internal thread.

4.7.5 Thread Roots

4.7.5.1 The major diameter of the GO setting ring gage shall be cleared beyond $p/8$ width of flat by either an extension of the flanks toward a sharp vee or by a clearance cut of substantially $p/8$ width and approximately central. See 5.1.6.

4.7.5.2 The major diameter of the HI setting ring gage shall be cleared by a clearance cut of substantially $0.385p$ width and approximately central. The form is optional. It may clear a $p/8$ flat if not undercut. See 5.2.6.

4.7.6 Runout of Pitch and Minor Diameter Cylinders for Sizes 5 mm and Larger. The pitch and minor cylinders of setting ring gages shall not exceed the runout as stated hereinafter. The permissible minimum effective minor diameter as determined by runout (full-indicator movement) with respect to the pitch cylinder subtracted from measured minor diameter shall not be less than the specified minimum minor diameter minus the sum of the W gage tolerances for pitch and minor diameter for GO setting gages, and minus twice the sum for HI setting gages.

4.7.7 Pitch Cylinder. Conformance of these elements is normally determined by the manufacturing of the setting ring gages to the applicable setting plug gage.

4.7.8 Pitch Diameter Limitation of Taper. The taper shall be within gage pitch diameter limits.

4.7.9 Lead and Half-Angle. Lead and half-angle variations shall be within limits specified in Table 7.

4.7.10 Incomplete Threads. The feather edge at both ends of the thread ring gage shall be removed. On gages larger than 12 mm nominal size, or having pitches coarser than 1.25 mm, not more than one complete turn of the end threads shall be removed to obtain a full-thread blunt start. On gages 12 mm nominal size and smaller, or having pitches of 1.25 mm or finer, a 60 deg. chamfer from the axis of the gage is acceptable in lieu of the blunt start.

4.7.11 Identification. The GO and HI thread-setting ring gages should be marked by metric nominal size, pitch-tolerance class, GO or HI, SETTING, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H GO SETTING PD7.350
M8 × 1-6H HI SETTING PD7.500

4.8 Plain Plug, Snap, and Indicating Gages to Check Minor Diameter of Internal Thread

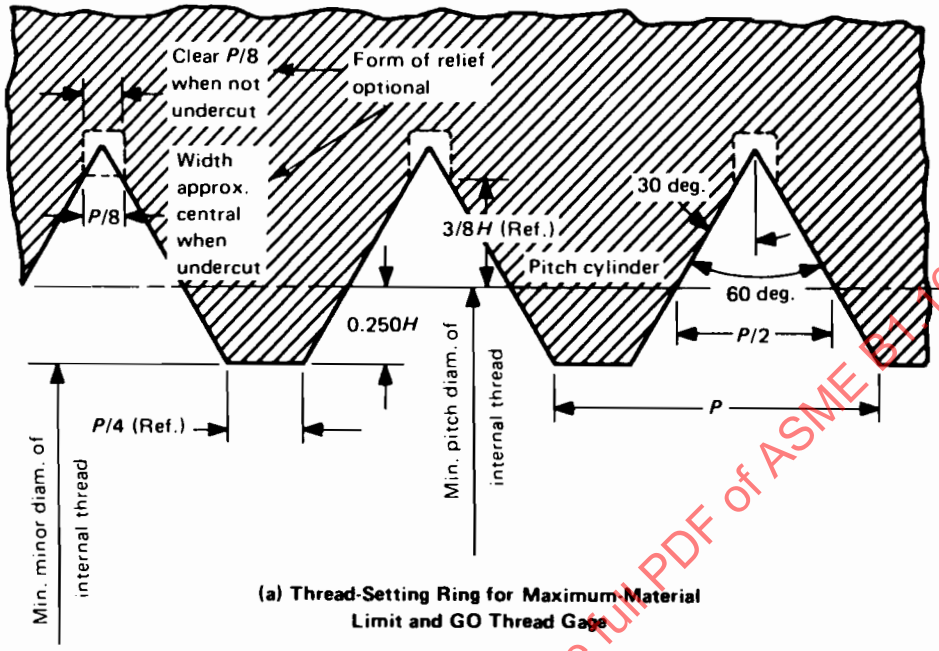
4.8.1 Purpose and Use. The GO and HI thread gages of all designs are cleared at the root but do not check the minor diameter of the product internal thread. Accordingly, 4.8.1 through 4.8.6 describe types of plain diameter gage or precision instruments used to check the maximum- and minimum-material limits of the minor diameter.

4.8.2 GO and NOT GO Plain Cylindrical Plug Gages (Table 2 — Gage 3.1). Plug gages shall be made to Z tolerances and as shown in Fig. 9. GO shall be made to plus tolerance; NOT GO shall be made to minus tolerance. GO cylindrical plug gage must enter and pass through the length of the product without force. NOT GO cylindrical plug must not enter. See Table 8 for gage tolerances.

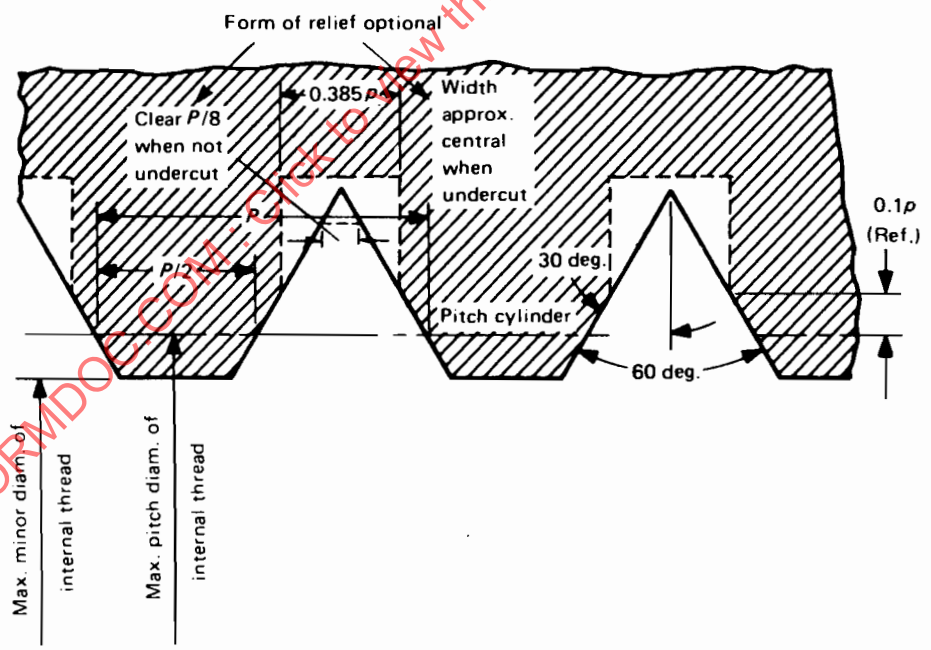
TABLE 7 W GAGE TOLERANCES FOR THREAD GAGES

Pitch, mm	Tolerance on Lead[1,3]		Tolerance on Half-Angle of Thread, deg. ± min.	Tolerance on Major or Minor Diameters[4]			Tolerance on Pitch Diameter[2,4]				
	To and Including 12 mm	Above 12 mm		To and Including 12 mm	Above 12 mm to 100 mm	Above 100 mm	To and Including 12 mm	Above 12 mm to 39 mm	Above 39 mm to 100 mm	Above 100 mm to 200 mm	Above 200 mm to 300 mm
1	2	3	4	5	6	7	8	9	10	11	12
0.2	0.003	. . .	0 30	0.008	. . .	. . .	0.003	. . .	. . .	. . .	. . .
0.25	.003	. . .	0 30	.008	. . .	. . .	.003	. . .	. . .	. . .	. . .
0.3	.003	. . .	0 30	.008	. . .	. . .	.003	. . .	. . .	. . .	. . .
0.35	.003	0.004	0 20	.008	0.008	. . .	.003	0.004	. . .	. . .	. . .
0.4	.003	.004	0 20	.008	.008	. . .	.003	.004	. . .	. . .	. . .
0.45	.003	.004	0 20	.008	.010	. . .	.003	.004	. . .	. . .	. . .
0.5	.003	.004	0 20	.008	.010	. . .	.003	.004	0.005	. . .	. . .
0.55	.003	.004	0 18	.008	.010	. . .	.003	.004	.005	. . .	. . .
0.6	.003	.004	0 18	.008	.010	. . .	.003	.004	.005	. . .	. . .
0.65	.003	.004	0 15	.008	.010	. . .	.003	.004	.005	. . .	. . .
0.7	.003	.004	0 15	.008	.010	. . .	.003	.004	.005	. . .	. . .
0.75	.003	.004	0 12	.008	.010	. . .	.003	.004	.005	. . .	. . .
0.8	.003	.004	0 12	.008	.013	0.018	.003	.004	.005	0.006	0.008
1	.004	.004	0 8	.013	.013	.018	.003	.004	.005	.006	.008
1.25	.004	.004	0 8	.013	.013	.018	.003	.004	.005	.006	.008
1.5	.004	.004	0 8	.013	.013	.018	.003	.004	.005	.006	.008
1.75	.004	.004	0 8	.015	.015	.023	.003	.005	.006	.008	.010
2	.005	.005	0 6	.015	.015	.023	.004	.005	.006	.008	.010
2.5	. . .	.005	0 6	. . .	.015	.023	. . .	.005	.006	.008	.010
3	. . .	.006	0 6	. . .	.015	.023	. . .	.005	.006	.008	.010
3.5	. . .	.006	0 5	. . .	.018	.028	. . .	.005	.006	.008	.010
4	. . .	.008	0 5	. . .	.018	.028	. . .	.005	.006	.008	.010
4.5	. . .	.008	0 4	. . .	.020	.033	. . .	.005	.006	.008	.010
5	. . .	.008	0 4	. . .	.020	.033	. . .	.005	.006	.008	.010
5.5	. . .	.008	0 4	. . .	.020	.033	. . .	.005	.006	.008	.010
6	. . .	.008	0 4	. . .	.023	.033	. . .	.005	.006	.008	.010
8	. . .	.008	0 4	. . .	.023	.038	. . .	.005	.006	.008	.010

NOTES:
(1) Allowable variation in lead between any two threads shall not be farther apart than the length of the standard gage that is shown in ANSI/ASME B47.1aM.
(2) Above M300, the tolerance is directly proportional to the tolerance in col. 12, in the ratio of the diameter to 300 mm.
(3) See 5.13.9.
(4) Tolerances apply to designated size of thread. Apply tolerance in accordance with Table 5.



(a) Thread-Setting Ring for Maximum-Material Limit and GO Thread Gage



(b) Thread-Setting Ring for Minimum-Material Limit and HI Thread Gage

FIG. 8 THREAD FORM OF SOLID THREAD-SETTING RING GAGES

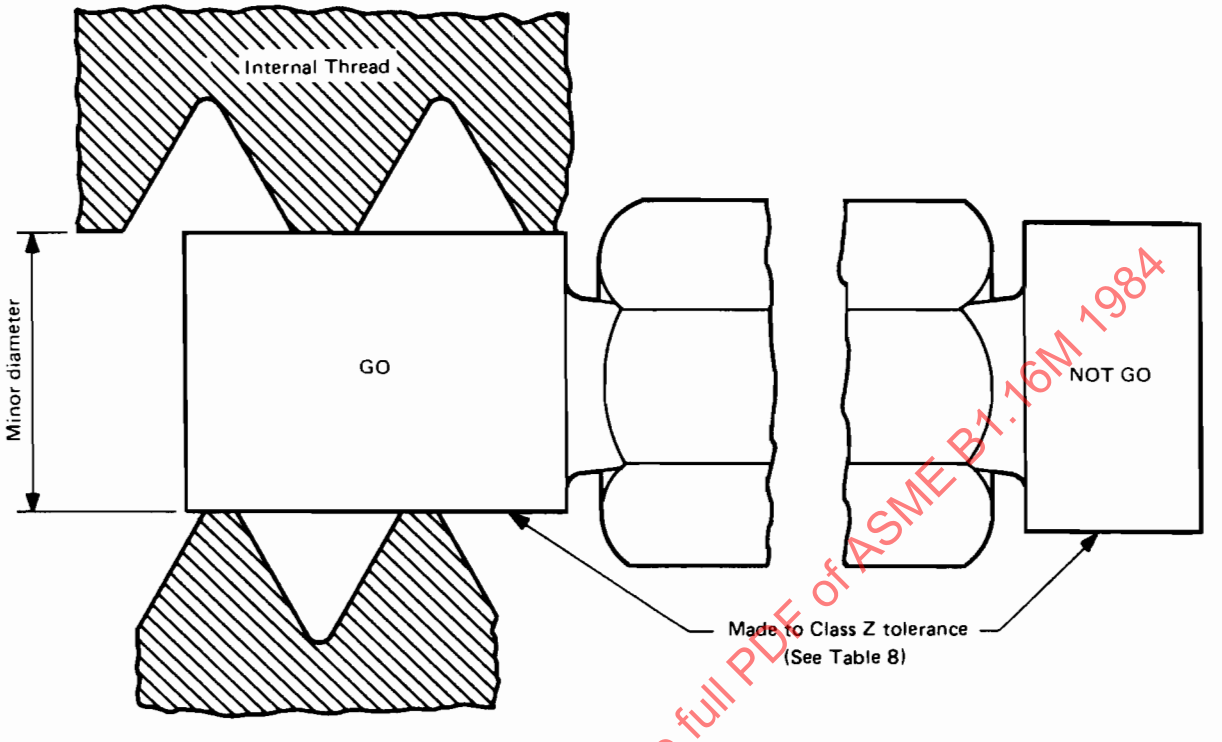


FIG. 9 MINOR DIAMETER LIMIT — CYLINDRICAL PLUG GAGES

The design of the GO and NOT GO cylindrical plain plug members has been standardized for various sizes, ranges, and pitches. See ANSI/ASME B47.1aM.

4.8.3 Identification. The cylindrical gage shall be marked with the metric nominal size, pitch-tolerance class, GO or NOT GO, minor diameter in millimeters, and MINOR DIAMETER.

EXAMPLE:
M8 × 1-6H GO 6.917 MINOR DIAMETER
M8 × 1-6H NOT GO 7.153 MINOR DIAMETER

4.8.4 Precision Instruments (Table 2 — Gage 13). Precision instruments such as dial calipers, inside micrometer calipers, pocket slide calipers, and vernier inside calipers can also be used to measure the minor diameter of product internal thread.

4.8.5 Snap (Table 2 — Gages 3.3 and 3.5) and Indicating Gages (Table 2 — Gages 3.3, 3.5, and 5.2): Plain Diameter Gages for Checking Minor Diameter of Internal Thread. Gages are made to the individual gage manufacturer's standard with gaging contacts (segments or rolls) at 120 deg. or 180 deg. Size range for segment type is approximately 5 mm to 65 mm in diameter. Above 65 mm, gage contacts are plain diameter rolls. Another design is the use of prism fingers for 5 mm size and larger with contacts at 180 deg. See Fig. 10 for details. In each design, the gages are set with cylindrical ring gages, outside micrometers, vernier calipers, or a gap made with gage blocks and jaw accessories. Gage contacts are collapsed into tapped hole and released to contact product minor diameter. Dial indicator gages give the size of the product between minimum and maximum tolerance. Snap gages check the minor diameter limits by sensing the resistance at contact after being set to master.

4.8.6 Identification. After contacts have been assembled in the snap or indicating gage, the assembled gage should be marked with the metric nominal size, pitch-tolerance class, and the minor diameter limits in millimeters.

EXAMPLE:
M8 × 1-6H 6.917–7.153

TABLE 8 GAGE TOLERANCES FOR PLAIN CYLINDRICAL GAGES

Size Range, mm		Tolerances, mm (Note 1)				
Above	To and Including	XX	X	Y	Z (Note 2)	ZZ
1	2	3	4	5	6	7
1	21	0.0005	0.0010	0.0018	0.003	0.005
21	38	0.0008	0.0015	0.0023	0.003	0.006
38	64	0.0010	0.0020	0.0030	0.004	0.008
64	115	0.0013	0.0025	0.0038	0.005	0.010
115	165	0.0017	0.0033	0.0048	0.006	0.013
165	230	0.0020	0.0041	0.0061	0.008	0.016
230	300	0.0025	0.0051	0.0076	0.010	0.020

NOTES:
(1) Tolerances apply to actual diameter of plug or ring. Apply tolerances in accordance with Table 4. Symbols XX, X, Y, Z, and ZZ are standard plain cylindrical gage tolerance classes.
(2) Used as tolerance on plain cylindrical plug and ring gages to check minor diameter for internal threads and outside diameter for external threads. Also used for masters for setting indicating thread gages where design permits.

4.9 Snap (Table 2 — Gage 3.4) and Indicating (Table 2 — Gage 5.1) Gages to Check Major Diameter of Internal Thread

4.9.1 Purpose and Use. The minimum major diameter limit of the product internal thread is considered acceptable when the product thread accepts GO gages. If further gaging is required, 4.9.2 describes the types of gages used to check the maximum- and minimum-material limits of the major diameter.

4.9.2 Snap and Indicating Major Diameter Gages. Gages are made to manufacturer's standard with 55 deg. maximum gage contacts at 180 deg. in the form of relieved thread contacts. See Fig. 11, sketch (a) for segment type. Size ranges from approximately 5 mm to 65 mm. Above 65 mm, gage contacts are thread relieved rolls at 120 deg. See Fig. 11, sketch (b). Another design is the use of conical contact on one finger and two "best size" thread balls on other contact as shown in Fig. 11, sketch (c). In each design, the indicating gages are set with cylindrical ring gages, outside micrometers, vernier calipers, or gap made with gage blocks and jaw accessories. Gage contacts are collapsed into tapped hole and released to contact product major diameter. Dial indicator gages give the size of the product between minimum and maximum tolerances. Snap gage checks the major diameter limit by sensing the resistance at contact after being set to master.

4.9.3 Identification. After contacts have been assembled in the snap or indicating gage, the assembled gage should be marked with the metric nominal size, pitch-tolerance class, GO, NOT GO, major diameter limits in millimeters, and MAJOR DIAMETER INTERNAL.

EXAMPLE:
M8 × 1-6H GO 8.000 NOT GO (Customer's Specifications)
MAJOR DIAMETER INTERNAL

4.10 Functional Indicating Thread Gages for Internal Thread (Table 2 — Gages 4.1 and 4.3)

4.10.1 Purpose and Use. The GO indicating thread gage (4.1 and 4.3) inspects the maximum-material GO functional limit and size, A_1 and A_2, and the HI functional diameter limit and size, B_1 and B_2, of product internal thread. By the use of segments, rolls, or fingers, the gage is also used to check roundness of pitch cylinder. Some types of indicating gages are set by using thread-setting ring gages. See 4.7. Other types may be set with plain ring gages or with gage blocks and jaws. Readings indicate the position of product thread within the tolerance range.

4.10.2 Basic Design. Indicating gages have three contacts at 120 deg. or two contacts at 180 deg. Gages are made with segments, rolls, or fingers with the length of the functional GO gaging elements equal to the length of the standard GO thread plug gage. Internal product threads less than 5 mm in diameter are not practical to check with indicating gages.

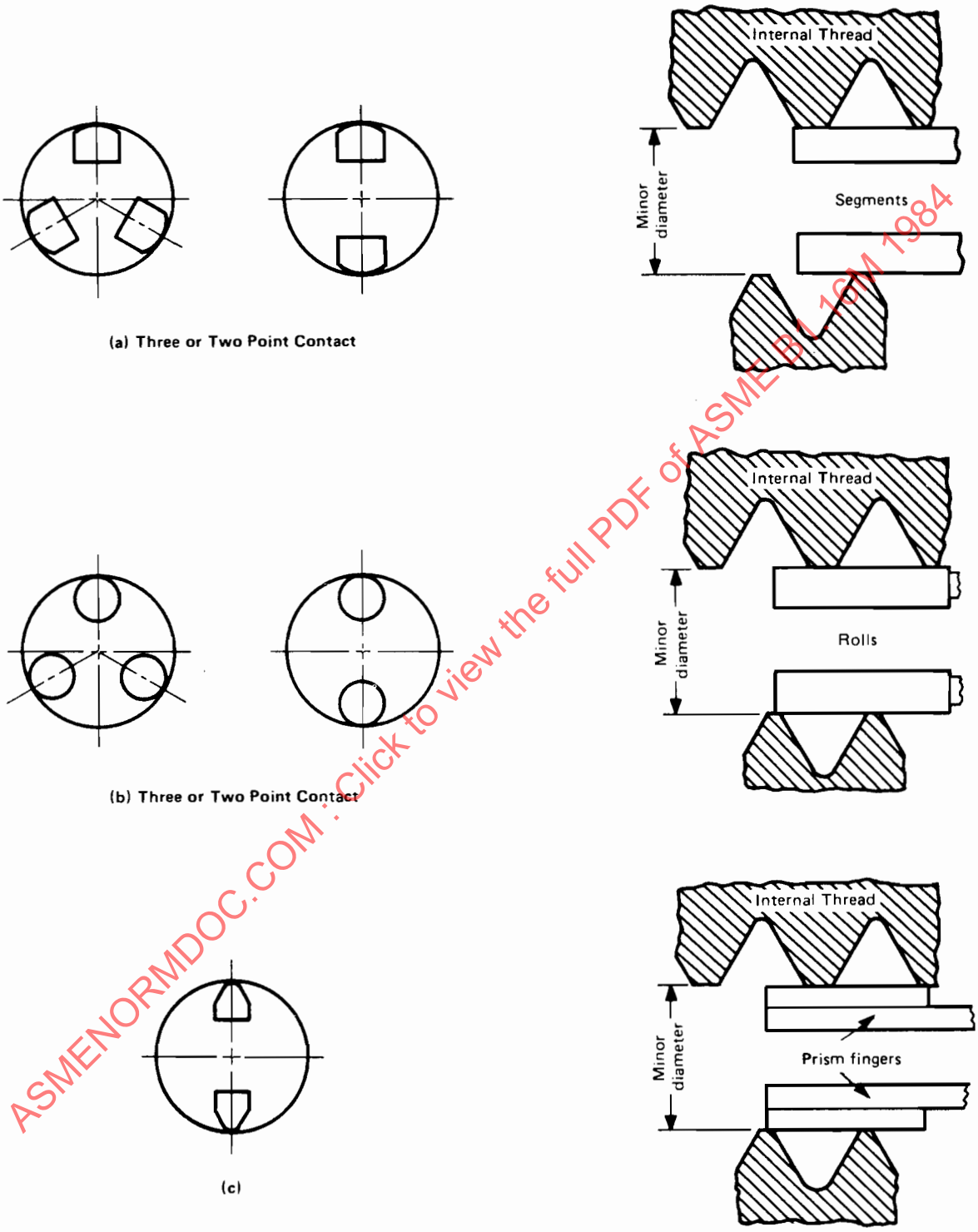


FIG. 10 INDICATING PLAIN DIAMETER GAGES — MAX.-MIN. MINOR DIAMETER LIMIT AND SIZE

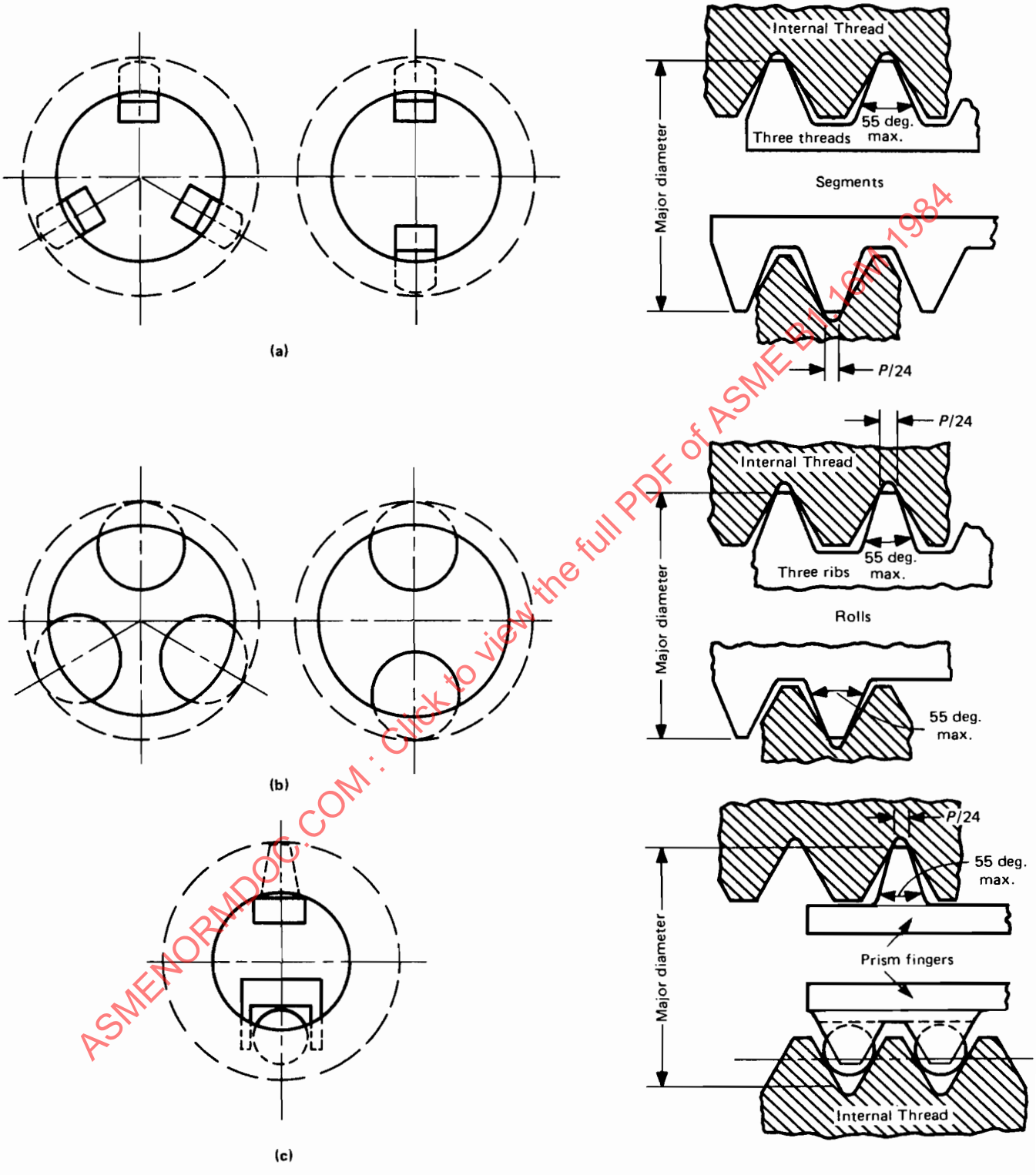


FIG. 11 SNAP AND INDICATING DIAMETER GAGES — MAX.-MIN. MAJOR DIAMETER LIMIT AND SIZE

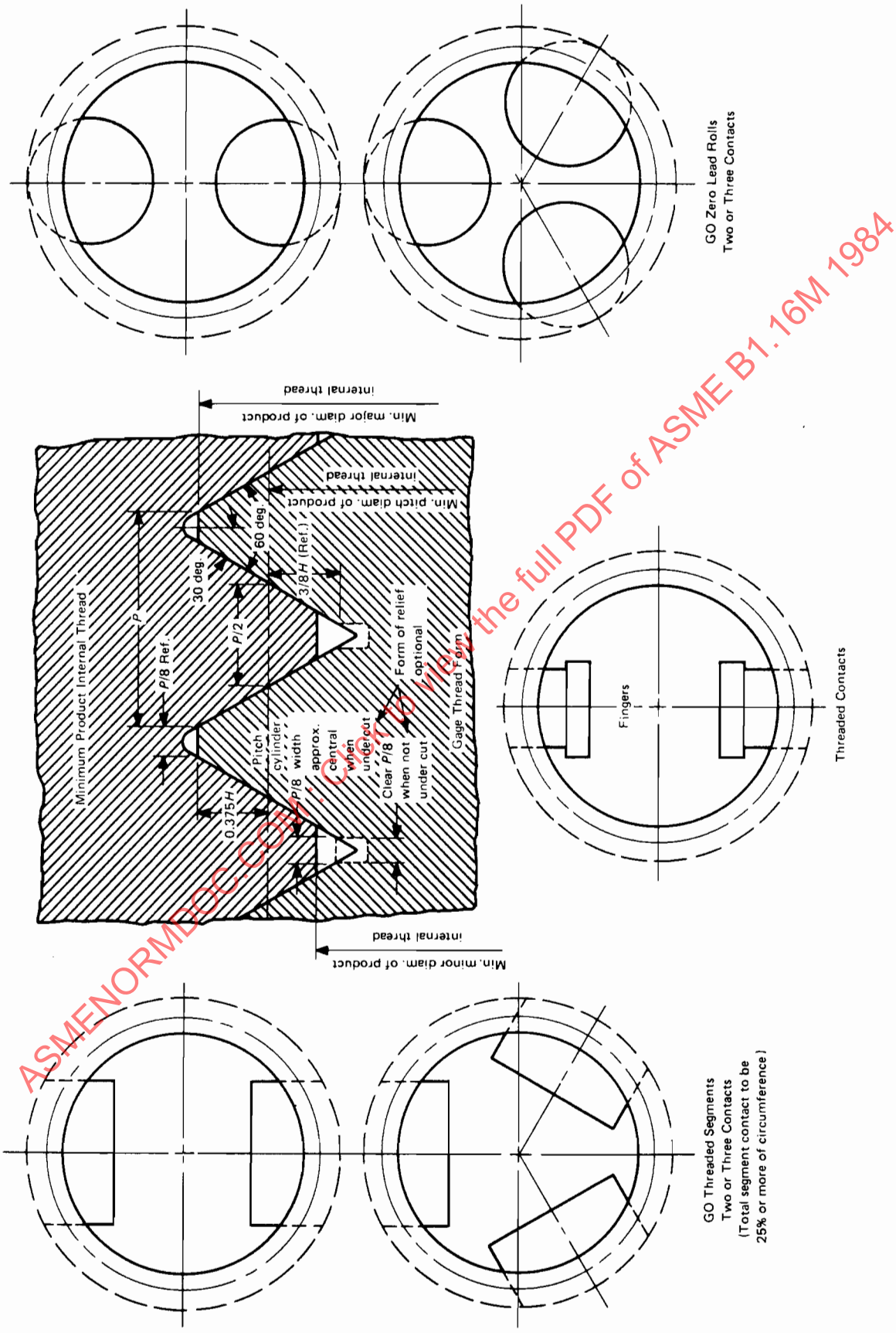


FIG. 12 INDICATING THREAD GAGES — MAXIMUM-MATERIAL GO FUNCTIONAL LIMIT AND SIZE

TABLE 9 CONSTANTS FOR COMPUTING THREAD GAGE DIMENSIONS

Pitch, p	Half Height of Cone Contact, $0.05p$	Distance Between Pitch Cylinder and Half Height of Cone Contact, $0.087p$	Height of Gage Cone Contact, $0.11547H = 0.1p$	Width of Flat on GO Plug $p/8 = 0.125p$	Distance Between HI PD and O.D. and LO PD and Minor Diam. Also Truncation on Set Plugs, $0.23094H = 0.2p$	Addendum of Ring Thread and Truncation of Internal Thread, $H/4 = 0.216506p$	Width of Flat on GO Ring, $p/4 = 0.25p$	Dedendum of Ring Thread and Addendum of Plug Thread, $\frac{5}{16}H = 0.32476p$	Width of Flat on Thread of LO Ring and HI Plug, $0.385p$	Mean Width of Cone Contact for Internal Thread, $0.4p$	Half Height of Sharp V-Thread, $H/2 = 0.433013p$	Mean Width of Cone Contact for External Thread, $0.6p$	Twice External Thread Height, $\frac{3}{4}H = 0.649519p$	Height of Sharp V-Thread, $H = 0.866025p$	Double Height of Internal Thread, $\frac{5}{4}H = 1.082532p$
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
*0.2	0.010	0.0174	0.020	0.0250	0.040	0.04330	0.0500	0.06495	0.07700	0.08	0.08660	0.12	0.12990	0.17321	0.21651
*0.25	0.012	0.0218	0.025	0.0312	0.050	0.05413	0.0625	0.08119	0.09625	0.10	0.10825	0.15	0.16238	0.21651	0.27063
*0.3	0.015	0.0261	0.030	0.0375	0.060	0.06495	0.0750	0.09743	0.11550	0.12	0.12990	0.18	0.19486	0.25981	0.32476
0.35	0.018	0.0304	0.035	0.0438	0.070	0.07578	0.0875	0.11367	0.13475	0.14	0.15155	0.21	0.22733	0.30311	0.37889
0.4	0.020	0.0348	0.040	0.0500	0.080	0.08660	0.1000	0.12990	0.15400	0.16	0.17321	0.24	0.25981	0.34641	0.43301
0.45	0.022	0.0392	0.045	0.0562	0.090	0.09743	0.1125	0.14614	0.17325	0.18	0.19486	0.27	0.29228	0.38971	0.48714
0.5	0.025	0.0435	0.050	0.0625	0.100	0.10825	0.1250	0.16238	0.19250	0.2	0.21651	0.3	0.32476	0.43301	0.54127
0.6	0.030	0.0522	0.060	0.0750	0.120	0.12990	0.1500	0.19486	0.23100	0.24	0.25981	0.36	0.38971	0.51962	0.64952
0.7	0.035	0.0609	0.070	0.0875	0.140	0.15155	0.1750	0.22733	0.26950	0.28	0.30311	0.42	0.45466	0.60622	0.75777
0.75	0.038	0.0652	0.075	0.0938	0.150	0.16238	0.1875	0.24357	0.28875	0.3	0.32476	0.45	0.48714	0.64952	0.81190
0.8	0.040	0.0696	0.080	0.1000	0.160	0.17320	0.2000	0.25981	0.30800	0.32	0.34641	0.48	0.51962	0.69282	0.86603
1	0.050	0.0870	0.100	0.1250	0.200	0.21651	0.2500	0.32476	0.38500	0.4	0.43301	0.6	0.64952	0.86603	1.08253
1.25	0.062	0.1088	0.125	0.1562	0.250	0.27063	0.3125	0.40595	0.48125	0.5	0.54127	0.75	0.81190	1.08253	1.35316
1.5	0.075	0.1305	0.150	0.1875	0.300	0.32476	0.3750	0.48714	0.57750	0.6	0.64952	0.9	0.97428	1.29904	1.62380
1.75	0.088	0.1522	0.175	0.2188	0.350	0.37889	0.4375	0.56833	0.67375	0.7	0.75777	1.05	1.13666	1.51554	1.89443
2	0.100	0.1740	0.200	0.2500	0.400	0.43301	0.5000	0.64952	0.77000	0.8	0.86603	1.2	1.29904	1.73205	2.16506
2.5	0.125	0.2175	0.250	0.3125	0.500	0.54127	0.6250	0.81190	0.96250	1.0	1.08253	1.5	1.62380	2.16506	2.70633
3	0.150	0.2610	0.300	0.3750	0.600	0.64952	0.7500	0.97428	1.15500	1.2	1.29904	1.8	1.94856	2.59808	3.24760
3.5	0.175	0.3045	0.350	0.4375	0.700	0.75777	0.8750	1.13666	1.34750	1.4	1.51554	2.1	2.27332	3.03109	3.78886
4	0.200	0.3480	0.400	0.5000	0.800	0.86603	1.0000	1.29904	1.54000	1.6	1.73205	2.4	2.59808	3.46410	4.33013
4.5	0.225	0.3915	0.450	0.5625	0.900	0.97428	1.1250	1.46142	1.73250	1.8	1.94856	2.7	2.92284	3.89711	4.87139
5	0.250	0.4350	0.500	0.6250	1.000	1.08253	1.2500	1.62380	1.92500	2.0	2.16506	3.0	3.24760	4.33013	5.41266
5.5	0.275	0.4785	0.550	0.6875	1.100	1.19078	1.3750	1.78618	2.11750	2.2	2.38157	3.3	3.57235	4.76314	5.95392
6	0.300	0.5220	0.600	0.7500	1.200	1.29904	1.5000	1.94856	2.31000	2.4	2.59808	3.6	3.89711	5.19615	6.49519
8	0.400	0.6960	0.800	1.0000	1.600	1.73205	2.0000	2.59808	3.08000	3.2	3.46410	4.8	5.19615	6.92820	8.66025

*Nonstandard pitches

4.10.3 Thread Form. The specifications for thread form on GO functional segments, rolls, or fingers are summarized in Table 4 and Fig. 12.

4.10.4 Thread Crests. The major diameter of the GO segments, rolls, or fingers is equivalent to a $p/8$ flat with a plus gage tolerance. The thread crests shall be flat in an axial plane and parallel to the axis of the segment, roll, or finger.

4.10.5 Pitch Cylinder. The pitch cylinder of the segments, rolls, or fingers shall be round and straight within the gage pitch diameter limits specified in Table 6.

4.10.6 Lead and Half-Angle Variations. Lead and half-angle variations on thread of segments, rolls, and fingers shall be within the limits specified. See Table 6.

4.10.7 Thread Roots

4.10.7.1 The minor diameter of the GO threaded segments, rolls, or fingers shall be cleared beyond a $p/8$ width of flat either by extension of the sides of the thread toward a sharp vee or by an undercut no greater than $p/8$ maximum width and approximately central.

4.10.8 Runout. The pitch and major cylinders of the threaded portion of the GO segments or rolls shall not exceed the runout as determined by measurements of runout (full-indicator movement) on each gaging member, with respect to pitch cylinder. Runout shall not exceed one-half X gage major diameter tolerance. See Table 6.

4.10.9 Identification. The gaging elements, segments, rolls, or fingers shall be identified by the metric nominal size and pitch. When indicating gage is assembled with proper contacts, the gage should be marked with the metric nominal size, pitch-tolerance class, PD, and pitch diameter limits in millimeters.

EXAMPLE:
M8 × 1-6H PD7.350-7.500

4.11 Minimum-Material Indicating Thread Gages for Internal Thread (Table 2 — Gages 4.5 and 4.6)

4.11.1 Purpose and Use. The indicating thread gage inspects the minimum-material limit and size (C_1 and C_2, D_1 and D_2) of product internal threads. By the use of interchangeable segments, rolls, or balls, the gage is also used to check roundness and taper of pitch cylinder. Some types of indicating gages are set by using a thread-setting ring gage. See 4.7. Readings indicate the position of product thread within the tolerance range. Other types may be set with gage blocks and jaws, plain ring gages, or measuring machine.

4.11.2 Basic Design. Indicating gages have three contacts at 120 deg. or two contacts at 180 deg. Gages are made with segments, rolls, or ball design with cone and vee configuration (pitch diameter type) or ball only (thread groove diameter type). It is impractical to attempt checking internal product threads smaller than 5 mm with indicating gages.

4.11.3 Thread Form. The specifications for cone and vee segments are shown in Fig. 13; the ball design and thread groove diameter type are shown in Fig. 14.

4.11.4 The major diameter of the cone and vee segments or rolls is made to manufacturer's standard. See Figs. 13 and 14.

4.11.5 Identification. The gaging elements, segments, rolls, or ball fingers should be marked with metric nominal size and pitch. When gage is asssembled with proper gaging contacts, the indicating gage should be marked with the metric nominal size, pitch-tolerance class, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6H PD7.500

4.12 Indicating Runout Thread Gage for Internal Thread (Table 2 — Gage 4.7)

4.12.1 Purpose and Use. This indicating gage inspects the runout of the minor diameter to the pitch diameter M_1 of the product internal thread. Readings indicate the position of product minor diameter to the pitch diameter within the tolerance specified.

4.12.2 Basic Design. Indicating gages have three contacts, one plain and two threaded, at 120 deg.; or two contacts, one plain and one threaded, at 180 deg. See Fig. 15, sketch (a). The range of segments is 5 mm and larger; the range of rolls is 75 mm and larger.

The ball-type indicating gage has two balls on one contact engaging two threads, and one contact has a

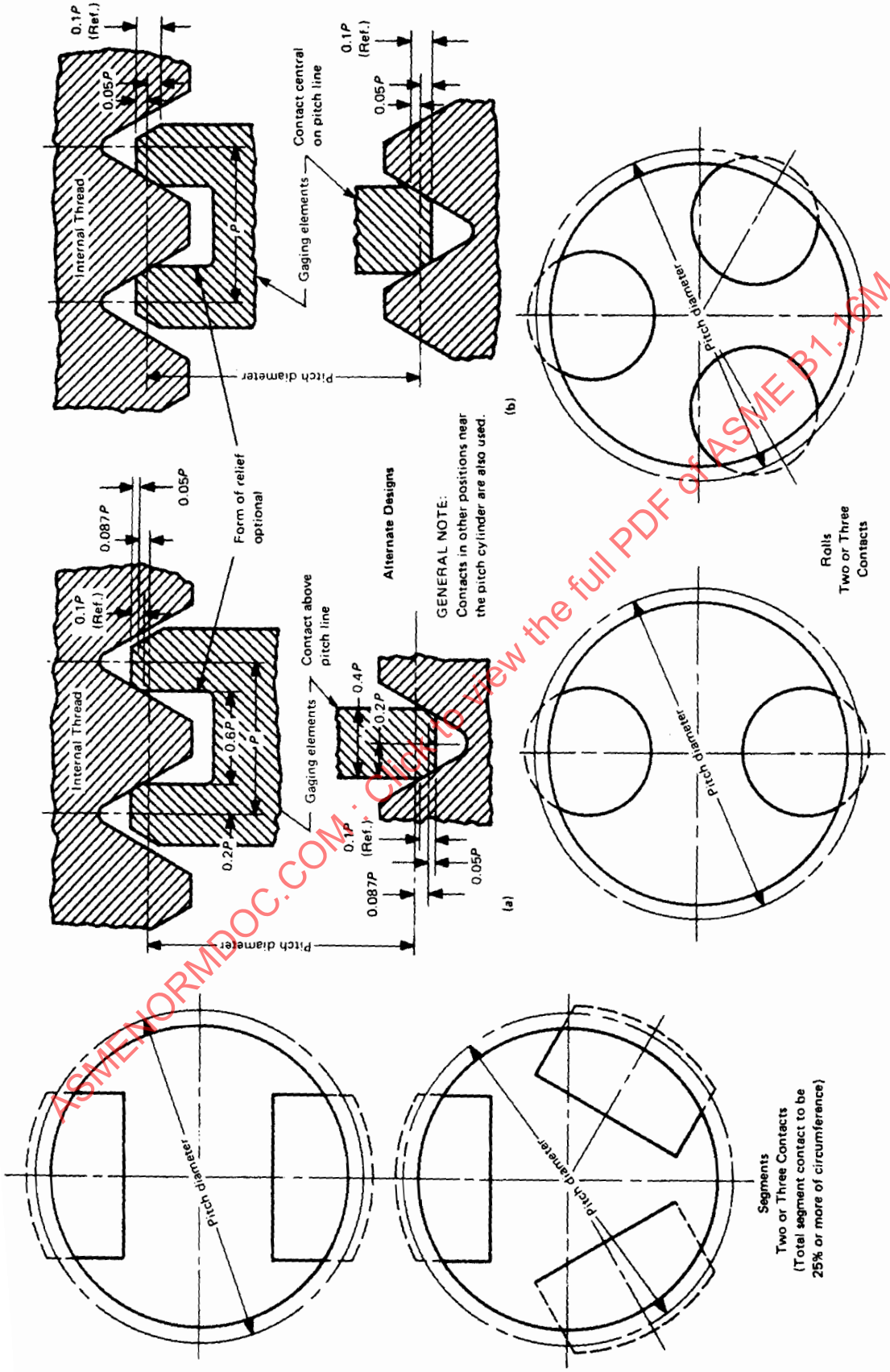


FIG. 13 INDICATING THREAD GAGES — MINIMUM-MATERIAL PITCH DIAMETER LIMIT AND SIZE — CONE AND VEE

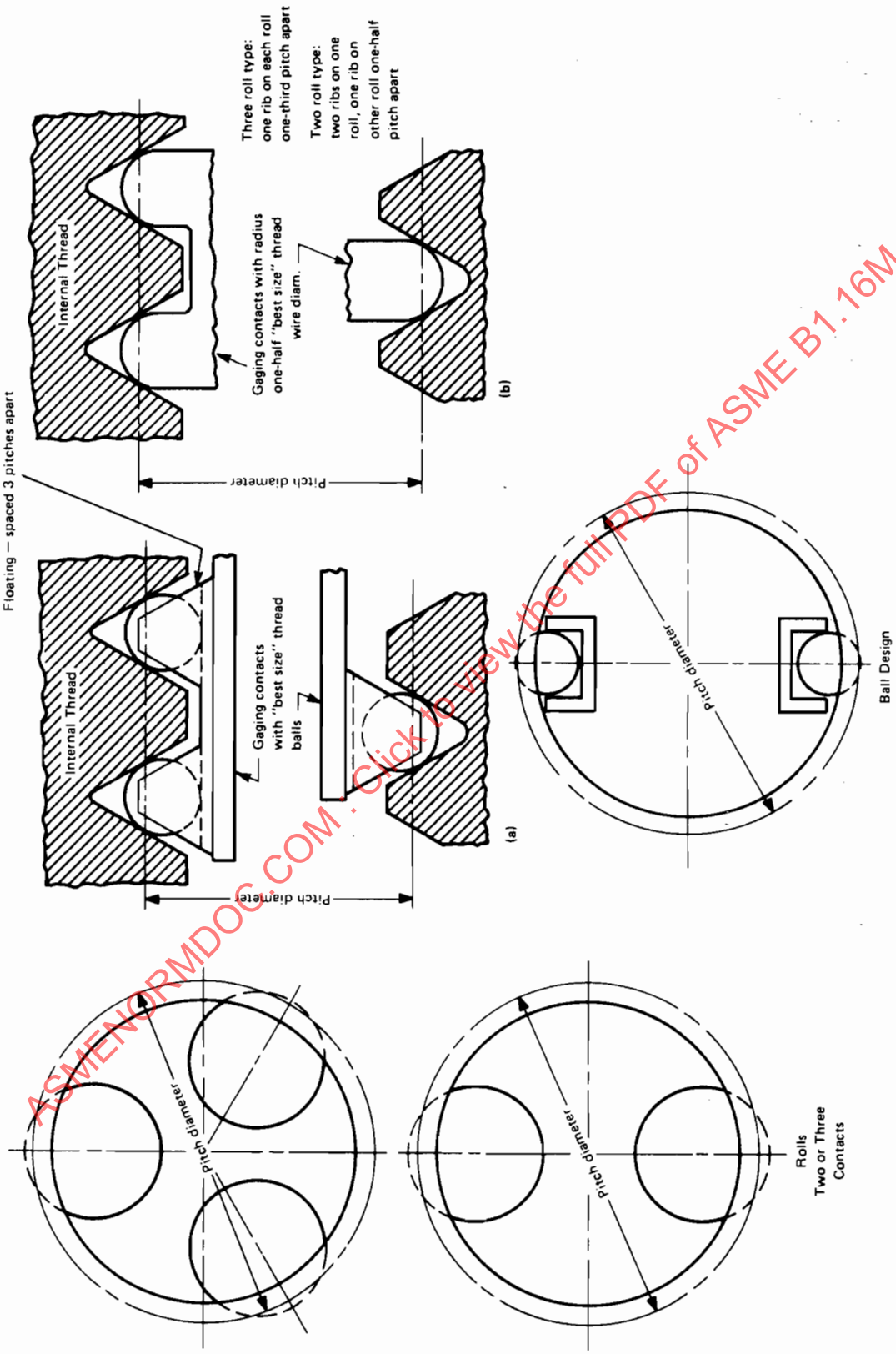


FIG. 14 INDICATING THREAD GAGES — MINIMUM-MATERIAL PITCH DIAMETER LIMIT AND SIZE — BALL AND RADIUS

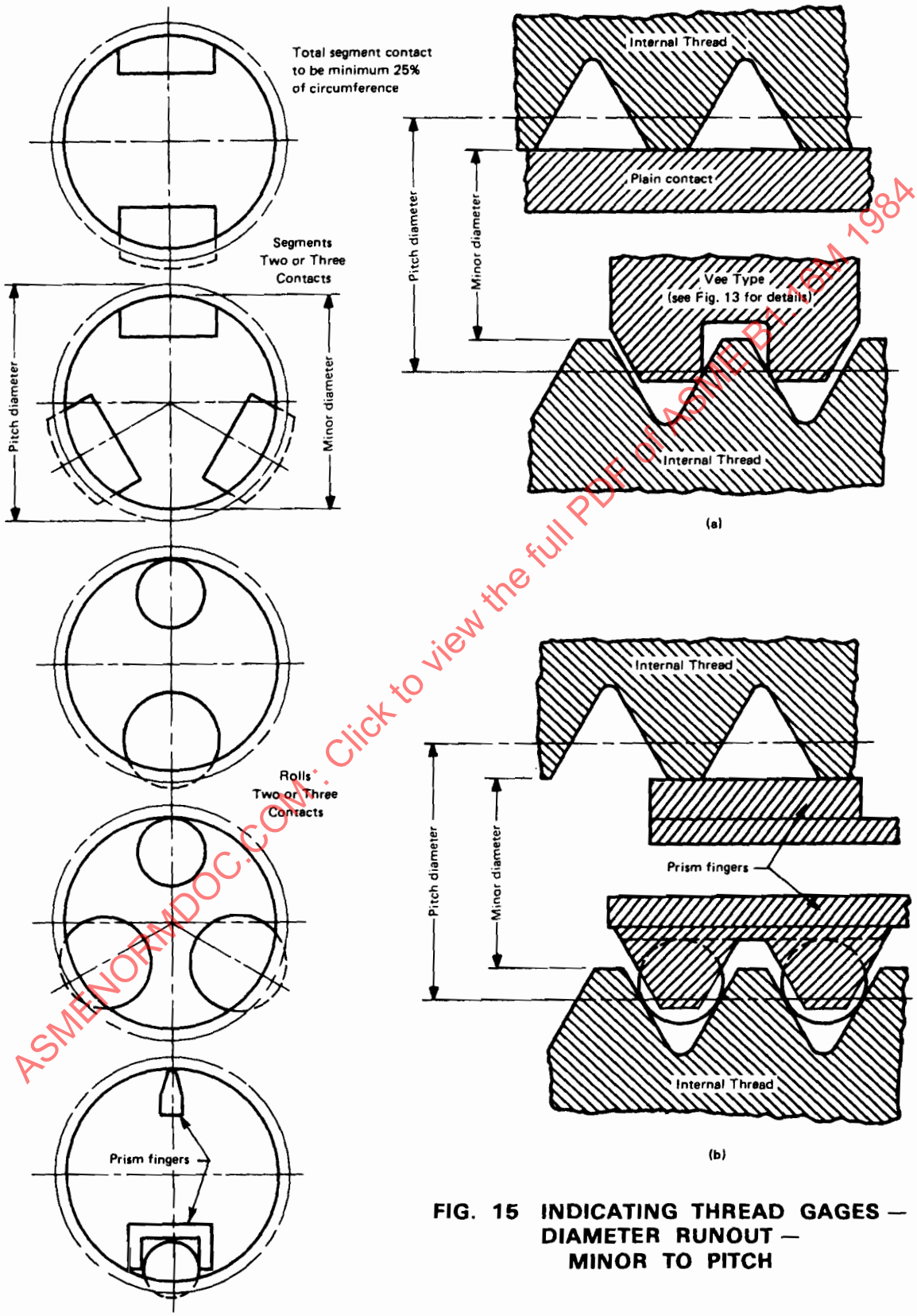


FIG. 15 INDICATING THREAD GAGES — DIAMETER RUNOUT — MINOR TO PITCH

plain prism shaped finger 180 deg. apart from the ball contact. See Fig. 15, sketch (b): the range is 15 mm and larger.

The indicating gage is set by a GO setting ring gage (see Fig. 8) with plain gaging contact on minor diameter of thread ring gage and the thread contact on pitch diameter of ring thread gage.

4.12.3 Thread Form. The specifications for thread form on vee segments or rolls are summarized in Fig. 15. Plain contacts have line bearing on minor diameter of product. Balls are "best size" thread ball contacting thread at pitch line.

4.12.4 Thread Crests. The thread crests shall be flat in an axial plane and parallel to axis of segment or roll.

4.12.5 Lead and Half-Angle Variations. Lead and half-angle variations on threaded segments or rolls shall be within the limits specified. See Table 6.

4.12.6 Identification. The gaging elements, segments, rolls, or ball finger should be marked with the nominal size and pitch. When gage is assembled with proper gaging contacts, the indicating gage should be marked with the metric nominal size, pitch-tolerance class, and RUNOUT.

EXAMPLE:
M8 × 1-6H RUNOUT

4.13 Differential Gaging (Table 2 — Gage 4.8)

4.13.1 The concept of differential gaging for product internal screw threads makes use of fundamental geometric theorems that relate directly to size, position, and form.

For differential gaging, two methods are used for measuring screw thread size:

(*a*) GO functional size

(*b*) pitch diameter (or thread groove diameter)

Only when a screw thread has perfect position and form [i.e., zero variation in lead (including helical path), flank angle, taper, and roundness] are these two measurements equal. Differential gaging is a variables method of in-process inspection, final conformance inspection, or both, that provides the actual numerical values for both GO functional and pitch diameter sizes. These are the two extreme sizes of any product screw thread. One of the sizes, pitch diameter, is the size of the thread pitch diameter with essentially zero variation in all other thread elements, while the other size, GO functional size, is the size of the thread with the effects of all variations in all other thread elements added to the pitch diameter. The numerical difference between these two sizes is called a *cumulative thread element variation differential* and represents the diametral effect of the total amount of thread element variations.

The inspection process that further refines the total amount of thread element variation so that the amount of variation for each individual element becomes known is called *single thread element variation differential.*

4.13.2 Cumulative Thread Element Variation Differential. Indicating gages have either three contacts at 120 deg. spacing or two contacts at 180 deg. spacing. The indicating gages with segments or rolls as shown in Figs. 12 and 16, sketch (a) give the functional size indicating reading, Z. The indicating gages with cone and vee segments or rolls with one thread pitch engagement at pitch diameter line, Fig. 13, and thread groove diameter type, Fig. 14, sketch (a) or (b), or both, shown in Fig. 16, sketches (c) and (d), give the pitch diameter size indicating reading, X. The difference in the indicator readings, X − Z, between the two types of gages gives the cumulative form differential reading which corresponds to the pitch diameter equivalent, $\Delta D_2 c$, for the combination of lead, helix, flank angle, roundness, and taper variations on the product thread. See Fig. 16.

4.13.3 Single Thread Element Variation Differential

4.13.3.1 Lead (Helix) Differential Reading. The indicating gage reading, Y, using the full-form thread segments or rolls with one thread pitch engagement, similar to Figs. 12 and 16, sketch (b), is compared to the reading, Z, using the functional size gage shown in Figs. 12 and 16, sketch (a). The difference between the measured values, Y − Z, is the lead differential reading which corresponds to the pitch diameter equivalent, $\Delta D_2 \lambda$, for the lead and helix variation of the product thread.

4.13.3.2 Flank Angle Differential Reading. The indicating gage reading, X, using segments or rolls with cone and vee design, Figs. 13 and 16, sketch (c), is compared to the reading, Y, using the full-form thread segments or rolls, similar to Figs. 12 and 16, sketch (b). Both designs have one thread pitch engagement. The difference between the measured values, X − Y, is the flank angle differential reading which corresponds approximately to the pitch diame-

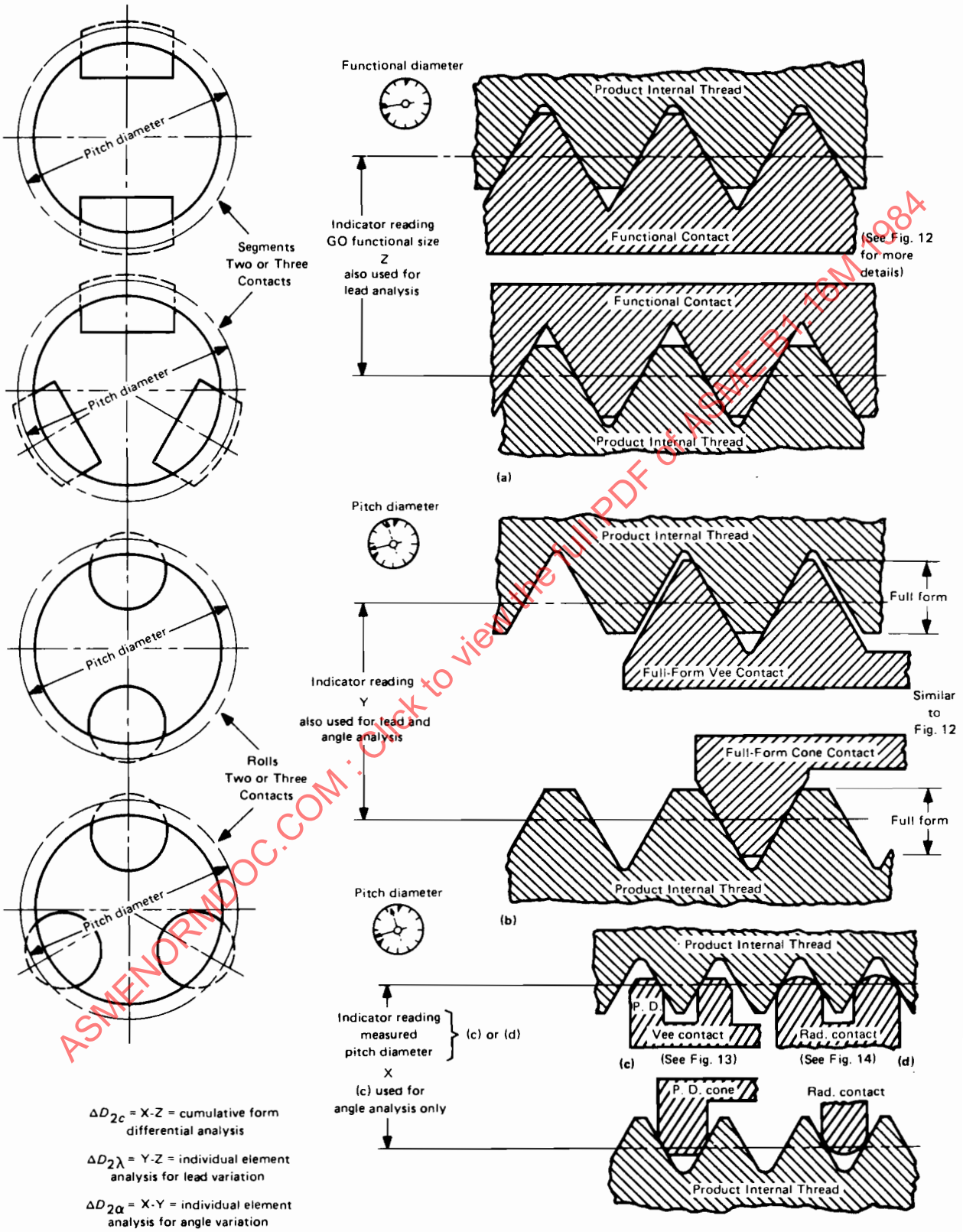


FIG. 16 INDICATING THREAD GAGES — DIFFERENTIAL GAGING

ter equivalent, $\Delta D_2\propto$, for the combined flank angle variation on the product thread.

4.13.3.3 Roundness and Taper Differential Readings. By the use of full-form thread segments or rolls with one thread pitch engagement, similar to Figs. 12 and 16, sketch (b), cone and vee segments or rolls, Figs. 13 and 16, sketch (c), or thread groove diameter type, Figs. 14, sketch (a) or (b), and 16, sketch (d), the roundness and taper of pitch cylinder is checked. Rotate the product between contacts at different axial locations on thread for maximum difference in roundness and taper readings. Two contacts spaced 180 deg. apart give even lobing out-of-round measurement. Three contacts spaced 120 deg. apart give odd lobing out-of-round measurements.

4.13.4 Thread Form. The functional segments or rolls, Fig. 16, sketch (a), are described in 4.10. The full-form one thread vee segment or roll, Figs. 12 and 16, sketch (b) upper contact, has a depth of thread equivalent to the functional type, but relieved on the outside thread flanks. The full-form cone segment or roll, Figs. 12 and 16, sketch (b) lower contact, has a $p/8$ flat on outside diameter. The cone and vee segments or rolls, Fig. 16, sketch (c), are described and shown in Fig. 13. Thread groove diameter type, Fig. 16, sketch (d), is described and shown in Fig. 14.

4.13.5 Identification. The gaging elements, segments, or rolls should be marked by metric nominal size and pitch. Indicating gages, assembled with proper contacts, should be marked with metric nominal size, pitch-tolerance class, and the type of differential reading specified above.

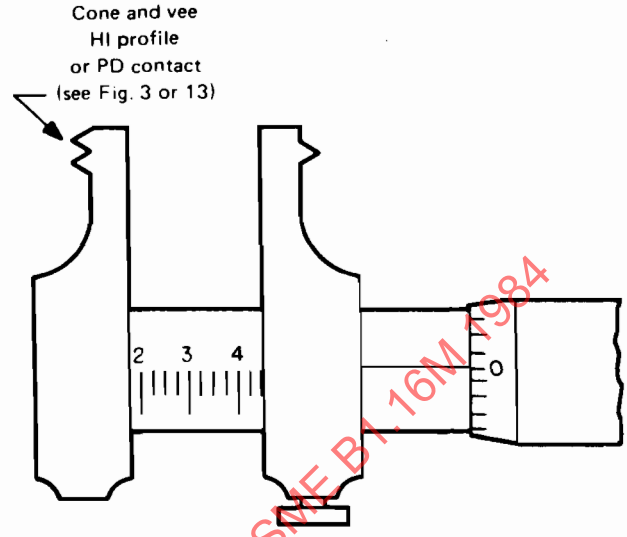
EXAMPLE:
M8 × 1-6H Flank Angle Differential Variation

4.14 Pitch Micrometers (Table 2 — Gages 6 and 7)

4.14.1 Purpose and Use. Inside micrometers, caliper type, are direct reading measuring instruments. Cone and vee contact points are modified for a HI profile or pitch diameter contact only. See Fig. 17.

4.15 Thread-Measuring Balls (Table 2 — Gage 8)

4.15.1 Purpose and Use. One indicating gage using thread-measuring balls as gaging elements



Inside Micrometer
Caliper Type
(Ref. Table 2 — B_1, B_2, C_1, C_2, E_1, E_2, G_1, G_2)

FIG. 17 INSIDE MICROMETER, CALIPER TYPE

inspects the pitch diameter of the internal thread. It is shown in Fig. 14, sketch (a). Special fixturing and ball probes may be required when using a three-axis coordinate measuring machine for internal measurement of pitch diameter. See Appendices B9 and B10 for more information on thread-measuring balls.

4.16 Optical Comparator and Toolmaker's Microscope (Table 2 — Gage 9)

4.16.1 Purpose and Use. The optical comparator magnifies and projects the thread profile on a screen. Internal threads are checked using cast replicas. For best profile image, the threaded item is positioned so that the light is aligned with the thread lead angle. Since the thread profile is defined in a plane containing the axis, a correction factor must be added to the measured flank angle observed normal to the lead angle. For most standard single lead threads, the correction factor is less than 0 deg., 5 min. See A2.6.1.

Optical comparators are generally fitted with lenses providing various magnifications between 10X and 100X. Profile dimensions are checked using appropriate linear and angular scales on the machine and by application of thread profile, radius, and other overlay charts. Flank angles, thread crest and root flats, root radius, other groove and ridge di-

mensions, and axial plane pitch and lead may be checked. Major, minor, and pitch diameters are identified, then measured using table traverse readouts.

4.16.2 The toolmaker's microscope is similar in function to the optical comparator but does not include screen projection or overlay charts. Magnifications are generally lower than those of optical comparators. Profile reticules are used in place of charts.

4.17 Profile Tracing Instrument (Table 2 — Gage 10)

4.17.1 Purpose and Use. The instrument inspects thread contour to an accuracy of 0.005 mm for 25 mm of horizontal and 2.5 mm of vertical travel at 100X magnification.

The tracing on the chart paper may be analyzed for elements of the thread profile, including depth, crest width, lead, angle, and radius at root of thread.

The instrument is generally able to check internal threads of 4.5 mm and larger at magnifications from 5X to 100X.

4.18 Surface Roughness Equipment (Table 2 — Gage 14)

4.18.1 Purpose and Use. Measurement of surface roughness on screw thread flanks is usually made with an instrument which traverses a radiused stylus across the lay. The stylus displacement due to the surface irregularities is electronically amplified and the meter reading displays the arithmetical average roughness height in micrometers (see ANSI B46.1, Surface Texture: Surface Roughness, Waviness, and Lay). Some instruments produce a chart of the traced path which shows the peak-to-valley heights of the surface irregularities. Special fixturing is required to position and guide stylus over thread surface.

4.19 Roundness Equipment (Table 2 — Gage 15)

4.19.1 Purpose and Use. There are two types of precision roundness measuring instruments: precision rotary tables and precision spindles. A special stylus coupled to an electric unit records the out-of-roundness on a circular chart as it traces around the internal cylindrical surface of the workpiece. The instrument provides a series of magnifications for stylus displacement, a filtering system for isolating lobing from surface irregularities, various means for centering the amplified stylus trace on the polar chart, and a selection of rotating speeds. For details on measuring and for other methods for checking roundness, see ANSI B89.3.1, Measurement of Out-of-Roundness.

4.20 Miscellaneous Gages and Gaging Equipment

4.20.1 The description of internal gages in 4.1 through 4.19 is definitely not a complete catalog of the various types available for inspection purposes. The gages not described above may be used provided they adhere to the standard thread practice noted in this Standard (i.e., truncation, form of thread, tolerance, etc.) and have producer and consumer agreement.

5 TYPES OF GAGES FOR PRODUCT EXTERNAL THREAD

5.1 GO Working Thread Ring Gages (Table 1 — Gage 1.1)

5.1.1 Purpose and Use. The GO thread ring gage inspects the maximum-material GO functional limit, A_1, of product external thread. The GO thread ring gage when properly set to its respective calibrated thread-setting plug represents the maximum-material GO functional limit of the product external thread, and its purpose is to assure interchangeable assembly of maximum-material mating parts.

Adjustable GO thread ring gages must be set to the applicable W (see Table 5, Note 2) tolerance-setting plugs. The product thread must freely enter the GO thread ring gage for the entire length of the threaded portion. The GO thread ring gage is a cumulative check of all thread elements except the major diameter.

5.1.2 Basic Design. The maximum-material limit or GO thread ring gage is made to the prescribed maximum-material limit of the product thread, and the gaging length is equal to the thickness of the thread ring gage.

5.1.3 Gage Blanks. For practical and economic reasons, the designs and thicknesses of thread ring

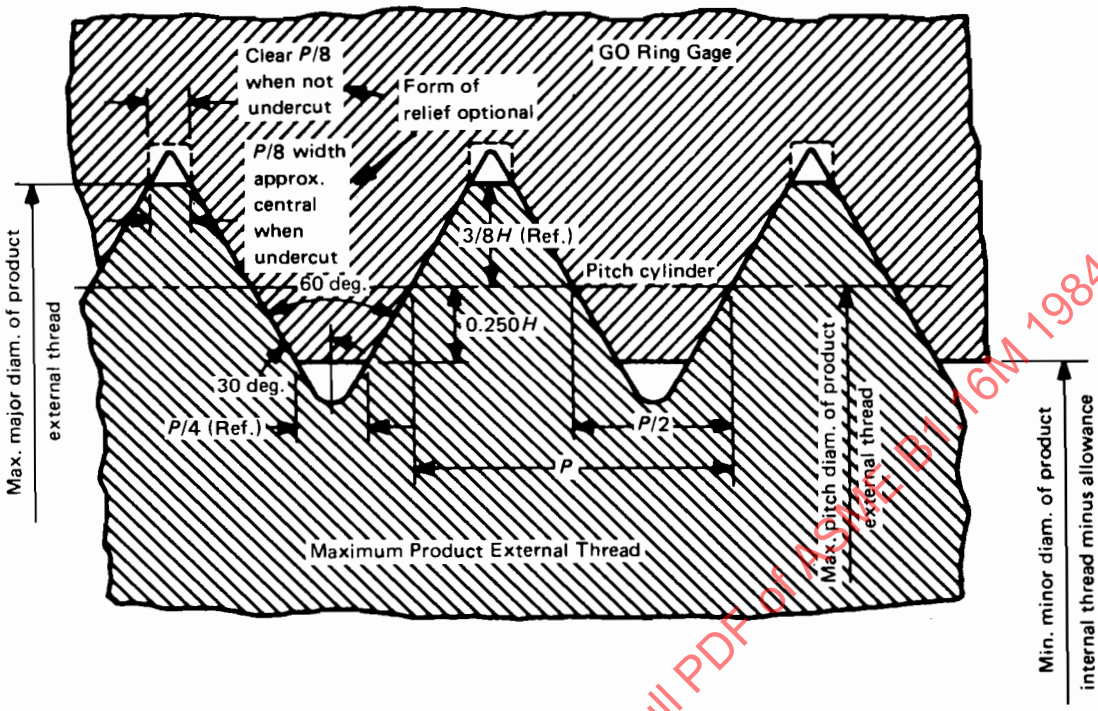


FIG. 18 MAXIMUM-MATERIAL GO FUNCTIONAL LIMIT

gages have been standardized for various size ranges and pitches (see ANSI/ASME B47.1aM or Table C2).

5.1.4 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 18.

5.1.5 Thread Crests. The minor diameter of the GO thread ring gage shall be equal to the maximum pitch diameter of the product external thread minus $H/2$ with a minus gage tolerance. This corresponds to a width of flat of $P/4$. The thread crests shall be flat in an axial section and parallel to the axis.

5.1.6 Thread Roots. The major diameter of the GO thread ring gage shall be cleared beyond $P/8$ width of flat by either an extension of the flanks toward a sharp vee or by a clearance cut of substantially $P/8$ width and approximately central. The root clearance must be such that the maximum major diameter of the full-form section of the truncated thread-setting plug gage is cleared after the gage has been properly set to size.

5.1.7 Runout of Pitch and Minor Cylinders. On thread ring gages, an eccentric condition results in an undersize effective minor diameter, having a width of flat less than $P/4$, which may encroach on the maximum permissible limit for the root profile of the product external thread. The permissible minimum effective minor diameter as determined by measurements of runout (full-indicator movement) with respect to the pitch cylinder shall not be less than the specified minimum minor diameter minus the sum of the gage tolerances for the pitch and minor diameters.

5.1.8 Pitch Cylinder. Pitch cylinder is transferred by the setting of the thread ring gage to the applicable truncated setting plug gage.

5.1.9 Lead and Half-Angle Variations. Lead and half-angle variations shall be within the limits specified in Table 6. Misalignment of the threads on each side of the adjustable slot may not exceed the lead limits.

5.1.10 Incomplete Thread. The feather edge at both ends of the thread ring gage shall be removed. On gages larger than M12 or with a pitch coarser than 1.25 mm, remove not more than one pitch of the partially formed thread at each end to obtain a full-thread blunt start. On gages M12 and smaller or with a pitch of 1.25 mm or finer, the end threads may have a 60 deg. chamfer from the axis of the gage to a depth of half to one pitch. This is acceptable in lieu of the blunt start.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M1.6 × 0.35	6g	1.354 1.349	1.202 1.194	1.291 1.296	1.221 1.229	1.581 1.578	1.496 1.499	1.600 1.608	1.373 1.378	1.528 1.520	1.458 1.453	1.221 1.224	1.321 1.318	6H
M2 × 0.4	6g	1.721 1.716	1.548 1.538	1.654 1.659	1.574 1.584	1.981 1.978	1.886 1.889	2.000 2.010	1.740 1.745	1.910 1.900	1.830 1.825	1.567 1.570	1.679 1.676	6H
M2.5 × 0.45	6g	2.188 2.183	1.993 1.983	2.117 2.122	2.027 2.037	2.480 2.477	2.380 2.383	2.500 2.510	2.208 2.213	2.393 2.383	2.303 2.298	2.013 2.016	2.138 2.135	6H
M3 × 0.5	6g	2.655 2.650	2.438 2.428	2.580 2.585	2.480 2.490	2.980 2.977	2.874 2.877	3.000 3.010	2.675 2.680	2.875 2.865	2.775 2.770	2.459 2.462	2.599 2.596	6H
M3.5 × 0.6	6g	3.089 3.084	2.829 2.819	3.004 3.009	2.884 2.894	3.479 3.476	3.354 3.357	3.500 3.510	3.110 3.115	3.342 3.332	3.222 3.217	2.850 2.853	3.010 3.007	6H
M4 × 0.7	6g	3.523 3.518	3.220 3.210	3.433 3.438	3.293 3.303	3.978 3.975	3.838 3.841	4.000 4.010	3.545 3.550	3.803 3.793	3.663 3.658	3.242 3.245	3.422 3.419	6H
M5 × 0.8	6g	4.456 4.448	4.110 4.097	4.361 4.369	4.201 4.214	4.976 4.973	4.826 4.829	5.000 5.013	4.480 4.488	4.765 4.752	4.605 4.597	4.134 4.137	4.334 4.331	6H
M6 × 1	6g	5.324 5.316	4.891 4.878	5.212 5.220	5.012 5.025	5.974 5.971	5.794 5.797	6.000 6.013	5.350 5.358	5.700 5.687	5.500 5.492	4.917 4.920	5.153 5.150	6H
M8 × 1.25	6g	7.160 7.152	6.619 6.606	7.042 7.050	6.792 6.805	7.972 7.969	7.760 7.763	8.000 8.013	7.188 7.196	7.598 7.585	7.348 7.340	6.647 6.650	6.912 6.909	6H
M8 × 1	6g	7.324 7.316	6.891 6.878	7.212 7.220	7.012 7.025	7.974 7.971	7.794 7.797	8.000 8.013	7.350 7.358	7.700 7.687	7.500 7.492	6.917 6.920	7.153 7.150	6H
M10 × 1.5	6g	8.994 8.986	8.344 8.329	8.862 8.870	8.562 8.577	9.968 9.965	9.732 9.735	10.000 10.015	9.026 9.034	9.506 9.491	9.206 9.198	8.376 8.379	8.676 8.673	6H
M10 × 1.25	6g	9.160 9.152	8.619 8.606	9.042 9.050	8.792 8.805	9.972 9.969	9.760 9.763	10.000 10.013	9.188 9.196	9.598 9.585	9.348 9.340	8.647 8.650	8.912 8.909	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M10 × 0.75	6g	9.491 9.486	9.166 9.156	9.391 9.396	9.241 9.251	9.978 9.975	9.838 9.841	10.000 10.010	9.513 9.518	9.795 9.785	9.645 9.640	9.188 9.191	9.378 9.375	6H
M12 × 1.75	6g	10.829 10.821	10.071 10.056	10.679 10.687	10.329 10.344	11.966 11.963	11.701 11.704	12.000 12.015	10.863 10.871	11.413 11.398	11.063 11.055	10.106 10.109	10.441 10.438	6H
M12 × 1.5	6g	10.994 10.986	10.344 10.329	10.854 10.862	10.554 10.569	11.968 11.965	11.732 11.735	12.000 12.015	11.026 11.034	11.516 11.501	11.216 11.208	10.917 10.920	11.153 11.150	6H
M12 × 1.25	6g	11.160 11.152	10.619 10.606	11.028 11.036	10.778 10.791	11.972 11.969	11.760 11.763	12.000 12.013	11.188 11.196	11.618 11.605	11.368 11.360	10.647 10.650	10.912 10.909	6H
M12 × 1 (Note 1)	6g	11.324 11.316	10.891 10.878	11.206 11.214	11.006 11.019	11.974 11.971	11.794 11.797	12.000 12.013	11.350 11.358	11.710 11.697	11.510 11.502	10.917 10.920	11.153 11.150	6H
M14 × 2	6g	12.663 12.655	11.797 11.782	12.503 12.511	12.103 12.118	13.962 13.959	13.682 13.685	14.000 14.015	12.701 12.709	13.313 13.298	12.913 12.905	11.835 11.838	12.210 12.207	6H
M14 × 1.5	6g	12.994 12.986	12.344 12.329	12.854 12.862	12.554 12.569	13.968 13.965	13.732 13.735	14.000 14.015	13.026 13.034	13.516 13.501	13.216 13.208	12.376 12.379	12.676 12.673	6H
M15 × 1	6g	14.324 14.316	13.891 13.878	14.206 14.214	14.006 14.019	14.974 14.971	14.794 14.797	15.000 15.013	14.350 14.358	14.710 14.697	14.510 14.502	13.917 13.920	14.153 14.150	6H
M16 × 2	6g	14.663 14.655	13.797 13.782	14.503 14.511	14.103 14.118	15.962 15.959	15.682 15.685	16.000 16.015	14.701 14.709	15.313 15.298	14.913 14.905	13.835 13.838	14.210 14.207	6H
M16 × 1.5	6g	14.994 14.986	14.344 14.329	14.854 14.862	14.554 14.569	15.968 15.965	15.732 15.735	16.000 16.015	15.026 15.034	15.516 15.501	15.216 15.208	14.376 14.379	14.676 14.673	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H M PROFILE SCREW THREADS—LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M17 × 1	6g	16.324 16.316	15.891 15.878	16.206 16.214	16.006 16.019	16.974 16.971	16.794 16.797	17.000 17.013	16.350 16.358	16.710 16.697	16.510 16.502	15.917 15.920	16.153 16.150	6H
M18 × 1.5	6g	16.994 16.986	16.344 16.329	16.854 16.862	16.554 16.569	17.968 17.965	17.732 17.735	18.000 18.015	17.026 17.034	17.516 17.501	17.216 17.208	16.376 16.379	16.676 16.673	6H
M20 × 2.5	6g	18.334 18.326	17.251 17.236	18.164 18.172	17.664 17.679	19.958 19.955	19.623 19.626	20.000 20.015	16.376 16.384	19.100 19.085	18.600 18.592	17.294 17.297	17.744 17.741	6H
M20 × 1.5	6g	18.994 18.986	18.344 18.329	18.854 18.862	18.554 18.569	19.968 19.965	19.732 19.735	20.000 20.015	19.026 19.034	19.516 19.501	19.216 19.208	18.376 18.379	18.676 18.673	6H
M20 × 1	6g	19.324 19.316	18.891 18.878	19.206 19.214	19.006 19.019	19.974 19.971	19.794 19.797	20.000 20.013	19.350 19.358	19.710 19.697	19.510 19.502	18.917 18.920	19.153 19.150	6H
M22 × 2.5	6g	20.334 20.326	19.251 19.236	20.164 20.172	19.664 19.679	21.958 21.955	21.623 21.626	22.000 22.015	20.376 20.384	21.100 21.085	20.600 20.592	19.294 19.297	19.744 19.741	6H
M22 × 1.5	6g	20.994 20.986	20.344 20.329	20.854 20.862	20.554 20.569	21.968 21.965	21.732 21.735	22.000 22.015	21.026 21.034	21.516 21.501	21.216 21.208	20.376 20.379	20.676 20.673	6H
M24 × 3	6g	22.003 21.993	20.704 20.686	21.803 21.813	21.203 21.221	23.952 23.949	23.577 23.580	24.000 24.018	22.051 22.061	22.916 22.898	22.316 22.306	20.752 20.755	21.252 21.249	6H
M24 × 2	6g	22.663 22.655	21.797 21.782	22.493 22.501	22.093 22.108	23.962 23.959	23.682 23.685	24.000 24.015	22.701 22.709	23.325 23.310	22.925 22.917	21.835 21.838	22.210 22.207	6H
M25 × 1.5	6g	23.994 23.986	23.344 23.329	23.844 23.852	23.544 23.559	24.968 24.965	24.732 24.735	25.000 25.015	24.026 24.034	24.526 24.511	24.226 24.218	23.376 23.379	23.676 23.673	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M27 × 3	6g	25.003 24.993	23.704 23.686	24.803 24.813	24.203 24.221	26.952 26.949	26.577 26.580	27.000 27.018	25.051 25.061	25.916 25.898	25.316 25.306	23.752 23.755	24.252 24.249	6H
M27 × 2	6g	25.663 25.655	24.797 24.782	25.493 25.501	25.093 25.108	26.962 26.959	26.682 26.685	27.000 27.015	25.701 25.709	26.325 26.310	25.925 25.917	24.835 24.838	25.210 25.207	6H
M30 × 3.5	6g	27.674 27.664	26.158 26.140	27.462 27.472	26.762 26.780	29.947 29.944	29.522 29.525	30.000 30.018	27.727 27.737	28.707 28.689	28.007 27.997	26.211 26.214	26.771 26.768	6H
M30 × 2	6g	28.663 28.655	27.797 27.782	28.493 28.501	28.093 28.108	29.962 29.959	29.682 29.685	30.000 30.015	28.701 28.709	29.325 29.310	28.925 28.917	27.835 27.838	28.210 28.207	6H
M30 × 1.5	6g	28.994 28.986	28.344 28.329	28.844 28.852	28.544 28.559	29.968 29.965	29.732 29.735	30.000 30.015	29.026 29.034	29.526 29.511	29.226 29.218	28.376 28.379	28.676 28.673	6H
M33 × 2	6g	31.663 31.655	30.797 30.782	31.493 31.501	31.093 31.108	32.962 32.959	32.682 32.685	33.000 33.015	31.701 31.709	32.325 32.310	31.925 31.917	30.835 30.838	31.210 31.207	6H
M35 × 1.5	6g	33.994 33.986	33.344 33.329	33.844 33.852	33.544 33.559	34.968 34.965	34.732 34.735	35.000 35.015	34.026 34.034	34.526 34.511	34.226 34.218	33.376 33.379	33.676 33.673	6H
M36 × 4	6g	33.342 33.332	31.610 31.592	33.118 33.128	32.318 32.336	35.940 35.937	35.465 35.468	36.000 36.018	33.402 33.412	34.502 34.484	33.702 33.692	31.670 31.673	32.270 32.267	6H
M36 × 2	6g	34.663 34.655	33.797 33.782	34.493 34.501	34.093 34.108	35.962 35.959	35.682 35.685	36.000 36.015	34.701 34.709	35.325 35.310	34.925 34.917	33.835 33.838	34.210 34.207	6H
M39 × 2	6g	37.663 37.655	36.797 36.782	37.493 37.501	37.093 37.108	38.962 38.958	38.682 38.686	39.000 39.015	37.701 37.709	38.325 38.310	37.925 37.917	36.835 36.838	37.210 37.207	6H
M40 × 1.5	6g	38.994 38.984	38.344 38.329	38.844 38.854	38.544 38.559	39.968 39.964	39.732 39.736	40.000 40.015	39.026 39.036	39.526 39.511	39.226 39.216	38.376 38.380	38.676 38.672	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M42 × 4.5	6g	39.014 39.001	37.065 37.045	38.778 38.791	37.878 37.898	41.937 41.933	41.437 41.441	42.000 42.020	39.077 39.090	40.292 40.272	39.392 39.379	37.129 37.133	37.799 37.795	6H
M42 × 2	6g	40.663 40.653	39.797 39.782	40.493 40.503	40.093 40.108	41.962 41.958	41.682 41.686	42.000 42.015	40.701 40.711	41.325 41.310	40.925 40.915	39.835 39.839	40.210 40.206	6H
M45 × 1.5	6g	43.994 43.984	43.344 43.329	43.844 43.854	43.544 43.559	44.968 44.964	44.732 44.736	45.000 45.015	44.026 44.036	44.526 44.511	44.226 44.216	43.376 43.380	43.676 43.672	6H
M48 × 5	6g	44.681 44.668	42.516 42.496	44.431 44.444	43.431 43.451	47.929 47.925	47.399 47.403	48.000 48.020	44.752 44.765	46.087 46.067	45.087 45.074	42.587 42.591	43.297 43.293	6H
M48 × 2	6g	46.663 46.653	45.797 45.782	46.483 46.493	46.083 46.098	47.962 47.958	47.682 47.686	48.000 48.015	46.701 46.711	47.337 47.322	46.937 46.927	45.835 45.839	46.210 46.206	6H
M50 × 1.5	6g	48.994 48.984	48.344 48.329	48.834 48.844	48.534 48.549	49.968 49.964	49.732 49.736	50.000 50.015	49.026 49.036	49.538 49.523	49.238 49.228	48.376 48.380	48.676 48.672	6H
M55 × 1.5	6g	53.994 53.984	53.344 53.329	53.834 53.844	53.534 53.549	54.968 54.964	54.732 54.736	55.000 55.015	54.026 54.036	54.538 54.523	54.238 54.228	53.376 53.380	53.676 53.672	6H
M56 × 5.5	6g	52.353 52.340	49.970 49.950	52.088 52.101	50.988 51.008	55.925 55.921	55.365 55.369	56.000 56.020	52.428 52.441	53.883 53.863	52.783 52.770	50.046 50.050	50.796 50.792	6H
M56 × 2	6g	54.663 54.653	53.797 53.782	54.483 54.493	54.083 54.098	55.962 55.958	55.682 55.686	56.000 56.015	54.701 54.711	55.337 55.322	54.937 54.927	53.835 53.839	54.210 54.206	6H
M60 × 1.5	6g	58.994 58.984	58.344 58.329	58.834 58.844	58.534 58.549	59.968 59.964	59.732 59.736	60.000 60.015	59.026 59.036	59.538 59.523	59.238 59.228	58.376 58.380	58.676 58.672	6H
M64 × 6	6g	60.023 60.010	57.425 57.402	59.743 59.756	58.543 58.566	63.920 63.916	63.320 63.324	64.000 64.023	60.103 60.116	61.678 61.655	60.478 60.465	57.505 57.509	58.305 58.301	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M64 × 2	6g	62.663 62.653	61.797 61.782	62.483 62.493	62.083 62.098	63.962 63.958	63.682 63.686	64.000 64.015	62.701 62.711	63.337 63.322	62.937 62.927	61.835 61.839	62.210 62.206	6H
M65 × 1.5	6g	63.994 63.984	63.344 63.329	63.834 63.844	63.534 63.549	64.968 64.963	64.732 64.737	65.000 65.015	64.026 64.036	64.538 64.523	64.238 64.228	63.376 63.380	63.676 63.672	6H
M70 × 1.5	6g	68.994 68.984	68.344 68.329	68.834 68.844	68.534 68.549	69.968 69.963	69.732 69.737	70.000 70.015	69.026 69.036	69.538 69.523	69.238 69.228	68.376 68.381	68.676 68.671	6H
M72 × 6	6g	68.023 68.010	65.425 65.402	67.743 67.756	66.543 66.566	71.920 71.915	71.320 71.325	72.000 72.023	68.103 68.116	69.678 69.655	68.478 68.465	65.505 65.510	66.305 66.300	6H
M72 × 2	6g	70.663 70.653	69.797 69.782	70.483 70.493	70.083 70.098	71.962 71.957	71.682 71.687	72.000 72.015	70.701 70.711	71.337 71.322	70.937 70.927	69.835 69.840	70.210 70.205	6H
M75 × 1.5	6g	73.994 73.984	73.344 73.329	73.834 73.844	73.534 73.549	74.968 74.963	74.732 74.737	75.000 75.015	74.026 74.036	74.538 74.523	74.238 74.228	73.376 73.381	73.676 73.671	6H
M80 × 6	6g	76.023 76.010	73.425 73.402	75.743 75.756	74.543 74.566	79.920 79.915	79.320 79.325	80.000 80.023	76.103 76.116	77.678 77.655	76.478 76.465	73.505 73.510	74.305 74.300	6H
M80 × 2	6g	78.663 78.653	77.797 77.782	78.483 78.493	78.083 78.098	79.962 79.957	79.682 79.687	80.000 80.015	78.701 78.711	79.337 79.322	78.937 78.927	77.835 77.840	78.210 78.205	6H
M80 × 1.5	6g	78.994 78.984	78.344 78.329	78,834 78.844	78.534 78.549	79.968 79.963	79.732 79.737	80.000 80.015	79.026 79.036	79.538 79.523	79.238 79.228	78.376 78.381	78.676 78.671	6H
M85 × 2	6g	83.663 83.653	82.797 82.782	83.483 83.493	83.083 83.098	84.962 84.957	84.682 84.687	85.000 85.015	83.701 83.711	84.337 84.322	83.937 83.927	82.835 82.840	83.210 83.205	6H
M90 × 6	6g	86.023 86.010	83.425 83.402	85.743 85.756	84.543 84.566	89.920 89.915	89.320 89.325	90.000 90.023	86.103 86.116	87.678 87.655	86.478 86.465	83.505 83.510	84.305 84.300	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M90 × 2	6g	88.663 88.653	87.797 87.782	88.483 88.493	88.083 88.098	89.962 89.957	89.682 89.687	90.000 90.015	88.701 88.711	89.337 89.322	88.937 88.927	87.835 87.840	88.210 88.205	6H
M95 × 2	6g	93.663 93.653	92.797 92.782	93.473 93.483	93.073 93.088	94.962 94.957	94.682 94.687	95.000 95.015	93.701 93.711	94.351 94.336	93.951 93.941	92.835 92.840	93.210 93.205	6H
M100 × 6	6g	96.023 96.010	93.425 93.402	95.723 95.736	94.523 94.546	99.920 99.915	99.320 99.325	100.000 100.023	96.103 96.116	97.703 97.680	96.503 96.490	93.505 93.510	94.305 94.300	6H
M100 × 2	6g	98.663 98.653	97.797 97.782	98.473 98.483	98.073 98.088	99.962 99.957	99.682 99.687	100.000 100.015	98.701 98.711	99.351 99.336	98.951 98.941	97.835 97.840	98.210 98.205	6H
M105 × 2	6g	103.663 103.648	102.797 102.774	103.473 103.488	103.073 103.096	104.962 104.957	104.682 104.687	105.000 105.023	103.701 103.716	104.351 104.328	103.951 103.936	102.835 102.840	103.210 103.205	6H
M110 × 2	6g	108.663 108.648	107.797 107.774	108.473 108.488	108.073 108.096	109.962 109.957	109.682 109.687	110.000 110.023	108.701 108.716	109.351 109.328	108.951 108.936	107.835 107.840	108.210 108.205	6H
M120 × 2	6g	118.663 118.648	117.797 117.774	118.473 118.488	118.073 118.096	119.962 119.956	119.682 119.688	120.000 120.023	118.701 118.716	119.351 119.328	118.951 118.936	117.835 117.841	118.210 118.204	6H
M130 × 2	6g	128.663 128.648	127.797 127.774	128.473 128.488	128.073 128.096	129.962 129.956	129.682 129.688	130.000 130.023	128.701 128.716	129.351 129.328	128.951 128.936	127.835 127.841	128.210 128.204	6H
M140 × 2	6g	138.663 138.648	137.797 137.774	138.473 138.488	138.073 138.096	139.962 139.956	139.682 139.688	140.000 140.023	138.701 138.716	139.351 139.328	138.951 138.936	137.835 137.841	138.210 138.204	6H

See Notes at end of table.

TABLE 10 GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M150 × 2	6g	148.663 148.648	147.797 147.774	148.473 148.488	148.073 148.096	149.962 149.956	149.682 149.688	150.000 150.023	148.701 148.716	149.351 149.328	148.951 148.936	147.835 147.841	148.210 148.204	6H
M160 × 3	6g	158.003 157.988	156.704 156.676	157.779 157.794	157.179 157.207	159.952 159.946	159.577 159.583	160.000 160.028	158.051 158.066	158.951 158.923	158.351 158.336	156.752 156.758	157.252 157.246	6H
M170 × 3	6g	168.003 167.988	166.704 166.676	167.779 167.794	167.179 167.207	169.952 169.944	169.577 169.585	170.000 170.028	168.051 168.066	168.951 168.923	168.351 168.336	166.752 166.760	167.252 167.244	6H
M180 × 3	6g	178.003 177.988	176.704 176.676	177.779 177.794	177.179 177.207	179.952 179.944	179.577 179.585	180.000 180.028	178.051 178.066	178.951 178.923	178.351 178.336	176.752 176.760	177.252 177.244	6H
M190 × 3	6g	188.003 187.988	186.704 186.676	187.753 187.768	187.153 187.181	189.952 189.944	189.577 189.585	190.000 190.028	188.051 188.066	188.986 188.958	188.386 188.371	186.752 186.760	187.252 187.244	6H
M200 × 3	6g	198.003 197.988	196.704 196.676	197.753 197.768	197.153 197.181	199.952 199.944	199.577 199.585	200.000 200.028	198.051 198.066	198.986 198.958	198.386 198.371	196.752 196.760	197.252 197.244	6H

GENERAL NOTE: All GO gages for external threads are the same as 4g6g sizes.

NOTE:
(1) M14 × 1.25 — special thread for spark plugs only. See applicable document for thread tolerance class and limiting dimensions.

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g and 6H M PROFILE SCREW THREADS — LIMITS OF SIZE

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M1.6 × 0.35	6g	1.424 1.416	1.581 1.589	1.354 1.351	1.361 1.353	1.542 1.550	1.291 1.294	... ...	... ...	... ...	... ...	... ...
M2 × 0.4	6g	1.801 1.793	1.981 1.989	1.721 1.718	1.734 1.726	1.949 1.957	1.654 1.657	... ...	... ...	... ...	... ...	... ...
M2.5 × 0.45	6g	2.278 2.270	2.480 2.488	2.188 2.185	2.207 2.199	2.454 2.462	2.117 2.120	... ...	... ...	... ...	... ...	... ...
M3 × 0.5	6g	2.755 2.747	2.980 2.988	2.655 2.652	2.680 2.672	2.961 2.969	2.580 2.583	...	...	...	...	...
M3.5 × 0.6	6g	3.209 3.201	3.479 3.487	3.089 3.086	3.124 3.116	3.472 3.480	3.004 3.007	... ...	... ...	... ...	... ...	... ...
M4 × 0.7	6g	3.663 3.655	3.978 3.986	3.523 3.520	3.573 3.565	3.978 3.986	3.433 3.436	... ...	... ...	... ...	... ...	... ...
M5 × 0.8	6g	4.616 4.608	4.976 4.984	4.456 4.453	4.521 4.513	4.976 4.984	4.361 4.364	4.480 4.483	4.134 4.126	4.605 4.602	4.334 4.329	6H
M6 × 1	6g	5.524 5.511	5.974 5.987	5.324 5.321	5.412 5.399	5.974 5.987	5.212 5.215	5.350 5.353	4.917 4.904	5.500 5.497	5.153 5.140	6H
M8 × 1.25	6g	7.410 7.397	7.972 7.985	7.160 7.157	7.292 7.279	7.972 7.985	7.042 7.045	7.188 7.191	6.647 6.634	7.348 7.345	6.912 6.899	6H
M8 × 1	6g	7.524 7.511	7.974 7.987	7.324 7.321	7.412 7.399	7.974 7.987	7.212 7.215	7.350 7.353	6.917 6.904	7.500 7.497	7.153 7.140	6H
M10 × 1.5	6g	9.294 9.281	9.968 9.981	8.994 8.991	9.162 9.149	9.968 9.981	8.862 8.865	9.026 9.029	8.376 8.363	9.206 9.203	8.676 8.663	6H
M10 × 1.25	6g	9.410 9.397	9.972 9.985	9.160 9.157	9.292 9.279	9.972 9.985	9.042 9.045	9.188 9.191	8.647 8.634	9.348 9.345	8.912 8.899	6H

See Notes at end of table.

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g and 6H
M PROFILE SCREW THREADS—LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M10 × 0.75	6g	9.641 9.633	9.978 9.986	9.491 9.488	9.541 9.533	9.978 9.986	9.391 9.394	9.513 9.516	9.188 9.180	9.645 9.642	9.378 9.370	6H
M12 × 1.75	6g	11.179 11.164	11.966 11.981	10.829 10.826	11.029 11.014	11.966 11.981	10.679 10.682	10.863 10.866	10.106 10.091	11.063 11.060	10.441 10.426	6H
M12 × 1.5	6g	11.294 11.281	11.968 11.981	10.994 10.991	11.154 11.141	11.968 11.981	10.854 10.857	11.026 11.029	10.376 10.363	11.216 11.213	11.676 11.663	6H
M12 × 1.25	6g	11.410 11.397	11.972 11.985	11.160 11.157	11.278 11.265	11.972 11.985	11.028 11.031	11.188 11.191	10.647 10.634	11.368 11.365	10.912 10.899	6H
M12 × 1 (Note 1)	6g	11.524 11.511	11.974 11.987	11.324 11.321	11.406 11.393	11.974 11.987	11.206 11.209	11.350 11.353	10.917 10.904	11.510 11.507	11.153 11.140	6H
M14 × 2	6g	13.063 13.048	13.962 13.977	12.663 12.658	12.903 12.888	13.962 13.977	12.503 12.508	12.701 12.706	11.835 11.820	12.913 12.908	12.210 12.195	6H
M14 × 1.5	6g	13.294 13.281	13.968 13.981	12.994 12.990	13.154 13.141	13.968 13.981	12.854 12.858	13.026 13.030	12.376 12.363	13.216 13.212	12.676 12.663	6H
M15 × 1	6g	14.524 14.511	14.974 14.987	14.324 14.320	14.406 14.393	14.974 14.987	14.206 14.210	14.350 14.354	13.917 13.904	14.510 14.506	14.153 14.140	6H
M16 × 2	6g	15.063 15.048	15.962 15.977	14.663 14.658	14.903 14.888	15.962 15.977	14.503 14.508	14.701 14.706	13.835 13.820	14.913 14.908	14.210 14.195	6H
M16 × 1.5	6g	15.294 15.281	15.968 15.981	14.994 14.990	15.154 15.141	15.968 15.981	14.854 14.858	15.026 15.030	14.376 14.363	15.216 15.212	14.676 14.663	6H
M17 × 1	6g	16.524 16.511	16.974 16.987	16.324 16.320	16.406 16.393	16.974 16.987	16.206 16.210	16.350 16.354	15.917 15.904	16.510 16.506	16.153 16.140	6H
M18 × 1.5	6g	17.294 17.281	17.968 17.981	16.994 16.990	17.154 17.141	17.968 17.981	16.854 16.858	17.026 17.030	16.376 16.363	17.216 17.212	16.676 16.663	6H

See Notes at end of table.

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g and 6H M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M20 × 2.5	6g	18.834 18.819	19.958 19.973	18.334 18.329	18.664 18.649	19.958 19.973	18.164 18.169	18.376 18.381	17.294 17.279	18.600 18.595	17.744 17.729	6H
M20 × 1.5	6g	19.294 19.281	19.968 19.981	18.994 18.990	19.154 19.141	19.968 19.981	18.854 18.858	19.026 19.030	18.376 18.363	19.216 19.212	18.676 18.663	6H
M20 × 1	6g	19.524 19.511	19.974 19.987	19.324 19.320	19.406 19.393	19.974 19.987	19.206 19.210	19.350 19.354	18.917 18.904	19.510 19.506	19.153 19.140	6H
M22 × 2.5	6g	20.834 20.819	21.958 21.973	20.334 20.329	20.664 20.649	21.958 21.973	20.164 20.169	20.376 20.381	19.294 19.279	20.600 20.595	19.744 19.729	6H
M22 × 1.5	6g	21.294 21.281	21.968 21.981	20.994 20.990	21.154 21.141	21.968 21.981	20.854 20.858	21.026 21.030	20.376 20.363	21.216 21.212	20.676 20.663	6H
M24 × 3	6g	22.603 22.588	23.952 23.967	22.003 21.998	22.403 22.388	23.952 23.967	21.803 21.808	22.051 22.056	20.752 20.737	22.316 22.311	21.252 21.237	6H
M24 × 2	6g	23.063 23.048	23.962 23.977	22.663 22.658	22.893 22.878	23.962 23.977	22.493 22.498	22.701 22.706	21.835 21.820	22.925 22.920	22.210 22.195	6H
M25 × 1.5	6g	24.294 24.281	24.968 24.981	23.994 23.990	24.144 24.131	24.968 24.981	23.844 23.848	24.026 24.030	23.376 23.363	24.226 24.222	23.676 23.663	6H
M27 × 3	6g	25.603 25.588	26.952 26.967	25.003 24.998	25.403 25.388	26.952 26.967	24.803 24.808	25.051 25.056	23.752 23.737	25.316 25.311	24.252 24.237	6H
M27 × 2	6g	26.063 25.893	26.962 26.977	25.663 25.658	25.893 25.878	26.962 26.977	25.493 25.498	25.701 25.706	24.835 25.820	25.925 25.920	25.210 25.195	6H
M30 × 3.5	6g	28.374 28.356	29.947 29.965	27.674 27.669	28.162 28.144	29.947 29.965	27.462 27.467	27.727 27.732	26.211 26.193	28.007 28.002	26.771 26.753	6H
M30 × 2	6g	29.063 29.048	29.962 29.977	28.663 28.658	28.893 28.878	29.962 29.977	28.493 28.498	28.701 28.706	27.835 27.820	28.925 28.920	28.210 28.195	6H

See Notes at end of table.

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g and 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M30 × 1.5	6g	29.294 29.281	29.968 29.981	28.994 28.990	29.144 29.131	29.968 29.981	28.844 28.848	29.026 29.030	28.376 28.363	29.226 29.222	28.676 28.663	6H
M33 × 2	6g	32.063 32.048	32.962 32.977	31.663 31.658	31.893 31.878	32.962 32.977	31.493 31.498	31.701 31.706	30.835 30.820	31.925 31.920	31.210 31.195	6H
M35 × 1.5	6g	34.294 34.281	34.968 34.981	33.994 33.990	34.144 34.131	34.968 34.981	33.844 33.848	34.026 34.030	33.376 33.363	34.226 34.222	33.676 33.663	6H
M36 × 4	6g	34.142 34.124	35.940 35.958	33.342 33.337	33.918 33.900	35.940 35.958	33.118 33.123	33.402 33.407	31.670 31.652	33.702 33.697	32.270 32.252	6H
M36 × 2	6g	35.063 35.048	35.962 35.977	34.663 34.658	34.893 34.878	35.962 35.977	34.493 34.498	34.701 34.706	33.835 33.820	34.925 34.920	34.210 34.195	6H
M39 × 2	6g	38.063 38.048	38.962 38.977	37.663 37.658	37.893 37.878	38.962 38.977	37.493 37.498	37.701 37.706	36.835 36.820	37.925 37.920	37.210 37.195	6H
M40 × 1.5	6g	39.294 39.281	39.968 39.981	38.994 38.989	39.144 39.131	39.968 39.981	38.844 38.849	39.026 39.031	38.376 38.363	39.226 39.221	38.676 38.663	6H
M42 × 4.5	6g	39.914 39.894	41.937 41.957	39.014 39.008	39.678 39.658	41.937 41.957	38.778 38.784	39.077 39.083	37.129 37.109	39.392 39.386	37.799 37.779	6H
M42 × 2	6g	41.063 41.048	41.962 41.977	40.663 40.657	40.893 40.878	41.962 41.977	40.493 40.499	40.701 40.707	39.835 39.820	40.925 40.919	40.210 40.195	6H
M45 × 1.5	6g	44.294 44.281	44.968 44.981	43.994 43.989	44.144 44.131	44.968 44.981	43.844 43.849	44.026 44.031	43.376 43.363	44.226 44.221	43.676 43.663	6H
M48 × 5	6g	45.681 45.661	47.929 47.949	44.681 44.675	45.431 45.413	47.929 47.949	44.431 44.437	44.752 44.758	42.587 42.567	45.087 45.081	43.297 43.277	6H
M48 × 2	6g	47.063 47.048	47.962 47.977	46.663 46.657	46.883 46.868	47.962 47.977	46.483 46.489	46.701 46.707	45.835 45.820	46.937 46.931	46.210 46.195	6H

See Notes at end of table.

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g and 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M50 × 1.5	6g	49.294 49.281	49.968 49.981	48.994 48.989	49.134 49.121	49.968 49.981	48.834 48.839	49.026 49.031	48.376 48.363	49.238 49.233	48.676 48.663	6H
M55 × 1.5	6g	54.294 54.281	54.968 54.981	53.994 53.989	53.134 54.121	54.968 54.981	53.834 53.839	54.026 54.031	53.376 53.363	54.238 54.233	53.676 53.663	6H
M56 × 5.5	6g	53.452 53.432	55.925 55.945	52.353 52.347	53.188 53.168	55.925 55.945	52.088 52.094	52.428 52.434	50.046 50.026	52.783 52.777	50.796 50.776	6H
M56 × 2	6g	55.063 55.048	55.962 55.977	54.663 54.657	54.883 54.868	55.962 55.977	54.483 54.489	54.701 54.707	53.835 53.820	54.937 54.931	54.210 54.195	6H
M60 × 1.5	6g	59.294 59.281	59.968 59.981	58.994 58.989	59.134 59.121	55.968 55.981	58.834 58.839	59.026 59.031	58.376 58.363	59.238 59.233	58.676 58.663	6H
M64 × 6	6g	61.223 61.200	63.920 63.943	60.023 60.017	60.943 60.920	63.920 63.943	59.743 59.749	60.103 60.109	57.505 57.482	60.478 60.472	58.305 58.282	6H
M64 × 2	6g	63.063 63.048	63.962 63.977	62.663 62.657	62.883 62.868	63.962 63.977	62.483 62.489	62.701 62.707	61.835 61.820	62.937 62.931	62.210 62.195	6H
M65 × 1.5	6g	64.294 64.281	64.968 64.981	63.994 63.989	64.134 64.121	64.968 64.981	63.834 63.839	64.026 64.031	63.376 63.363	64.238 64.233	63.676 63.663	6H
M70 × 1.5	6g	69.294 69.281	69.968 69.981	68.994 68.989	69.134 69.121	69.968 69.981	68.834 68.839	69.026 69.031	68.376 68.363	69.238 69.233	68.676 68.663	6H
M72 × 6	6g	69.223 69.200	71.920 71.943	68.023 68.017	68.943 68.920	71.920 71.943	67.743 67.749	68.103 68.109	65.505 65.482	68.478 68.472	66.305 66.282	6H
M72 × 2	6g	71.063 71.048	71.962 71.977	70.663 70.657	70.883 70.868	71.962 71.977	70.483 70.489	70.701 70.707	69.835 69.820	70.937 70.931	70.210 70.195	6H
M75 × 1.5	6g	74.294 74.281	74.968 74.981	73.994 73.989	74.134 74.121	74.968 74.981	73.834 73.839	74.026 74.031	73.376 73.363	74.238 74.233	73.676 73.663	6H

See Notes at end of table.

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g and 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M80 × 6	6g	77.223 77.200	79.920 79.943	76.023 76.017	76.943 76.920	79.920 79.943	75.743 75.749	76.103 76.109	73.505 73.482	76.478 76.472	74.305 74.282	6H
M80 × 2	6g	79.063 79.048	79.962 79.977	78.663 78.657	78.883 78.868	79.962 79.977	78.483 78.489	78.701 78.707	77.835 77.820	78.937 78.931	78.210 78.195	6H
M80 × 1.5	6g	79.294 79.281	79.968 79.981	78.994 78.989	79.134 79.121	79.968 79.981	78.834 78.839	79.026 79.031	78.376 78.363	79.238 79.233	78.676 78.663	6H
M85 × 2	6g	84.063 84.048	84.962 84.977	83.663 83.657	83.883 83.868	84.962 84.977	83.483 83.489	83.701 83.707	82.835 82.820	83.937 83.931	83.210 83.195	6H
M90 × 6	6g	87.223 87.200	89.920 89.943	86.023 86.017	86.943 86.920	89.920 89.943	85.743 85.749	86.103 86.109	83.505 83.482	86.478 86.472	84.305 84.282	6H
M90 × 2	6g	89.063 89.048	89.962 89.977	88.663 88.657	88.883 88.868	89.962 89.977	88.483 88.489	88.701 88.707	87.835 87.820	88.937 88.931	88.210 88.195	6H
M95 × 2	6g	94.063 94.048	94.962 94.977	93.663 93.657	93.873 93.858	94.962 94.977	93.473 93.479	93.701 93.707	92.835 92.820	93.951 93.945	93.210 93.195	6H
M100 × 6	6g	97.223 97.200	99.920 99.943	96.023 96.017	96.923 96.900	99.920 99.943	95.723 95.729	96.103 96.109	93.505 93.482	96.503 96.497	94.305 94.282	6H
M100 × 2	6g	99.063 99.048	99.962 99.977	98.663 98.657	98.873 98.858	99.962 94.977	98.473 98.479	98.701 98.707	97.835 97.820	98.951 98.945	98.210 98.195	6H
M105 × 2	6g	104.063 104.040	104.962 104.985	103.663 103.655	103.873 103.850	104.962 104.985	103.473 103.481	103.701 103.709	102.835 102.812	103.951 103.943	103.210 103.187	6H
M110 × 2	6g	109.063 109.040	109.962 109.985	108.663 108.655	108.873 108.850	109.962 109.985	108.473 108.481	108.701 108.709	107.835 107.812	108.951 108.943	108.210 108.187	6H

TABLE 11 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 6g AND 6H M PROFILE SCREW THREADS—LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M120 × 2	6g	119.063 119.040	119.962 119.985	118.663 118.655	118.873 118.850	119.962 119.985	118.473 118.481	118.701 118.709	117.835 117.812	118.951 118.943	118.210 118.187	6H
M130 × 2	6g	129.063 129.040	129.962 129.985	128.663 128.655	128.873 128.850	129.962 129.985	128.473 128.481	128.701 128.709	127.835 127.812	128.951 128.943	128.210 128.187	6H
M140 × 2	6g	139.063 139.040	139.962 139.985	138.663 138.655	138.873 138.850	139.962 139.985	138.473 138.481	138.701 138.709	137.835 137.812	138.951 138.943	138.210 138.187	6H
M150 × 2	6g	149.063 149.040	149.962 149.985	148.663 148.655	148.873 148.850	149.962 149.985	148.473 148.481	148.701 148.709	147.835 147.812	148.951 148.943	148.210 148.187	6H
M160 × 3	6g	158.603 158.580	159.952 159.975	158.003 157.995	158.379 158.356	159.952 159.975	157.779 157.787	158.051 158.059	156.752 156.729	158.351 158.343	157.252 157.229	6H
M170 × 3	6g	168.603 168.580	169.952 169.975	168.003 167.995	168.379 168.356	169.952 169.975	167.779 167.787	168.051 168.059	166.752 166.729	168.351 168.343	167.252 167.229	6H
M180 × 3	6g	178.603 178.580	179.952 179.975	178.003 177.995	178.379 178.356	179.952 179.975	177.779 177.787	178.051 178.059	176.752 176.729	178.351 178.343	177.252 177.229	6H
M190 × 3	6g	188.603 188.580	189.952 189.975	188.003 187.995	188.353 188.330	189.952 189.975	187.753 187.761	188.051 188.059	186.752 186.729	188.386 188.378	187.252 187.229	6H
M200 × 3	6g	198.603 198.580	199.952 199.975	198.003 197.995	198.353 198.330	199.952 199.975	197.753 197.761	198.051 198.059	196.752 196.729	198.386 198.378	197.252 197.229	6H

GENERAL NOTE: All GO setting plug gages are the same as 4g6g sizes.

NOTE:
(1) M14 × 1.25 — special thread for spark plugs only. See applicable document for thread tolerance class and limiting dimensions.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M1.6 × 0.35	4g6g	1.354 1.349	1.202 1.194	1.314 1.319	1.244 1.252	1.581 1.578	1.496 1.499	1.600 1.608	1.373 1.378	1.528 1.520	1.458 1.453	1.221 1.224	1.321 1.318	6H
M2 × 0.4	4g6g	1.721 1.716	1.548 1.538	1.679 1.684	1.599 1.609	1.981 1.978	1.886 1.889	2.000 2.010	1.740 1.745	1.910 1.900	1.830 1.825	1.567 1.570	1.679 1.676	6H
M2.5 × 0.45	4g6g	2.188 2.183	1.993 1.983	2.143 2.148	2.053 2.063	2.480 2.477	2.380 2.383	2.500 2.510	2.208 2.213	2.393 2.383	2.303 2.298	2.013 2.016	2.138 2.135	6H
M3 × 0.5	4g6g	2.655 2.650	2.438 2.428	2.607 2.612	2.507 2.517	2.980 2.977	2.874 2.877	3.000 3.010	2.675 2.680	2.875 2.865	2.775 2.770	2.459 2.462	2.599 2.596	6H
M3.5 × 0.6	4g6g	3.089 3.084	2.829 2.819	3.036 3.041	2.916 2.926	3.479 3.476	3.354 3.357	3.500 3.510	3.110 3.115	3.342 3.332	3.222 3.217	2.850 2.853	3.010 3.007	6H
M4 × 0.7	4g6g	3.523 3.518	3.220 3.210	3.467 3.472	3.327 3.337	3.978 3.975	3.838 3.841	4.000 4.010	3.545 3.550	3.803 3.793	3.663 3.658	3.242 3.245	3.422 3.419	6H
M5 × 0.8	4g6g	4.456 4.448	4.110 4.097	4.396 4.404	4.236 4.249	4.976 4.973	4.826 4.829	5.000 5.013	4.480 4.488	4.765 4.752	4.605 4.597	4.134 4.137	4.334 4.331	6H
M6 × 1	4g6g	5.324 5.316	4.891 4.878	5.253 5.261	5.053 5.066	5.974 5.971	5.794 5.797	6.000 6.013	5.350 5.358	5.700 5.687	5.500 5.492	4.917 4.920	5.153 5.150	6H
M8 × 1.25	4g6g	7.160 7.152	6.619 6.606	7.085 7.093	6.835 6.848	7.972 7.969	7.760 7.763	8.000 8.013	7.188 7.196	7.598 7.585	7.348 7.340	6.647 6.650	6.912 6.909	6H
M8 × 1	4g6g	7.324 7.316	6.891 6.878	7.253 7.261	7.053 7.066	7.974 7.971	7.794 7.797	8.000 8.013	7.350 7.358	7.700 7.687	7.500 7.492	6.917 6.920	7.153 7.150	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M10 × 1.5	4g6g	8.994 8.986	8.344 8.329	8.909 8.917	8.609 8.624	9.968 9.965	9.732 9.735	10.000 10.015	9.026 9.034	9.506 9.491	9.206 9.198	8.376 8.379	8.676 8.673	6H
M10 × 1.25	4g6g	9.160 9.152	8.619 8.606	9.085 9.093	8.835 8.848	9.972 9.969	9.760 9.763	10.000 10.013	9.188 9.196	9.598 9.585	9.348 9.340	8.647 8.650	8.912 8.909	6H
M10 × 0.75	4g6g	9.491 9.486	9.166 9.156	9.428 9.433	9.278 9.268	9.978 9.975	9.838 9.841	10.000 10.010	9.513 9.518	9.795 9.785	9.645 9.640	9.188 9.191	9.378 9.375	6H
M12 × 1.75	4g6g	10.829 10.821	10.071 10.056	10.734 10.742	10.384 10.399	11.966 11.963	11.701 11.704	12.000 12.015	10.863 10.871	11.413 11.398	11.063 11.055	10.106 10.109	10.441 10.438	6H
M12 × 1.25	4g6g	11.160 11.152	10.619 10.606	11.075 11.083	10.725 10.738	11.972 11.969	11.760 11.763	12.000 12.013	11.188 11.196	11.618 11.605	11.368 11.360	10.647 10.650	10.912 10.909	6H
M12 × 1 (Note 1)	4g6g	11.324 11.316	10.891 10.878	11.249 11.257	11.049 11.062	11.974 11.971	11.794 11.797	12.000 12.013	11.350 11.358	11.710 11.697	11.510 11.502	10.917 10.920	11.153 11.150	6H
M14 × 2	4g6g	12.663 12.655	11.797 11.782	12.563 12.571	12.163 12.178	13.962 13.959	13.682 13.685	14.000 14.015	12.701 12.709	13.313 13.298	12.913 12.905	11.835 11.838	12.210 12.207	6H
M14 × 1.5	4g6g	12.994 12.986	12.344 12.329	12.904 12.912	12.604 12.619	13.968 13.965	13.732 13.735	14.000 14.015	13.026 13.034	13.516 13.501	13.216 13.208	12.376 12.379	12.676 12.673	6H
M15 × 1	4g6g	14.324 14.316	13.891 13.878	14.249 14.257	14.049 14.062	14.974 14.971	14.794 14.797	15.000 15.013	14.350 14.358	14.710 14.697	14.510 14.502	13.917 13.920	14.153 14.150	6H
M16 × 2	4g6g	14.663 14.655	13.797 13.782	14.563 14.571	14.163 14.178	15.962 15.959	15.682 15.685	16.000 16.015	14.701 14.709	15.313 15.298	14.913 14.905	13.835 13.838	14.210 14.207	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M16 × 1.5	4g6g	14.994 14.986	14.344 14.329	14.904 14.912	14.604 14.619	15.968 15.963	15.732 15.735	16.000 16.015	15.026 15.034	15.516 15.501	15.216 15.208	14.376 14.379	14.676 14.673	6H
M17 × 1	4g6g	16.324 16.316	15.891 15.878	16.249 16.257	16.049 16.062	16.974 16.971	16.794 16.797	17.000 17.013	16.350 16.358	16.710 16.697	16.510 16.502	15.917 15.920	16.153 16.150	6H
M18 × 1.5	4g6g	16.994 16.986	16.344 16.329	16.904 16.912	16.604 16.619	17.968 17.963	17.732 17.735	18.000 18.015	17.026 17.034	17.516 17.501	17.216 17.208	16.376 16.379	16.676 16.673	6H
M20 × 2.5	4g6g	18.334 18.326	17.251 17.236	18.228 18.236	17.728 17.743	19.958 19.955	19.623 19.626	20.000 20.015	16.376 16.384	19.100 19.085	18.600 18.592	17.294 17.297	17.744 17.741	6H
M20 × 1.5	4g6g	18.994 18.986	18.344 18.329	18.904 18.912	18.604 18.619	19.968 19.965	19.732 19.735	20.000 20.015	19.026 19.034	19.516 19.501	19.216 19.208	18.376 18.379	18.676 18.673	6H
M20 × 1	4g6g	19.324 19.316	18.891 18.878	19.249 19.257	19.049 19.062	19.974 19.971	19.794 19.797	20.000 20.013	19.350 19.358	19.710 19.697	19.510 19.502	18.917 18.920	19.153 19.150	6H
M22 × 1.5	4g6g	20.994 20.986	20.344 20.329	20.904 20.912	20.604 20.619	21.968 21.965	21.732 21.735	22.000 22.015	21.026 21.034	21.516 21.501	21.216 21.208	20.376 20.379	20.676 20.673	6H
M24 × 3	4g6g	22.003 21.993	20.704 20.686	21.878 21.888	21.278 21.296	23.952 23.949	23.577 23.580	24.000 24.018	22.051 22.061	22.916 22.898	22.316 22.306	20.752 20.755	21.252 21.249	6H
M24 × 2	4g6g	22.663 22.655	21.797 21.782	22.557 22.565	22.157 22.172	23.962 23.959	23.682 23.685	24.000 24.015	22.701 22.709	23.325 23.310	22.925 22.917	21.835 21.838	22.210 22.207	6H
M25 × 1.5	4g6g	23.994 23.986	23.344 23.329	23.899 23.907	23.599 23.614	24.968 24.965	24.732 24.735	25.000 25.015	24.026 24.034	24.526 24.511	24.226 24.218	23.376 23.379	23.676 23.673	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M27 × 2	4g6g	25.663 25.655	24.797 24.782	25.557 25.565	25.157 25.172	26.962 29.959	26.682 26.685	27.000 27.015	25.701 25.709	26.325 26.310	25.925 25.917	24.835 24.838	25.210 25.207	6H
M30 × 3.5	4g6g	27.674 27.664	26.158 26.140	27.542 27.552	26.842 26.860	29.947 29.944	29.522 29.525	30.000 30.018	27.727 27.737	28.707 28.689	28.007 27.997	26.211 26.214	26.771 26.768	6H
M30 × 2	4g6g	28.663 28.655	27.797 27.782	28.557 28.565	28.157 28.172	29.962 29.959	29.682 29.685	30.000 30.015	28.701 28.709	29.325 29.310	28.925 28.917	27.835 27.838	28.210 28.207	6H
M30 × 1.5	4g6g	28.994 28.986	28.344 28.329	28.899 28.907	28.599 28.614	29.968 29.965	29.732 29.735	30.000 30.015	29.026 29.034	29.526 29.511	29.226 29.218	28.376 28.379	28.676 28.673	6H
M33 × 2	4g6g	31.663 31.655	30.797 30.782	31.557 31.565	31.157 31.172	32.962 32.959	32.682 32.685	33.000 33.015	31.701 31.709	32.325 32.310	31.925 31.917	30.835 30.838	31.210 31.207	6H
M36 × 4	4g6g	33.342 33.332	31.610 31.592	33.202 33.212	32.402 32.420	35.940 35.937	35.465 35.468	36.000 36.018	33.402 33.412	34.502 34.484	33.702 33.692	31.670 31.673	32.270 32.267	6H
M36 × 2	4g6g	34.663 34.655	33.797 33.782	34.557 34.565	34.157 34.172	35.962 35.959	35.682 35.685	36.000 36.015	34.701 34.709	35.325 35.310	34.925 34.917	33.835 33.838	34.210 34.207	6H
M39 × 2	4g6g	37.663 37.655	36.797 36.782	37.557 37.565	37.157 37.172	38.962 38.959	38.682 38.685	39.000 39.015	37.701 37.709	38.325 38.310	37.925 37.917	36.835 36.838	37.210 37.207	6H
M40 × 1.5	4g6g	38.994 38.984	38.344 38.329	38.899 38.889	38.599 38.614	39.968 39.964	39.732 39.736	40.000 40.015	39.026 39.036	39.526 39.511	39.226 39.216	38.376 38.380	38.676 38.672	6H
M42 × 4.5	4g6g	39.014 39.001	37.065 37.045	38.864 38.877	38.064 38.084	41.937 41.933	41.437 41.441	42.000 42.020	39.077 39.090	40.292 40.272	39.392 39.379	37.129 37.133	37.799 37.795	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M42 × 2	4g6g	40.663 40.653	39.797 39.782	40.557 40.567	40.157 40.172	41.962 41.958	41.682 41.686	42.000 42.015	40.701 40.711	41.325 41.310	40.925 40.915	39.835 39.839	40.210 40.206	6H
M45 × 1.5	4g6g	43.994 43.984	43.344 43.329	43.899 43.909	43.599 43.614	44.968 44.964	44.732 44.736	45.000 45.015	44.026 44.036	44.526 44.511	44.226 44.216	43.376 43.380	43.676 43.672	6H
M48 × 5	4g6g	44.681 44.668	42.516 42.496	44.521 44.534	43.521 43.541	47.929 47.925	47.399 47.403	48.000 48.020	44.752 44.765	46.087 46.067	45.087 45.074	42.587 42.591	43.297 43.293	6H
M48 × 2	4g6g	46.663 46.653	45.797 45.782	46.551 46.561	46.151 46.166	47.962 47.958	47.682 47.686	48.000 48.015	46.701 46.711	47.337 47.322	46.937 46.927	45.835 45.839	46.210 46.206	6H
M50 × 1.5	4g6g	48.994 48.984	48.344 48.329	48.894 48.904	48.594 48.609	49.968 49.964	49.732 49.736	50.000 50.015	49.026 49.036	49.538 49.523	49.238 49.228	48.376 48.380	48.676 48.672	6H
M55 × 1.5	4g6g	53.994 53.984	53.344 53.329	53.894 53.904	53.594 53.609	54.968 54.964	54.732 54.736	55.000 55.015	54.026 54.036	54.538 54.523	54.238 54.228	53.376 53.380	53.676 53.672	6H
M56 × 5.5	4g6g	52.353 52.340	49.970 49.950	52.183 52.196	51.083 51.103	55.925 55.921	55.365 55.369	56.000 56.020	52.428 52.441	53.883 53.863	52.783 52.770	50.046 50.050	50.796 50.792	6H
M56 × 2	4g6g	54.663 54.653	53.797 53.782	54.551 54.561	54.151 54.166	55.962 55.958	55.682 55.686	56.000 56.015	54.701 54.711	55.337 55.322	54.937 54.927	53.835 53.839	54.210 54.206	6H
M60 × 1.5	4g6g	58.994 58.984	58.344 58.329	58.894 58.904	58.594 58.609	59.968 59.964	59.732 59.736	60.000 60.015	59.026 59.036	59.538 59.523	59.238 59.228	58.376 58.380	58.676 58.672	6H
M64 × 6	4g6g	60.023 60.010	57.425 57.402	59.843 59.856	58.643 58.620	63.920 63.916	63.320 63.324	64.000 64.023	60.103 60.116	61.678 61.655	60.478 60.465	57.505 57.509	58.305 58.301	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M64 × 2	4g6g	62.663 62.653	61.797 61.782	62.551 62.561	62.151 62.166	63.962 63.958	63.682 63.686	64.000 64.015	62.701 62.711	63.337 63.322	62.937 62.927	61.835 61.839	62.210 62.206	6H
M65 × 1.5	4g6g	63.994 63.984	63.344 63.329	63.894 63.904	63.594 63.609	64.968 64.963	64.732 64.737	65.000 67.015	64.026 64.036	64.538 64.523	64.238 64.228	63.376 63.380	63.676 63.672	6H
M70 × 1.5	4g6g	68.994 68.894	68.344 68.329	68.894 68.904	68.594 68.609	69.968 69.963	69.732 69.737	70.000 70.015	69.026 69.036	69.538 69.523	69.238 69.228	68.376 68.381	68.676 68.671	6H
M72 × 6	4g6g	68.023 68.010	65.425 65.402	67.843 67.856	66.643 66.666	71.920 71.915	71.320 71.325	72.000 72.023	68.103 68.116	69.678 69.655	68.478 68.465	65.505 65.510	66.305 66.300	6H
M72 × 2	4g6g	70.663 70.653	69.797 69.782	70.551 70.561	70.151 70.166	71.962 71.957	71.682 71.687	72.000 72.015	70.701 70.711	71.337 71.322	70.937 70.927	69.835 69.840	70.210 70.205	6H
M75 × 1.5	4g6g	73.994 73.984	73.344 73.329	73.894 73.904	73.594 73.609	74.968 74.963	74.732 74.737	75.000 75.015	74.026 74.036	74.538 74.523	74.238 74.228	73.376 73.381	73.676 73.671	6H
M80 × 6	4g6g	76.023 76.010	73.425 73.402	75.843 75.856	74.643 74.666	79.920 79.915	79.320 79.325	80.000 80.023	76.103 76.116	77.678 77.655	76.478 76.465	73.505 73.510	74.305 74.300	6H
M80 × 2	4g6g	78.663 78.653	77.797 77.782	78.551 78.561	78.151 78.166	79.962 79.957	79.682 79.687	80.000 80.015	78.701 78.711	79.337 79.322	78.937 78.927	77.835 77.840	78.210 78.205	6H
M80 × 1.5	4g6g	78.994 78.984	78.344 78.329	78.894 78.904	78.594 78.609	79.968 79.963	79.732 79.737	80.000 80.015	79.026 79.036	79.538 79.523	79.238 79.228	78.376 78.381	78.676 78.671	6H
M85 × 2	4g6g	83.663 83.653	82.797 82.782	83.551 83.561	83.151 83.166	84.962 84.957	84.682 84.687	85.000 85.015	83.701 83.711	84.337 84.322	83.937 83.927	82.835 82.840	83.210 83.205	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS—LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M90 × 6	4g6g	86.023 86.010	83.425 83.402	85.843 85.856	84.643 84.666	89.920 89.915	89.320 89.325	90.000 90.023	86.103 86.116	87.678 87.655	86.478 86.465	83.505 83.510	84.305 84.300	6H
M90 × 2	4g6g	88.663 88.653	87.797 87.782	88.551 88.561	88.151 88.166	89.962 89.957	89.682 89.687	90.000 90.015	88.701 88.711	89.337 89.322	88.937 88.927	87.835 87.840	88.210 88.205	6H
M95 × 2	4g6g	93.663 93.653	92.797 92.782	93.545 93.555	93.145 93.160	94.962 94.957	94.682 94.687	95.000 95.015	93.701 93.711	94.351 94.336	93.951 93.941	92.835 92.840	93.210 93.205	6H
M100 × 6	4g6g	96.023 96.010	93.425 93.402	95.833 95.846	94.633 94.656	99.920 99.915	99.320 99.325	100.000 100.023	96.103 96.116	97.703 97.680	96.503 96.490	93.505 93.510	94.305 94.300	6H
M100 × 2	4g6g	98.663 98.653	97.797 97.782	98.545 98.555	98.145 98.160	99.962 99.957	99.682 99.687	100.000 100.015	98.701 98.711	99.351 99.336	98.951 98.941	97.835 97.840	98.210 98.205	6H
M105 × 2	4g6g	103.663 103.648	102.797 102.774	103.545 103.560	103.145 103.168	104.962 104.957	104.682 104.687	105.000 105.023	103.701 103.716	104.351 104.328	103.951 103.936	102.835 102.840	103.210 103.205	6H
M110 × 2	4g6g	108.663 108.648	107.797 107.774	108.545 108.560	108.145 108.168	109.962 109.957	109.682 109.687	110.000 110.023	108.701 108.716	109.351 109.328	108.951 108.936	107.835 107.840	108.210 108.205	6H
M120 × 2	4g6g	118.663 118.648	117.797 117.774	118.545 118.560	118.145 108.168	119.962 119.956	119.682 119.688	120.000 120.023	118.701 118.716	119.351 119.328	118.951 118.936	117.835 117.841	118.210 118.204	6H
M130 × 2	4g6g	128.663 128.648	127.797 127.774	128.545 128.560	128.145 128.168	129.962 129.956	129.682 129.688	130.000 130.023	128.701 128.716	129.351 129.328	128.951 128.936	127.835 127.841	128.210 128.204	6H

See Notes at end of table.

TABLE 12 GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M140 × 2	4g6g	138.663 138.648	137.797 137.774	138.545 138.560	138.145 138.168	139.962 139.956	139.682 139.688	140.000 140.023	138.701 138.716	139.351 139.328	138.951 138.936	137.835 137.841	138.210 138.204	6H
M150 × 2	4g6g	148.663 148.648	147.797 147.774	148.545 148.560	148.145 148.168	149.962 149.956	149.682 149.688	150.000 150.023	148.701 148.716	149.351 149.328	148.951 148.936	147.835 147.841	148.210 148.204	6H
M160 × 3	4g6g	158.003 157.988	156.704 156.676	157.863 157.878	157.263 157.291	159.952 159.946	159.577 159.583	160.000 160.028	158.051 158.066	158.951 158.923	158.351 158.336	156.752 156.758	157.252 157.246	6H
M170 × 3	4g6g	168.003 167.988	166.704 166.676	167.863 167.878	167.263 167.291	169.952 169.944	169.577 169.585	170.000 170.028	168.051 168.066	168.951 168.923	168.351 168.336	166.752 166.760	167.252 167.244	6H
M180 × 3	4g6g	178.003 177.988	176.704 176.676	177.863 177.878	177.263 177.291	179.952 179.944	179.577 179.585	180.000 180.028	178.051 178.066	178.951 178.923	178.351 178.336	176.752 176.760	177.252 177.244	6H
M190 × 3	4g6g	188.003 187.988	186.704 186.676	187.843 187.858	187.243 187.271	189.952 189.944	189.577 189.585	190.000 190.028	188.051 188.066	188.986 188.958	188.386 188.371	186.752 186.760	187.252 187.244	6H
M200 × 3	4g6g	198.003 197.988	196.704 196.676	197.843 197.858	197.243 197.271	199.952 199.944	199.577 199.585	200.000 200.028	198.051 198.066	198.986 198.958	198.386 198.371	196.752 196.760	197.252 197.244	6H

GENERAL NOTE: All GO gages for external threads are the same as 6g sizes.

NOTE:
(1) M14 × 1.25 — special threads for spark plugs only. See applicable document for thread tolerance class and limiting dimensions.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M1.6 × 0.35	4g6g	1.424 1.416	1.581 1.589	1.354 1.351	1.384 1.376	1.573 1.565	1.314 1.317	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .
M2 × 0.4	4g6g	1.801 1.793	1.981 1.989	1.721 1.718	1.759 1.751	1.981 1.973	1.679 1.682	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .
M2.5 × 0.45	4g6g	2.278 2.270	2.480 2.488	2.188 2.185	2.233 2.225	2.480 2.488	2.143 2.146	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .
M3 × 0.5	4g6g	2.755 2.747	2.980 2.988	2.655 2.652	2.707 2.699	2.980 2.988	2.607 2.610	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .
M3.5 × 0.6	4g6g	3.209 3.201	3.479 3.487	3.089 3.086	3.156 3.148	3.479 3.487	3.036 3.039	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .
M4 × 0.7	4g6g	3.663 3.655	3.978 3.986	3.523 3.520	3.607 3.599	3.978 3.986	3.467 3.470	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .
M5 × 0.8	4g6g	4.616 4.608	4.976 4.984	4.456 4.453	4.556 4.548	4.976 4.984	4.396 4.399	4.480 4.483	4.134 4.126	4.605 4.602	4.334 4.329	6H
M6 × 1	4g6g	5.524 5.511	5.974 5.987	5.324 5.321	6.174 6.161	5.974 5.987	5.253 5.256	5.350 5.353	4.917 4.904	5.500 5.497	5.153 5.140	6H
M8 × 1.25	4g6g	7.410 7.397	7.972 7.985	7.160 7.157	7.335 7.322	7.972 7.985	7.085 7.088	7.188 7.191	6.647 6.634	7.348 7.345	6.912 6.899	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M8 × 1	4g6g	7.524 7.511	7.974 7.987	7.324 7.321	7.453 7.440	7.974 7.987	7.253 7.256	7.350 7.353	6.917 6.904	7.500 7.497	7.153 7.140	6H
M10 × 1.5	4g6g	9.294 9.281	9.968 9.981	8.994 8.991	9.209 9.196	9.968 9.981	8.909 8.912	9.026 9.029	8.376 8.363	9.206 9.203	8.676 8.663	6H
M10 × 1.25	4g6g	9.410 9.397	9.972 9.985	9.160 9.157	9.335 9.322	9.972 9.985	9.085 9.088	9.188 9.191	8.647 8.634	9.348 9.345	8.912 8.899	6H
M10 × 0.75	4g6g	9.641 9.633	9.978 9.986	9.491 9.488	9.578 9.570	9.978 9.986	9.428 9.431	9.513 9.516	9.188 9.180	9.645 9.642	9.378 9.370	6H
M12 × 1.75	4g6g	11.179 11.164	11.966 11.981	10.829 10.826	11.084 11.069	11.966 11.981	10.734 10.731	10.863 10.866	10.106 10.091	11.063 11.060	10.441 10.426	6H
M12 × 1.25	4g6g	11.410 11.397	11.972 11.985	11.160 11.157	11.325 11.312	11.972 11.985	11.075 11.078	11.188 11.191	10.647 10.634	11.368 11.365	10.912 10.899	6H
M12 × 1 (Note 1)	4g6g	11.524 11.511	11.974 11.987	11.324 11.321	11.449 11.436	11.974 11.987	11.249 11.252	11.350 11.353	10.917 10.904	11.510 11.507	11.153 11.140	6H
M14 × 2	4g6g	13.063 13.048	13.962 13.977	12.663 12.658	12.963 12.948	13.962 13.977	12.563 12.568	12.701 12.706	11.835 11.820	12.913 12.908	12.210 12.195	6H
M14 × 1.5	4g6g	13.294 13.281	13.968 13.981	12.994 12.990	13.204 13.191	13.968 13.981	12.904 12.900	13.026 13.030	12.376 12.363	13.216 13.212	12.676 12.663	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M15 × 1	4g6g	14.524 14.511	14.974 14.987	14.324 14.320	14.449 14.436	14.974 14.987	14.249 14.253	14.350 14.354	13.917 13.904	14.510 14.506	14.153 14.140	6H
M16 × 2	4g6g	15.063 15.048	15.962 15.977	14.663 14.658	14.963 14.948	15.962 15.977	14.563 14.568	14.701 14.706	13.835 13.820	14.913 14.908	14.210 14.195	6H
M16 × 1.5	4g6g	15.294 15.281	15.968 15.981	14.994 14.990	15.204 15.191	15.968 15.981	14.904 14.908	15.026 15.030	14.376 14.363	15.216 15.212	14.676 14.663	6H
M17 × 1	4g6g	16.524 16.511	16.974 16.987	16.324 16.320	16.449 16.436	16.974 16.987	16.249 16.253	16.350 16.354	15.917 15.904	16.510 16.506	16.153 16.140	6H
M18 × 1.5	4g6g	17.294 17.281	17.968 17.981	16.694 16.690	17.204 17.191	17.968 17.981	16.904 16.908	17.026 17.030	16.376 16.363	17.216 17.212	16.676 16.663	6H
M20 × 2.5	4g6g	18.834 18.819	19.958 19.973	18.334 18.329	18.728 18.713	19.958 19.973	18.228 18.233	18.376 18.381	17.294 17.279	18.600 18.595	17.744 17.729	6H
M20 × 1.5	4g6g	19.294 19.281	19.968 19.981	18.994 18.990	19.204 19.191	19.968 19.981	18.904 18.908	19.026 19.030	18.376 18.363	19.216 19.212	18.676 18.663	6H
M20 × 1	4g6g	19.524 19.511	19.973 19.986	19.324 19.320	19.449 19.436	19.973 19.986	19.249 19.253	19.350 19.354	18.917 18.904	19.510 19.506	19.153 19.140	6H
M22 × 1.5	4g6g	20.834 20.821	21.968 21.981	20.994 20.990	21.204 21.191	21.968 21.981	20.904 20.908	21.026 21.030	20.376 20.363	21.216 21.212	20.676 20.663	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M24 × 3	4g6g	22.603 22.588	23.952 23.967	22.003 21.998	22.478 22.463	23.952 23.967	21.878 21.883	22.051 22.056	20.752 20.737	22.316 22.311	21.252 21.237	6H
M24 × 2	4g6g	23.063 23.048	23.962 23.977	22.663 22.658	22.957 22.942	23.962 23.977	22.557 22.562	22.701 22.706	21.835 21.820	22.925 22.920	22.210 22.195	6H
M25 × 1.5	4g6g	24.294 24.281	24.968 24.981	23.994 23.990	24.199 24.186	24.968 24.981	23.899 23.903	24.026 24.030	23.376 23.363	24.226 24.222	23.676 23.663	6H
M27 × 2	4g6g	26.063 26.048	26.962 26.977	25.663 25.658	25.957 25.942	26.962 26.977	25.557 25.562	25.701 25.706	24.835 24.820	25.925 25.920	25.210 25.195	6H
M30 × 3.5	4g6g	28.374 28.356	29.947 29.965	27.674 27.669	28.242 28.224	29.947 29.965	27.542 27.547	27.727 27.732	26.211 26.193	28.007 28.002	26.771 26.753	6H
M30 × 2	4g6g	29.063 29.048	29.962 29.977	28.663 28.658	28.957 28.942	29.962 29.977	28.557 28.562	28.701 28.706	27.835 27.820	28.925 28.920	28.210 28.195	6H
M30 × 1.5	4g6g	29.294 29.281	29.968 29.981	28.994 28.990	29.199 29.186	29.968 29.981	28.899 28.903	29.026 29.030	28.376 28.363	29.226 29.222	28.676 28.663	6H
M33 × 2	4g6g	32.063 32.048	32.962 32.977	31.663 31.658	31.957 31.942	32.962 32.977	31.557 31.562	31.701 31.706	30.835 30.820	31.925 31.920	31.210 31.195	6H
M36 × 4	4g6g	34.142 34.124	35.940 35.958	33.342 33.337	34.002 33.984	35.940 35.958	33.202 33.207	33.402 33.407	31.670 31.652	33.702 33.697	32.270 32.252	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE(CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M36 × 2	4g6g	35.063 35.048	35.962 35.977	34.663 34.658	34.957 34.942	35.962 35.977	34.557 34.562	34.701 34.706	33.835 33.820	34.925 34.920	34.210 34.195	6H
M39 × 2	4g6g	38.063 38.048	38.962 38.977	37.663 37.658	37.957 37.942	38.962 37.977	37.557 37.562	37.701 37.706	36.835 36.820	37.925 37.920	37.210 37.195	6H
M40 × 1.5	4g6g	39.294 39.281	39.968 39.981	38.994 38.989	39.199 39.186	39.968 39.981	38.899 38.904	39.026 39.031	38.376 38.363	39.226 39.221	38.676 38.663	6H
M42 × 4.5	4g6g	39.914 39.894	41.937 41.957	39.014 39.008	39.764 39.744	41.937 41.957	38.864 38.870	39.077 39.083	37.129 37.109	39.392 39.386	37.799 37.779	6H
M42 × 2	4g6g	41.063 41.048	41.962 41.977	40.663 40.657	40.957 40.942	41.962 41.977	40.557 40.563	40.771 40.707	39.835 39.820	40.925 40.919	40.210 40.195	6H
M45 × 1.5	4g6g	44.294 44.281	44.968 44.981	43.994 43.989	44.199 44.186	44.968 44.981	43.899 43.904	44.026 44.031	43.376 43.363	44.226 44.221	43.676 43.663	6H
M48 × 5	4g6g	45.681 45.661	47.929 47.949	44.681 44.675	45.521 45.501	47.929 47.949	44.521 44.527	44.752 44.758	42.587 42.567	45.087 45.081	43.297 43.277	6H
M48 × 2	4g6g	47.063 47.048	47.962 47.977	46.663 46.657	46.951 46.936	47.962 47.977	46.551 46.557	46.701 46.707	45.835 45.820	46.937 46.931	46.210 46.195	6H
M50 × 1.5	4g6g	49.294 49.281	49.968 49.981	48.994 48.989	49.194 49.181	49.968 49.981	48.894 48.899	49.026 49.031	48.376 48.363	49.238 49.233	48.676 48.663	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H M PROFILE — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M55 × 1.5	4g6g	54.294 54.281	54.968 54.981	53.994 53.989	54.194 54.181	54.968 54.981	53.894 53.899	54.026 54.031	53.376 53.363	54.238 54.233	53.676 53.663	6H
M56 × 5.5	4g6g	53.452 53.432	55.925 55.945	52.353 53.347	53.283 53.263	55.925 55.945	52.183 52.189	52.428 52.434	50.046 50.026	52.788 52.777	50.796 50.776	6H
M56 × 2	4g6g	55.063 55.048	55.962 55.977	54.663 54.657	54.951 54.936	55.962 55.977	54.551 54.557	54.701 54.707	53.835 53.820	54.937 54.931	54.210 54.195	6H
M60 × 1.5	4g6g	59.294 59.281	59.968 59.981	58.994 58.989	59.194 59.181	59.968 59.981	58.894 58.899	59.026 59.031	58.376 58.363	59.238 59.233	58.676 58.663	6H
M64 × 6	4g6g	61.223 61.200	63.920 63.943	60.023 60.017	61.043 61.020	63.920 63.943	59.843 59.849	60.103 60.109	57.505 57.482	60.478 60.472	58.305 58.282	6H
M64 × 2	4g6g	63.063 63.048	63.962 63.977	62.663 62.657	62.951 62.936	63.962 63.977	62.551 62.557	62.701 62.707	61.835 61.820	62.937 62.931	62.210 62.195	6H
M65 × 1.5	4g6g	64.294 64.281	64.968 64.981	63.994 63.989	64.194 64.181	64.968 64.981	63.894 63.899	64.026 64.031	63.376 63.363	64.238 64.233	63.676 63.663	6H
M70 × 1.5	4g6g	69.294 69.281	69.968 69.981	68.994 68.989	69.194 69.181	69.968 69.981	68.894 68.899	69.026 69.031	68.376 68.363	69.238 69.233	68.676 68.663	6H
M72 × 6	4g6g	69.223 69.200	71.920 71.943	68.023 68.017	69.043 69.020	71.920 71.943	67.843 67.849	68.103 68.109	65.505 65.482	68.478 68.472	66.305 66.282	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M72 × 2	4g6g	71.063 71.048	71.962 71.977	70.663 70.657	70.951 70.936	71.962 71.977	70.551 70.557	70.701 70.707	69.835 69.820	70.937 70.931	70.210 70.195	6H
M75 × 1.5	4g6g	74.294 74.281	74.968 74.981	73.994 73.989	74.194 74.181	74.968 74.981	73.894 73.899	74.026 74.031	73.376 73.363	74.238 74.233	73.676 73.663	6H
M80 × 6	4g6g	77.223 77.200	79.920 79.943	76.023 76.017	77.043 77.020	79.920 79.943	75.843 75.849	76.103 76.109	73.505 73.482	76.478 76.472	74.305 74.282	6H
M80 × 2	4g6g	79.063 79.048	79.962 79.977	78.663 78.657	78.951 78.936	79.962 79.977	78.551 78.557	78.701 78.707	77.835 77.820	78.937 78.931	78.210 78.195	6H
M80 × 1.5	4g6g	79.294 79.281	79.968 79.981	78.994 78.989	79.194 79.181	79.968 79.981	78.894 78.899	79.026 79.031	78.376 78.363	79.238 79.233	78.676 78.663	6H
M85 × 2	4g6g	84.063 84.048	84.962 84.977	83.663 83.657	83.951 83.936	84.962 84.977	83.551 83.557	83.701 83.707	82.835 82.820	83.937 83.931	83.210 83.195	6H
M90 × 6	4g6g	87.223 87.200	89.920 89.943	86.023 86.017	87.043 87.020	89.920 89.943	85.843 85.849	86.103 86.109	83.505 83.482	86.478 86.472	84.305 84.282	6H
M90 × 2	4g6g	89.063 89.048	89.962 89.977	88.663 88.657	88.951 88.936	89.962 89.977	88.551 88.557	88.701 88.707	87.835 87.820	88.937 88.931	88.210 88.195	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE (CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.			Major Diam.							
		Truncated	Full Form	Pitch Diam.	Truncated	Full Form	Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
1	2	3	4	5	6	7	8	9	10	11	12	13
M95 × 2	4g6g	94.063 94.048	94.962 94.977	93.663 93.657	93.945 93.930	94.962 94.977	93.545 93.551	93.701 93.707	92.835 92.820	93.951 93.945	93.210 93.195	6H
M100 × 6	4g6g	97.223 97.200	99.920 99.943	96.023 96.017	97.033 97.010	99.920 99.943	95.833 95.839	96.103 96.109	93.505 93.482	96.503 96.497	94.305 94.282	6H
M100 × 2	4g6g	99.063 99.048	99.962 99.977	98.663 98.657	98.945 98.930	99.962 99.977	98.545 98.551	98.701 98.707	97.835 97.820	98.951 98.945	98.210 98.195	6H
M105 × 2	4g6g	104.063 104.040	104.962 104.985	103.663 103.655	103.945 103.922	104.962 104.985	103.545 103.553	103.701 103.709	102.835 102.812	103.951 103.943	103.210 103.187	6H
M110 × 2	4g6g	109.063 109.040	109.962 109.985	108.663 108.655	108.945 108.922	109.962 109.985	108.545 108.553	108.701 108.709	107.835 107.812	108.951 108.943	108.210 108.187	6H
M120 × 2	4g6g	119.063 119.040	119.962 119.985	118.663 118.655	118.945 118.922	119.962 119.985	118.545 118.553	118.701 118.709	117.835 117.812	118.951 118.943	118.210 118.187	6H
M130 × 2	4g6g	129.063 129.040	129.962 129.985	128.663 128.655	128.945 128.922	129.962 129.985	128.545 128.553	128.701 128.709	127.835 127.812	128.951 128.943	128.210 128.187	6H
M140 × 2	4g6g	139.063 139.040	139.962 139.985	138.663 138.655	138.945 138.922	139.962 139.985	138.545 138.553	138.701 138.709	137.835 137.812	138.951 138.943	138.210 138.187	6H

See Notes at end of table.

TABLE 13 SETTING GAGES FOR STANDARD THREAD SERIES, CLASSES 4g6g AND 6H
M PROFILE — LIMITS OF SIZE(CONT'D)

Nominal Size and Pitch	Class	W Thread-Setting Plugs						W Thread-Setting Rings				Class
		GO			LO			GO		HI		
		Major Diam.		Pitch Diam.	Major Diam.		Pitch Diam.	Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	
		Truncated	Full Form		Truncated	Full Form						
1	2	3	4	5	6	7	8	9	10	11	12	13
M150 × 2	4g6g	149.063 149.040	149.962 149.985	148.663 148.655	148.945 148.922	149.962 149.985	148.545 148.553	148.701 148.709	147.835 147.812	148.951 148.943	148.210 148.187	6H
M160 × 3	4g6g	158.603 158.580	159.952 159.975	158.003 157.995	158.463 158.440	159.952 159.975	157.863 157.871	158.051 158.059	156.752 156.729	158.351 158.343	157.252 157.229	6H
M170 × 3	4g6g	168.603 168.580	169.952 169.975	168.003 167.995	168.463 168.440	169.952 169.975	167.863 167.871	168.051 168.059	166.752 166.729	168.351 168.343	167.252 167.229	6H
M180 × 3	4g6g	178.603 178.580	179.952 179.975	178.003 177.995	178.463 178.440	179.952 179.975	177.863 177.871	178.051 178.059	176.752 176.729	178.351 178.343	177.252 177.229	6H
M190 × 3	4g6g	188.603 188.580	189.952 189.975	188.003 187.995	188.443 188.420	189.952 189.975	187.843 187.851	188.051 188.059	186.752 186.729	188.386 188.378	187.252 187.229	6H
M200 × 3	4g6g	198.603 198.580	199.952 199.975	198.003 197.995	198.443 198.420	199.952 199.975	197.843 197.851	198.051 198.059	196.752 196.729	198.386 198.378	197.252 197.229	6H

GENERAL NOTE: All GO setting plug gages are the same as 6g sizes.

NOTE:
(1) M14 × 1.25 — special thread for spark plugs only. See applicable document for thread tolerance class and limiting dimensions.

5.1.11 Chip Grooves. GO thread ring gages of the adjustable type do not require chip grooves as the adjusting slots serve this purpose. Solid working thread ring gages are made with or without chip grooves, depending upon the gage designer's requirements.

5.1.12 Identification. The GO thread ring gage should be marked by the metric nominal size, pitch-tolerance class, GO, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g GO PD7.324

5.2 LO Thread Ring Gages (Table 1 — Gage 1.2)

5.2.1 Purpose and Use. The LO thread ring gage inspects the LO functional diameter limit, B_1, of product thread. The LO thread ring gage, when properly set to its respective calibrated thread-setting plug, represents the LO functional diameter limit of the product external thread. The LO thread ring gage and LO threaded segment type indicating gage are more reliable for checking thin-walled parts which might be deformed by a LO thread snap. LO thread ring gages must be set to applicable W tolerance-setting plugs.

LO thread ring gages when applied to the product external thread may engage only the end threads (which may not be representative of the complete product thread).

Starting threads on LO thread ring gages are subject to greater wear than the remaining threads. Such wear in combination with the incomplete threads at the end of the product thread permit further entry in the gage. LO functional diameter limit is acceptable when the LO thread ring gage is applied to the product external thread if:

(*a*) it is not entered; or

(*b*) all complete product threads enter, provided that a definite drag from contact with the product material results on or before the second turn of entry. The gage should not be forced after the drag is definite.

Special requirements such as exceptionally thin or ductile material, small number of threads, etc., may necessitate modification of this practice.

5.2.2 Basic Design. To better check the LO functional diameter limit, the flank contact is less than that of the GO gage, and the length of the gaging element where practical is less than that of the GO gage.

5.2.3 Gage Blanks. For practical and economic reasons, the designs and thicknesses of thread ring gages have been standardized for various ranges and pitches (see ANSI/ASME B47.1aM or Table C2).

5.2.4. Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 19.

5.2.5 Thread Crests. The minimum minor diameter of the LO thread ring gage shall be equal to the minimum pitch diameter of the external thread minus $0.2p$ with gage tolerance plus. This corresponds to a width of flat at the crest of the gage equal to $0.385p$. See Table 4.

5.2.6 Thread Roots. The major diameter of the LO thread ring gage shall clear the product thread by using a clearance cut of $0.385p$ width approximately central, except for threads smaller than 5 mm and pitches smaller than 0.8 mm. The LO thread ring gage shall clear the maximum major diameter of the full-form portion of the truncated thread-setting plug for the LO thread ring gage. 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 variation on the fit of the gage with the product thread is minimized.

5.2.7 Runout of Pitch and Minor Diameter Cylinders. The permissible minimum effective minor diameter, as determined by subtracting runout measurement (full-indicator movement) with respect to the pitch cylinder from the measured minor diameter, shall not be less than the specified minimum minor diameter minus twice the sum of the gage tolerances for pitch and minor diameters.

5.2.8 Pitch Cylinder. Pitch cylinder is transferred by the setting of the thread ring gage to the applicable truncated setting plug gage.

5.2.9 Lead and Half-Angle Variations. Lead and half-angle variations shall be within the limits specified in Table 6.

5.2.10 Incomplete Thread. The feather edge at both ends of the thread ring gage shall be removed. On gages larger than M12 or having pitches coarser than 1.25 mm, not more than one complete turn of the end threads shall be removed to obtain a full-thread blunt start. On gages M12 and smaller or having pitches of 1.25 mm or finer, a 60 deg. chamfer from the axis of the gage is acceptable in lieu of the blunt start.

5.2.11 Identification. The LO thread gage should be marked by the metric nominal size, pitch-tolerance class, LO, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g LO PD7.212

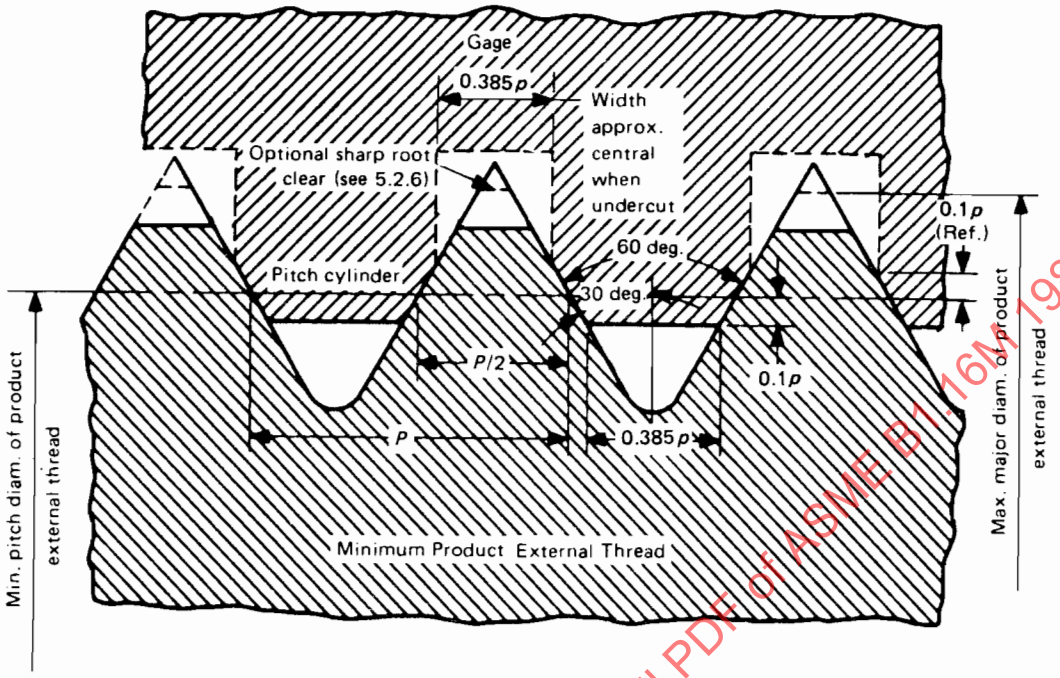


FIG. 19 LO FUNCTIONAL DIAMETER LIMIT

5.3 Thread Snap Gages—GO Segments or Rolls (Table 1—Gages 2.1 and 2.3)

5.3.1 Purpose and Use. The thread snap gage with two GO threaded segments or two GO zero lead rolls inspects the maximum-material GO functional limit, A_1, of product external thread. The setting of the GO segments or rolls represents the maximum material GO functional limit of the product external thread, and its purpose is to assure interchangable assembly of maximum-material mating parts. The gaging length of the segments or rolls is equal to the length of the standard GO ring gages. The segments or rolls have a cumulative check of all thread elements except the major diameter.

The GO thread snap gage can also check roundness of the pitch cylinder for 180 deg. ovality by using the gage at different external diametral locations on the product thread.

5.3.2 Basic Design. The GO segments and rolls assembled into gage frames are the design of the individual gage manufacturer. The lengths of the two threaded segments and the two thread rolls spaced 180 deg. apart are equal to the standard GO ring gage blank lengths for practical and economic reasons. See ANSI/ASME B47.1aM or Table C2.

GO thread segments shall engage 25% or more of the product circumference. Product shall be checked around full circumference of thread at sufficient axial positions to check the full-thread length.

Thread rolls shall be applied at several locations (three if possible) axially over the full-thread length of the product. The circumference shall be checked at each position.

5.3.3 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 20.

5.3.4 Thread Crests. The distance between the minor diameter of the GO thread segments and the outside diameter of GO thread rolls shall be equal to the maximum pitch diameter of the product external thread minus $H/2$ with a minus gage tolerance when assembled in gage frame. This corresponds to a width of flat of $P/4$ on crests. The thread crests shall be flat in an axial plane and parallel to the axis.

5.3.5 Thread Roots. The major diameter of the GO thread segments and root diameter of the GO rolls shall be cleared beyond a $P/8$ flat either by an extension of the flanks of the thread toward a sharp vee or by an undercut no greater than $P/8$ maximum width and approximately central. The root clearance must be such that the maximum major diameter of the full-form section of the truncated thread-setting plug gage is cleared after the gage has been properly set to size.

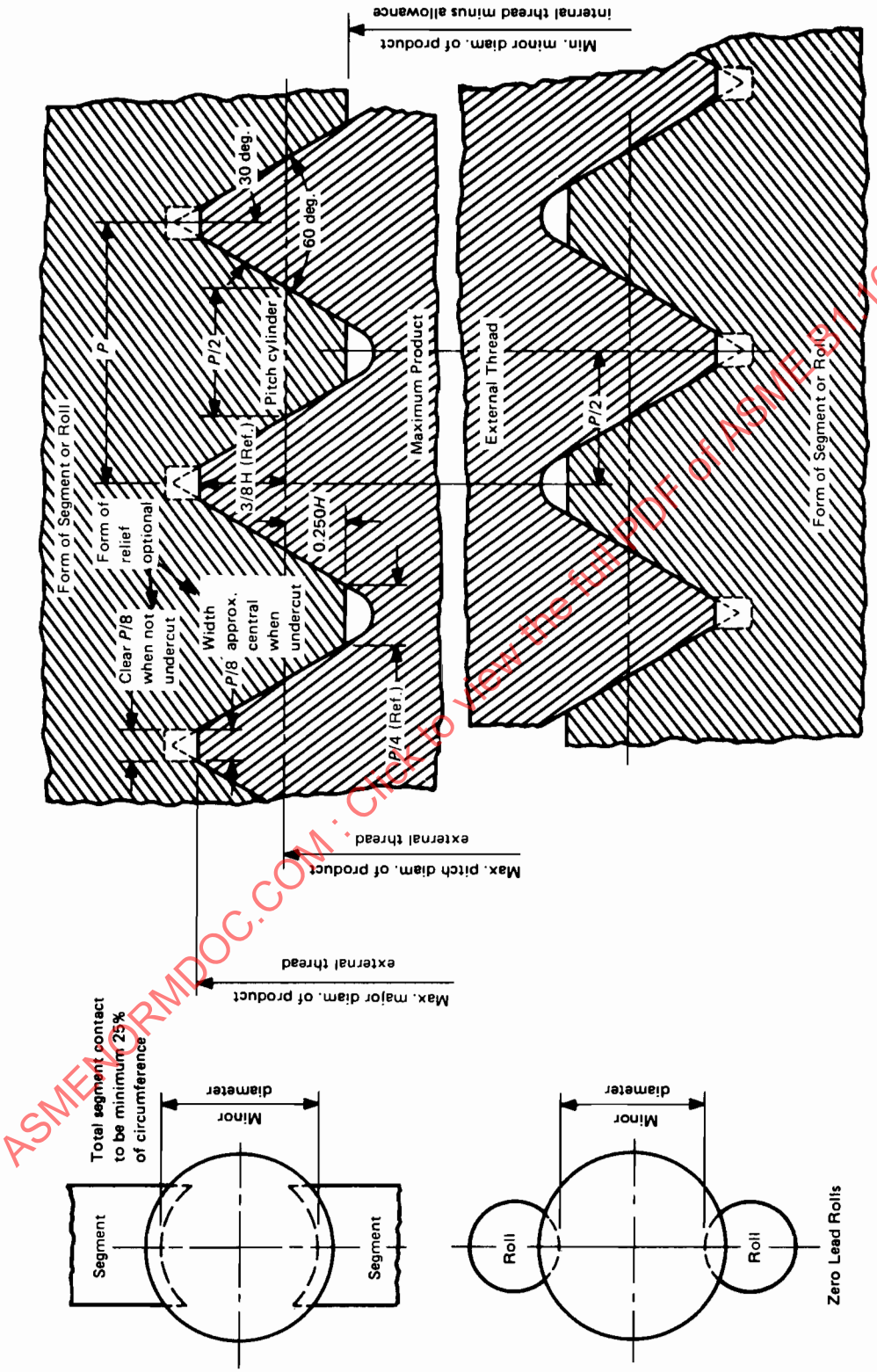


FIG. 20 THREAD SNAP GAGES — MAXIMUM-MATERIAL GO FUNCTIONAL LIMIT

5.3.6 Runout. The pitch and minor cylinders of the threaded portion of the GO segments or rolls shall not exceed the specified runout as determined by measurements of runout (full-indicator movement). On each gaging member, with respect to the pitch cylinder, runout shall not exceed one-half the X gage minor diameter tolerance.

5.3.7 Pitch Cylinder. The pitch cylinder of the threaded GO segments and rolls shall be straight within the X gage pitch diameter limits specified.

5.3.8 Lead, Pitch, and Half-Angle Variations. Lead, pitch, and half-angle variations shall be within the limits specified. See Table 6.

5.3.9 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, GO, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g GO PD7.324

5.4 Thread Snap Gages—LO Segments or Rolls (Table 1—Gages 2.2 and 2.4)

5.4.1 Purpose and Use. The thread snap gage with two LO segments or two LO rolls inspects the LO functional diameter limit, B_1, of product external thread. The setting of the LO segments or rolls represents the LO functional diameter limit of the product external thread. In applying the thread snap limit gage, the LO functional diameter limit is acceptable when gaging elements do not pass over the product thread.

The LO thread snap gage can also check roundness of the pitch cylinder for 180 deg. ovality by passing the gage over the thread at different diametral locations on the external thread.

The LO thread snap gage can also check taper of pitch cylinder by passing the gage over the thread at different locations axially on external thread.

5.4.2 Basic Design. In order that the LO thread snap gage may effectively check the LO functional diameter limit, the flank contact is reduced by truncating the thread on segments and rolls. As the design of the segments or rolls is different with each gage manufacturer, the number of threads engaged in product thread will vary. Usually, the number of pitches engaged is approximately two.

5.4.3 Thread Form. The specifications for thread form are summarized in Table 4 and Fig. 21.

5.4.4 Thread Crests. The minor diameter of the LO thread segments and the inner distance between the outside diameters of LO thread rolls shall be equal to the minimum pitch diameter of the product external thread minus $0.2p$ with the gage tolerance plus when assembled in gage frame. This corresponds to a width of flat at the crest equal to $0.385p$. See Table 4.

5.4.5 Thread Roots. The major diameter of the LO thread segments or root diameter of the LO rolls shall clear the product thread by using a clearance cut of $0.385p$ width approximately central except for threads smaller than 5 mm and pitches smaller than 0.8 mm. Snap gage contacts shall clear the maximum major diameter of the full-form portion of the setting plug for the LO thread snap gage. Thus, contact of the thread gage can occur on the sides of the thread but not on the crest or root. Also, the effect of angle variation on the fit of the gage with the product thread is minimized.

5.4.6 Runout. The pitch and minor cylinders of the threaded LO segments or the pitch and outside cylinders of the rolls shall not exceed the specified runout as determined by measurement of runout (full-indicator movement). On each gaging member, with respect to the pitch cylinder, runout shall not exceed one-half the X gage minor diameter tolerance.

5.4.7 Pitch Cylinder. The pitch cylinder of the threaded LO segments or rolls shall be straight within the X gage pitch diameter limits specified.

5.4.8 Lead, Pitch, and Half-Angle Variations. Lead, pitch, and half-angle variations shall be within the limits specified. See Table 6.

5.4.9 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, LO, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g LO PD7.212

5.5 Thread Snap Gages — Cone and Vee (Table 1 — Gage 2.5)

5.5.1 Purpose and Use. The thread snap gage with cone and vee rolls or segments inspects minimum-material diameter limit, C_1. The setting of the cone and vee rolls or segments represents the minimum-material limit pitch diameter of the product external thread.

The cone and vee snap gage can check roundness of pitch diameter for 180 deg. ovality by passing the gage over the thread at different diametral locations on the external thread.

The cone and vee snap gage can check taper of pitch cylinder by passing the gage over the thread at different locations axially on external thread.

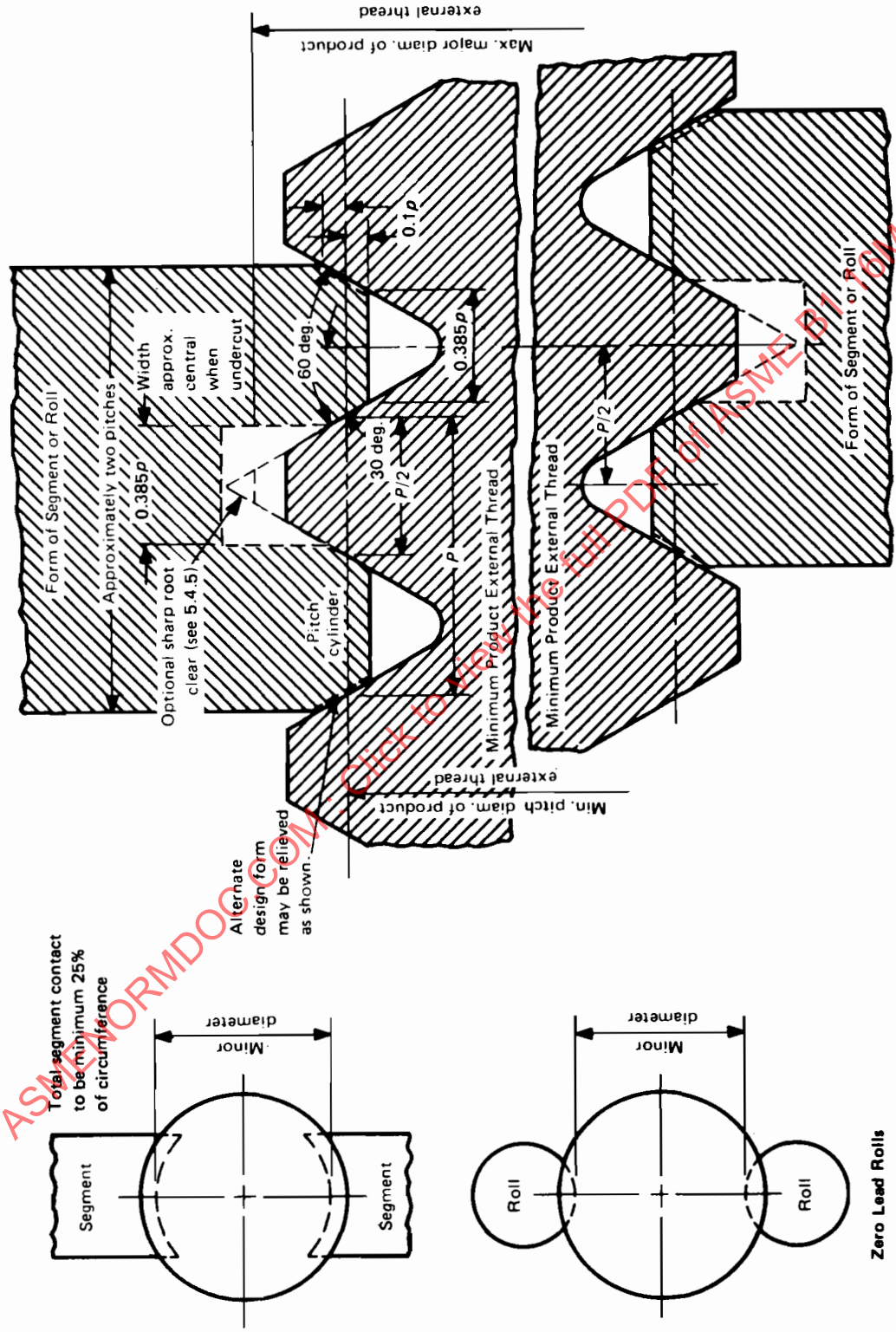


FIG. 21 THREAD SNAP GAGES — LO FUNCTIONAL DIAMETER LIMIT

5.5.2 Basic Design. The segments are usually made having a surface contact at or slightly above the pitch line near the center of the flank. The rolls make point or line contacts approximately at the pitch line, depending upon the angle variations of the thread flanks. See Fig. 22 for details.

5.5.3 Thread Form. The specifications for thread form, thread crests, and thread roots are shown in Fig. 22.

5.5.4 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g PD7.212

5.6 Thread Snap Gages — Minimum Material: Thread Groove Diameter Type (Table 1 — Gage 2.6)

5.6.1 Purpose and Use. The thread snap gage with radius type ribbed rolls inspects minimum-material diameter limit, D_1. The setting of the thread groove diameter type snap gage by LO setting plug gage represents the minimum-material limit pitch diameter of the product external thread.

The thread groove diameter type snap gage can check roundness for 180 deg. ovality by passing the gage over the thread at different diametral locations on the external thread.

The thread groove diameter type snap gage can check taper of pitch cylinder by passing the gage over the thread at different locations axially on external thread.

5.6.2 Basic Design. The thread groove diameter type has "best size" thread wire size radius ribbed rolls which contact at the pitch line.

5.6.3 Thread Form. The specifications for radius type rolls are shown in Fig. 23.

5.6.4 Identification. The assembled gage should be marked by the metric nominal size, pitch-tolerance class, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g PD7.212

5.7 Plain Ring and Snap Gages to Check Major Diameter of Product External Threads (Table 1 — Gages 3.1, 3.2, and 3.4)

5.7.1 Purpose and Use. The GO and NOT GO cylindrical ring and plain snap gages inspect the major diameter of the product external thread. The GO gage must completely receive or pass over the major diameter of the product external thred to assure that the major diameter does not exceed the maximum-material limit. The NOT GO cylindrical ring gage or NOT GO plain snap gage must not pass over the major diameter of the product external thread to assure that the major diameter is not less than the minimum-material limit.

5.7.2 Design of Gage Blanks and Gages. Plain cylindrical ring blanks and plain progressive adjustable snap gages have been standardized for various size ranges (see ANSI/ASME B47.1aM and Fig. 24).

5.7.3 Identification. Cylindrical rings or plain snap gages should be marked with metric nominal size, pitch-tolerance class, GO and/or NOT GO, and major diameters in millimeters.

EXAMPLE:
M8 × 1-6g GO 7.974 and/or NOT GO 7.794

5.7.4 Precision Instruments (Table 1 — Gage 14). Precision instruments such as dial calipers, outside micrometers, vernier calipers, and pocket slide calipers can also be used to measure the major diameter of product external thread.

5.8 Snap Gages for Minor Diameter of Product — External Threads (Table 1 — Gages 3.3 and 3.5)

5.8.1 Purpose and Use. The GO thread ring gages inspect the depth of thread equivalent to the minor diameter of the product internal thread. If the minor diameter of the external thread requires checking, a minimum-maximum thread snap gage may be used. GO segment or roll snap gage must pass over product thread. NOT GO segment or roll must not pass over product thread.

5.8.2 Basic Design. A thread snap gage has segments or rolls with a thread form of 55 deg. maximum. There usually are three threads on the segments or three ribs on the rolls on GO and NOT GO gaging elements. See Fig. 25.

5.8.3 Identification. Thread snap gages should be marked with metric nominal size, pitch-tolerance class, GO, NOT GO, minor diameter limits in millimeters, and MINOR DIAMETER EXTERNAL.

EXAMPLE:
M8 × 1-6g GO — NOT GO (Customer's Specifications)
MINOR DIAMETER EXTERNAL

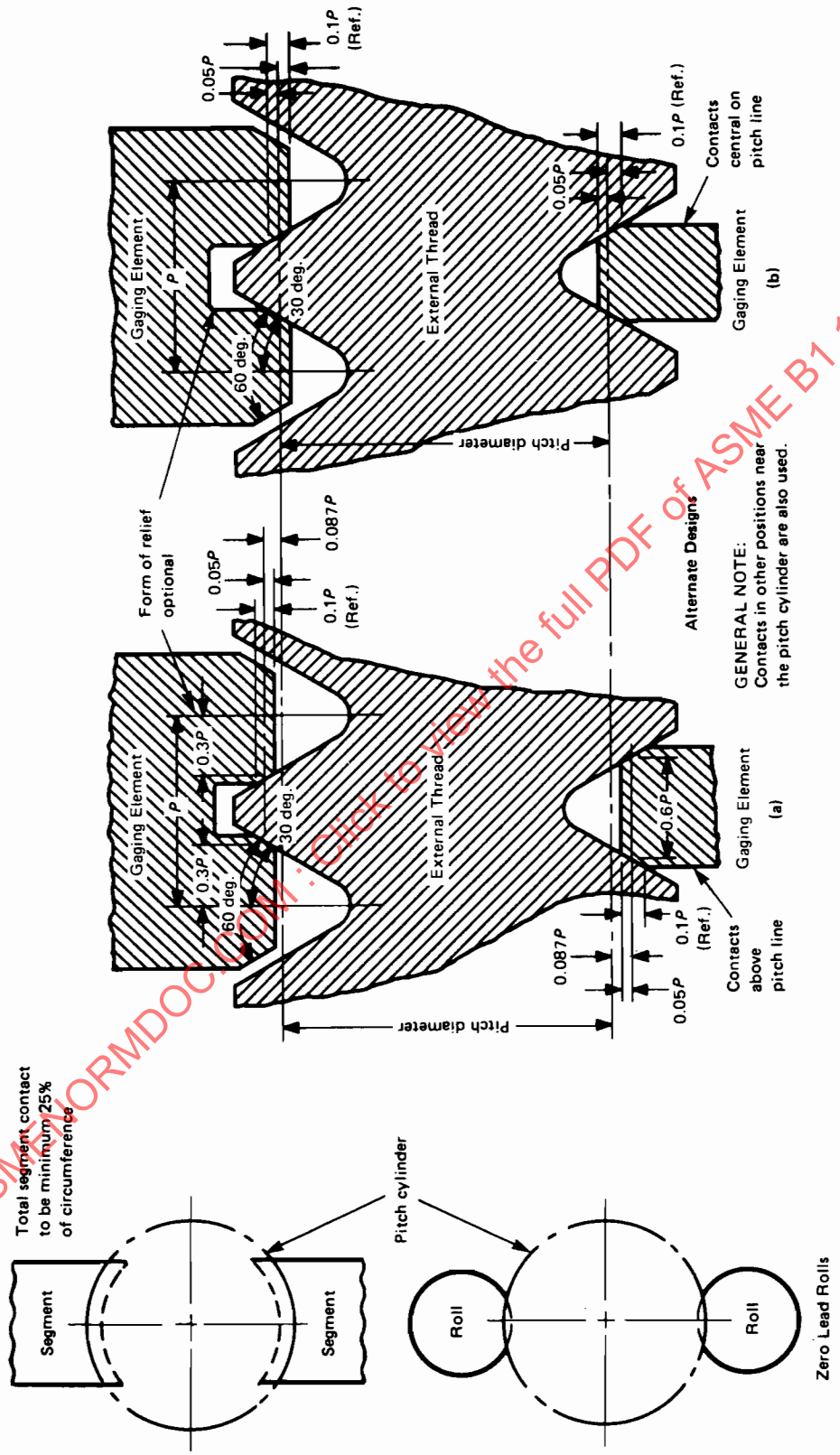


FIG. 22 THREAD SNAP GAGES — MINIMUM-MATERIAL PITCH DIAMETER LIMIT — CONE AND VEE

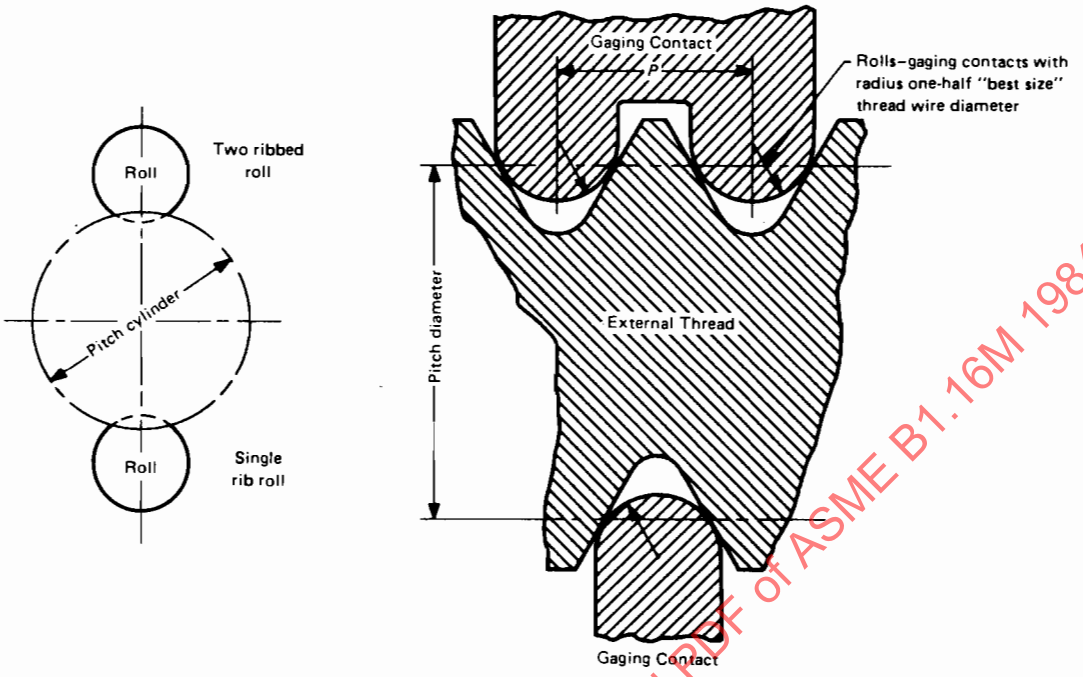


FIG. 23 THREAD SNAP GAGES—MINIMUM-MATERIAL THREAD GROOVE DIAMETER LIMIT

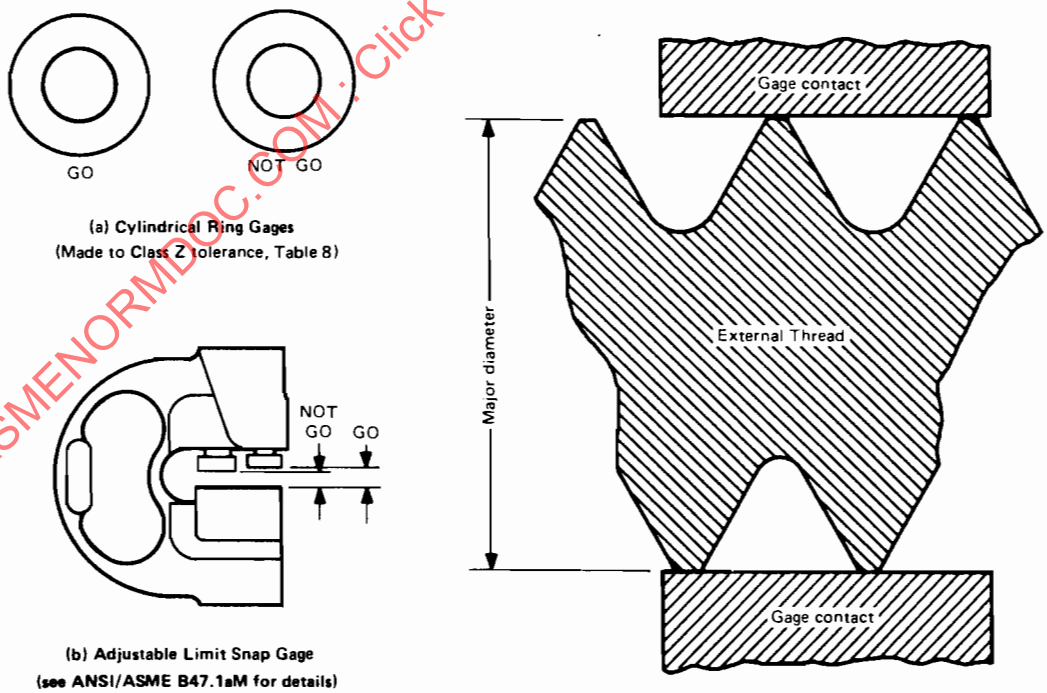


FIG. 24 MAJOR DIAMETER LIMIT

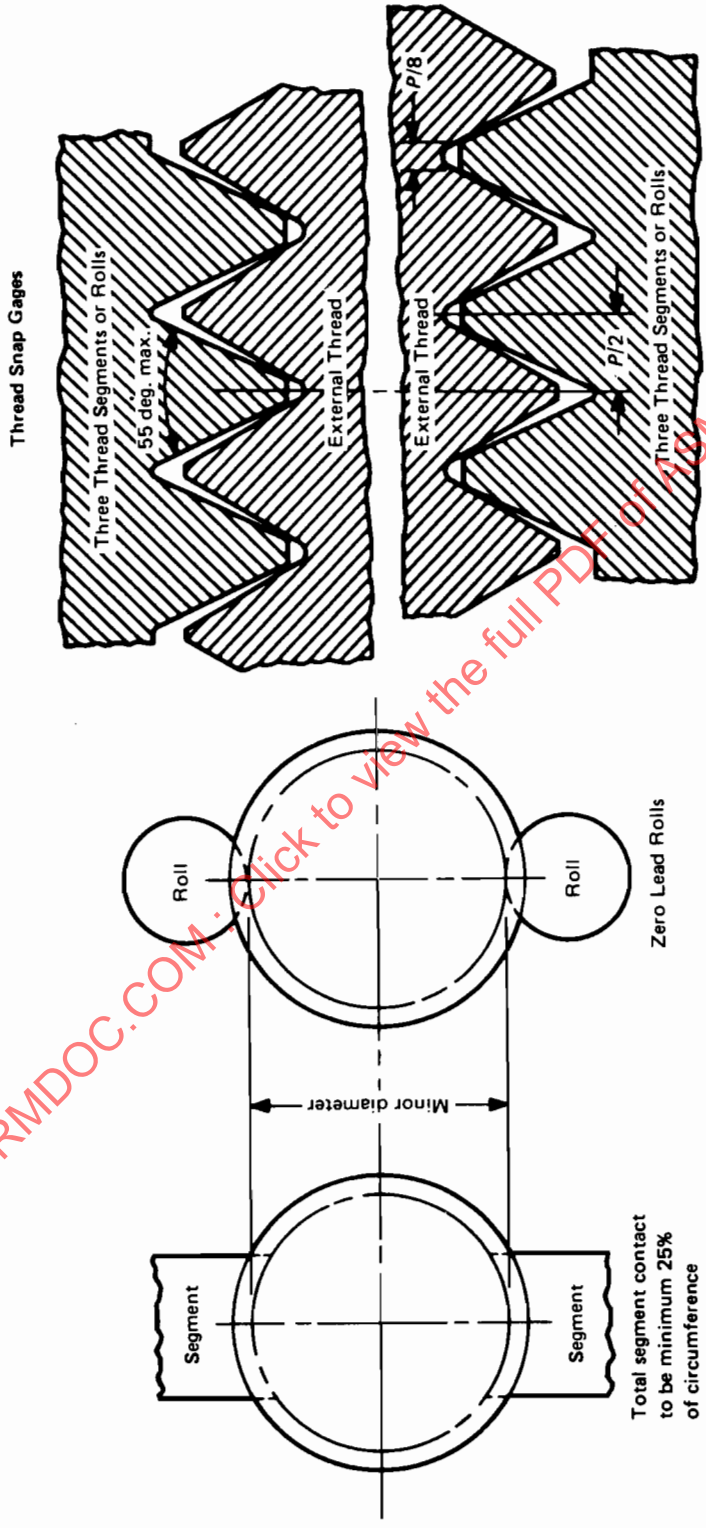


FIG. 25 MINOR DIAMETER LIMIT SNAP TYPE

5.9 Functional Indicating Thread Gages for External Thread (Table 1 — Gages 4.1 and 4.3)

5.9.1 Purpose and Use. The indicating thread gage with segments or rolls inspects the maximum-material GO functional limit and size, A_1 and A_2, and the LO functional diameter limit and size, B_1 and B_2, of product external thread. The gage is also used to check even or odd lobe roundness of pitch cylinder.

Indicating thread gages must be set to the proper thread-setting plug gages. Readings indicate the position of product external thread within the tolerance range.

5.9.2 Basic Design. Indicating gages have two or three contacts at 180 deg. or 120 deg., respectively. Gages with segments or rolls are designed with the length of the GO functional maximum-material gaging elements equal to the length of the standard GO ring gages.

5.9.3 Thread Form. The specifications for thread form for GO functional maximum-material segments and rolls are summarized in Table 4 and Fig. 26.

5.9.4 Thread Crests. The minor diameter of the GO functional maximum-material thread segments and the diameter of the circle surrounded by the roll cluster of GO functional maximum-material rolls shall be equal to the maximum pitch diameter of the product external threads minus H 2 with a minus X gage tolerance when assembled in gage frame. This corresponds to a width of flat of P 4 on crests. The thread crests shall be flat in an axial plane and parallel to the axis of segment or roll.

5.9.5 Thread Roots. The major diameter of the GO functional maximum-material thread segments and the root of the GO functional maximum-material rolls shall be cleared beyond a P 8 flat either by an extension of the flanks of the thread toward a sharp vee or by an undercut no greater than $P/8$ maximum width and approximately central. The root clearance must be such that the major diameter of the full-form section of the thread-setting plug gage is cleared after the assembled gage has been properly set to size.

5.9.6 Runout. The pitch and minor cylinders of the threaded segments and the pitch and outside cylinders of the rolls shall not exceed the specified runout as determined by measurements of runout (full-indicator movement). On each gaging member with respect to the pitch cylinder, runout shall not exceed one-half the X gage minor diameter tolerance.

5.9.7 Pitch Cylinder. The pitch cylinder of the thread segments and rolls should be straight within the X gage pitch diameter limits specified.

5.9.8 Lead, Pitch, and Half-Angle Variations. Lead, pitch, and half-angle variations shall be within the limits specified. See Table 6.

5.9.9 Identification. The segments and rolls shall be identified by the metric nominal size and pitch. When indicating gage is assembled with proper contacts, the gage should be marked with the metric nominal size, pitch-tolerance class, PD, and pitch diameter limits in millimeters.

EXAMPLE:
M8 × 1-6g PD7.324–7.212

5.10 Minimum-Material Indicating Thread Gages for External Thread (Table 1 — Gages 4.5 and 4.6)

5.10.1 Purpose and Use. The indicating thread gage with cone and vee rolls or segments and the thread groove diameter type with rolls inspect the minimum-material limit and size, C_1 and C_2, D_1 and D_2, of product external thread. Either type of three-roll and three-segment gage can check roundness of pitch cylinder for 120 deg. lobing and taper of pitch cylinder. The two rolls and two segments check even lobing roundness and taper. The indicating gages are set to proper thread-setting plug gage. Readings indicate the position of product external thread pitch diameter within the tolerance range.

5.10.2 Basic Design. The cone and vee indicating thread gage has rolls or segments with contact near the pitch line or contact slightly above the pitch line near the center of the flank. The thread groove diameter type indicating thread gage also has two or three rolls with the radii on the ribs of rolls made to "best size" thread wire size.

5.10.3 Thread Form. The specifications on form of cone and vee rolls and segments and thread groove diameter type rolls are shown in Figs. 27 and 28.

5.10.4 Identification. The assembled gage should be marked with the metric nominal size, pitch-tolerance class, PD, and pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g PD7.212

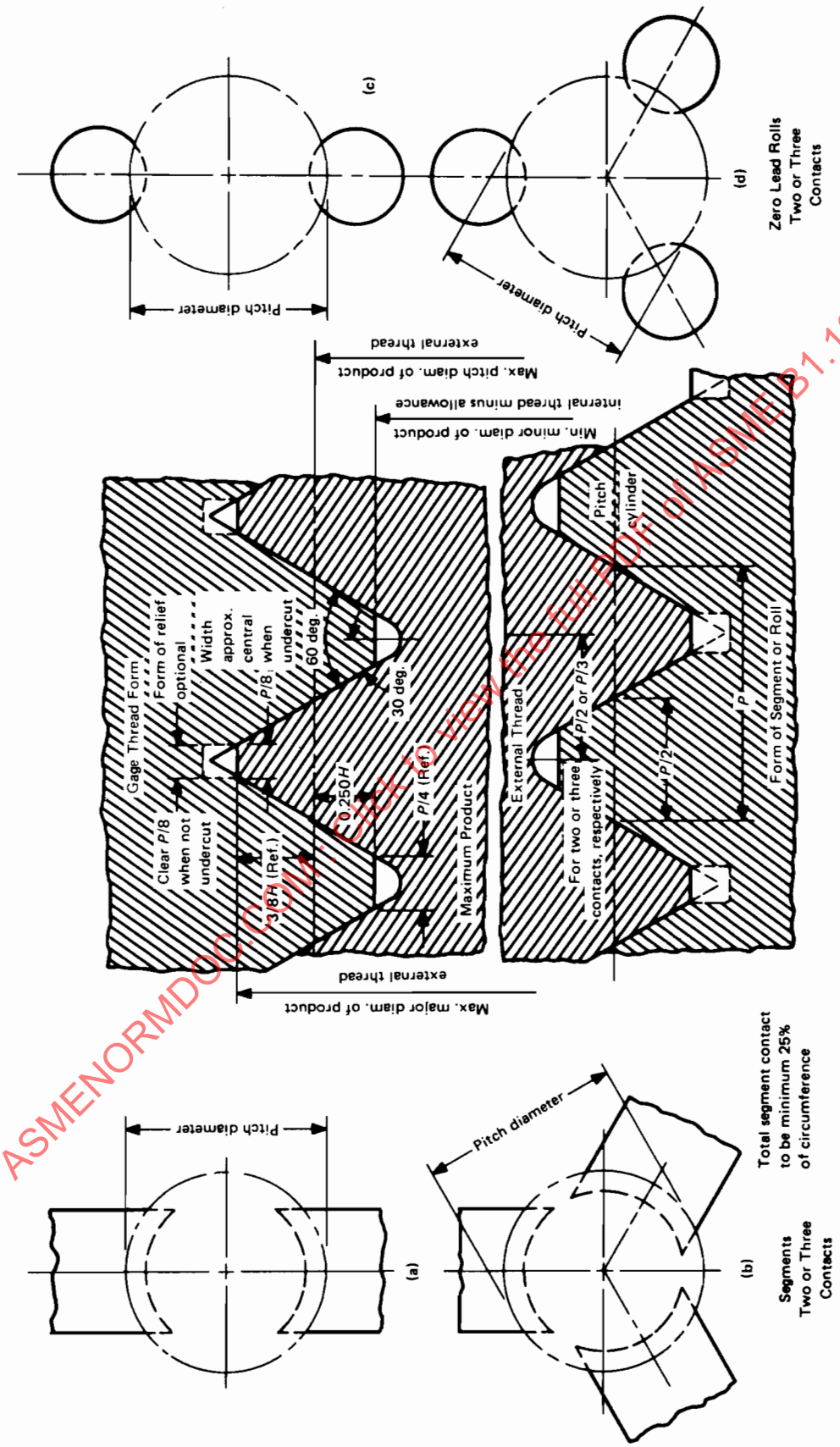


FIG. 26 INDICATING THREAD GAGES — MAXIMUM-MATERIAL GO FUNCTIONAL DIAMETER LIMIT AND SIZE

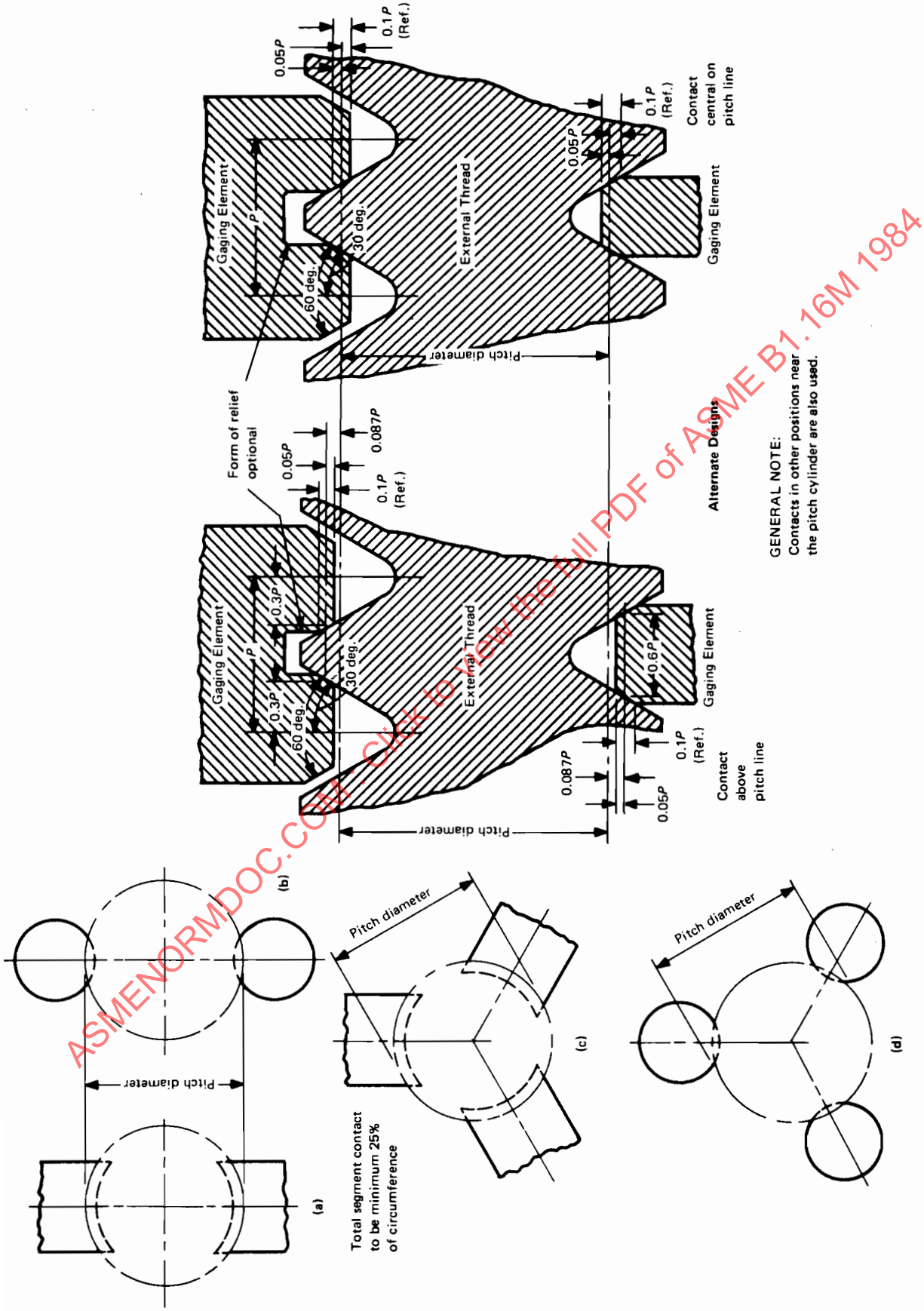
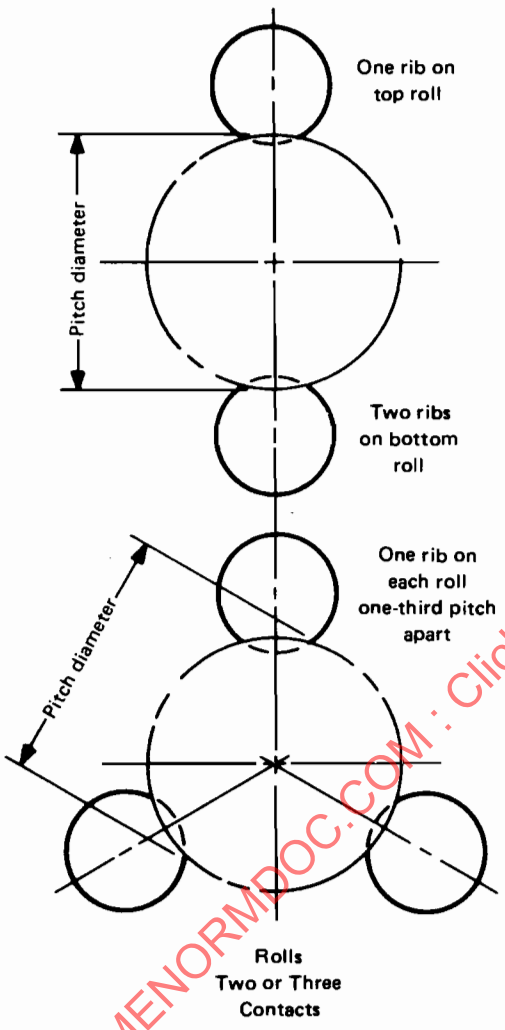


FIG. 27 INDICATING THREAD GAGES — MINIMUM-MATERIAL PITCH DIAMETER LIMIT AND SIZE — CONE AND VEE



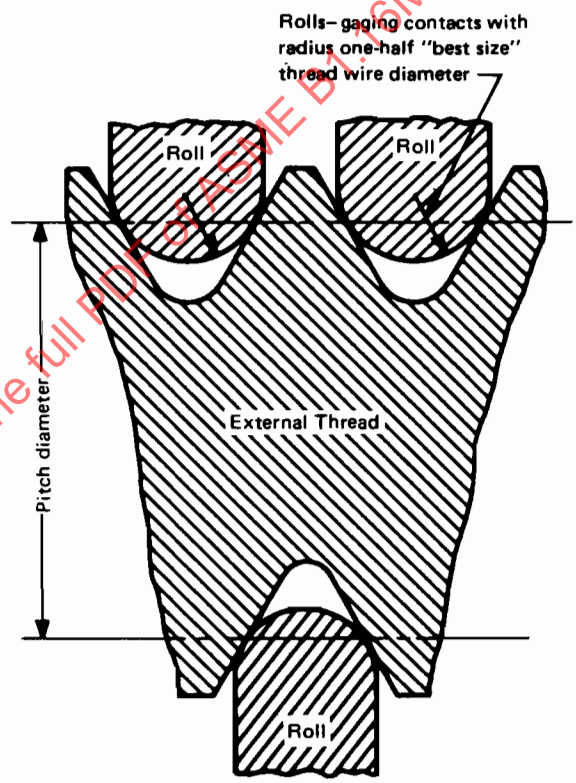


FIG. 28 INDICATING THREAD GAGES — MINIMUM-MATERIAL THREAD GROOVE DIAMETER LIMIT AND SIZE

5.11 Indicating Runout Gage for External Threads (Table 1 — Gage 4.7)

5.11.1 Purpose and Use. This indicating gage inspects the runout of the major diameter to the pitch diameter, M_1, of the product external thread. Readings indicate the position of product major diameter to the pitch diameter within the tolerance specified.

5.11.2 Basic Design. Indicating gages have three contacts, one plain and two threaded, at 120 deg., or two contacts, one plain and one threaded, at 180 deg. The threaded segments or roll contacts are minimum-material pitch diameter type. See Fig. 27. The lengths of the plain and threaded contacts are designed equal to the length of the standard GO ring gage. See ANSI/ASME B47.1aM and Table C2. The indicating gage is set to a basic full-form thread-setting plug gage with plain gaging contact on outside diameter of thread-setting plug gage and thread contact on pitch diameter of thread-setting plug gage.

5.11.3 Thread Form, Thread Crests, and Lead and Half-Angle Variations. The specifications for thread form, thread crests, and lead and half-angle of thread segments and thread rolls are noted in 5.9. Plain contacts have a line bearing on major diameter of product. See Fig. 29.

5.11.4 Identification. The gaging elements, segments, or rolls should be marked with metric nominal size and pitch. When indicating gage is assembled with proper gaging contacts, the indicating gage should be marked with the metric nominal size, pitch-tolerance class, and RUNOUT.

EXAMPLE:
M8 × 1-6g RUNOUT

5.12 Differential Gaging (Table 1 — Gage 4.8)

5.12.1 The concept of differential gaging for product external threads makes use of fundamental geometric theorems that relate directly to size, position, and form.

For differential gaging, two methods are used for measuring screw thread size:

(*a*) GO functional size

(*b*) pitch diameter (or thread groove diameter)

Only when a screw thread has perfect position and form [i.e., zero variation in lead (including helical path), flank angle, taper, and roundness] are these two measurements equal. Differential gaging is a variables method of in-process inspection, final conformance inspection, or both, that provides the actual numerical values for both GO functional and pitch diameter sizes. These are the two extreme sizes of any product screw thread. One of the sizes, pitch diameter, is the size of the thread pitch diameter with essentially zero variation in all other thread elements, while the other size, GO functional size, is the size of the thread with the effects of all variations in all other thread elements added to the pitch diameter. The numerical difference between these two sizes is called a *cumulative thread element variation differential* and represents the diametral effect of the total amount of thread element variation differential.

The inspection process that further refines the total amount of thread element variation so that the amount of variation for each individual element becomes known is called a *single thread element variation differential.*

5.12.2 Cumulative Thread Element Variation Differential. Indicating gages have either three contacts at 120 deg. spacing or two contacts at 180 deg. spacing. The indicating gages with segments or rolls as shown in Figs. 26 and 30, sketch (a), give the functional size indicating reading, Z. The indicating gage with cone and vee segments or rolls with one thread pitch engagement at pitch diameter line, Fig. 27, and thread groove diameter type, Fig. 28, or both, shown in Fig. 30, sketches (c) and (d), give the pitch diameter size indicating reading, X. The difference in the indicator readings, Z–X, between the two types of gages gives the cumulative form differential reading which corresponds to the pitch diameter equivalent, $\Delta d_2 C$, for the combination of lead, helix, flank angle, roundness, and taper variations on the product thread. See Fig. 30.

5.12.3 Single Thread Element Variation Differential

5.12.3.1 Lead (Helix) Differential Reading. The indicating gage reading, Y, using the full-form thread segments or rolls with one thread pitch engagement, similar to Figs. 26 and 30, sketch (b), is compared to the reading Z, using the functional size gage shown in Figs. 26 and 30, sketch (a). The difference between the measured values, Z − Y, is the lead differential reading which corresponds to the pitch diameter equivalent, $\Delta d_2 \lambda$, for the lead and helix variation on the product thread.

5.12.3.2 Flank Angle Differential Reading. The indicating gage reading, X, using segments or rolls with cone and vee design, Figs. 27 and 30, sketch (c), is compared to the reading, Y, using the full-form thread

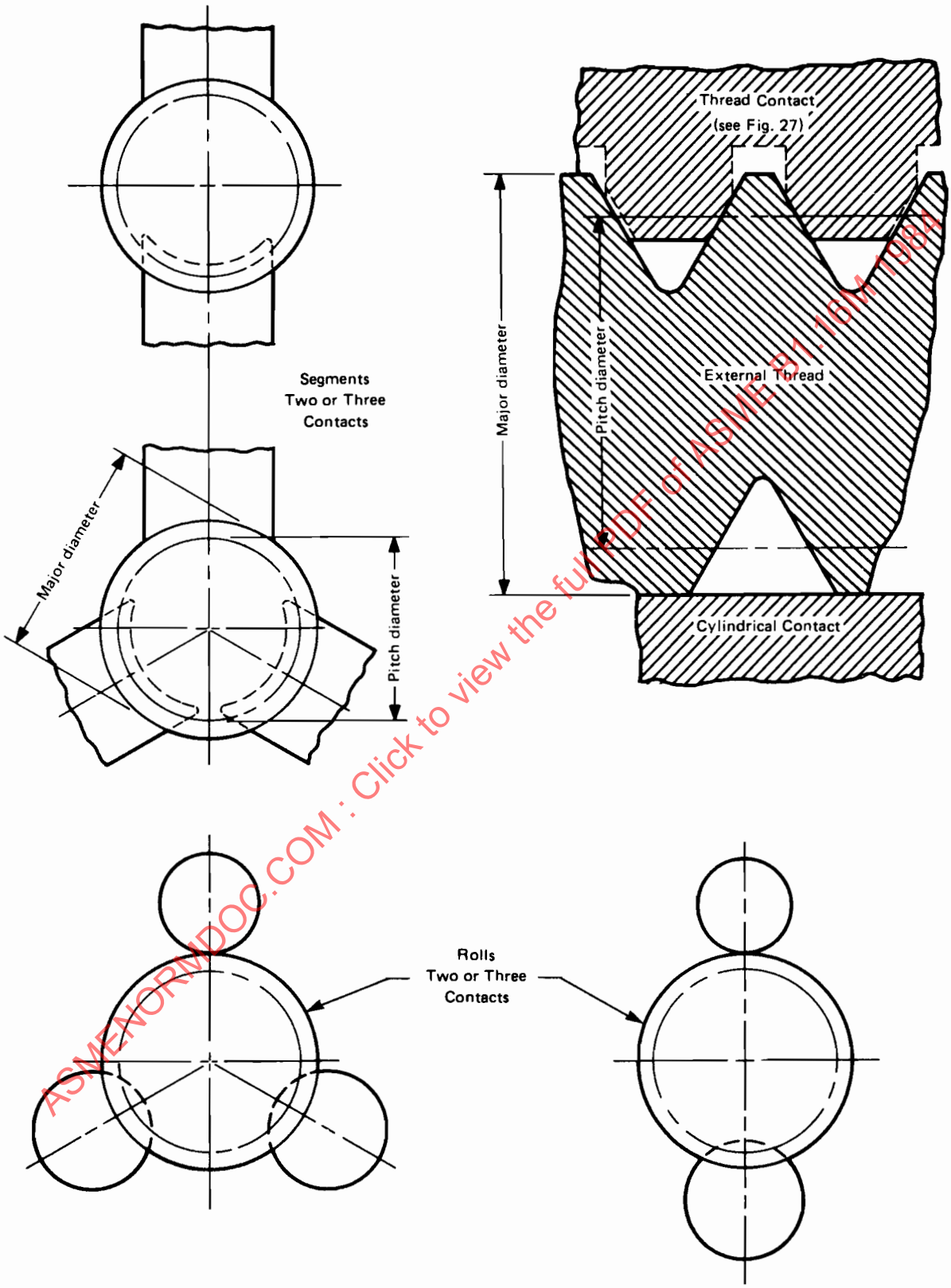


FIG. 29 INDICATING THREAD GAGES — DIAMETER RUNOUT — MAJOR TO PITCH

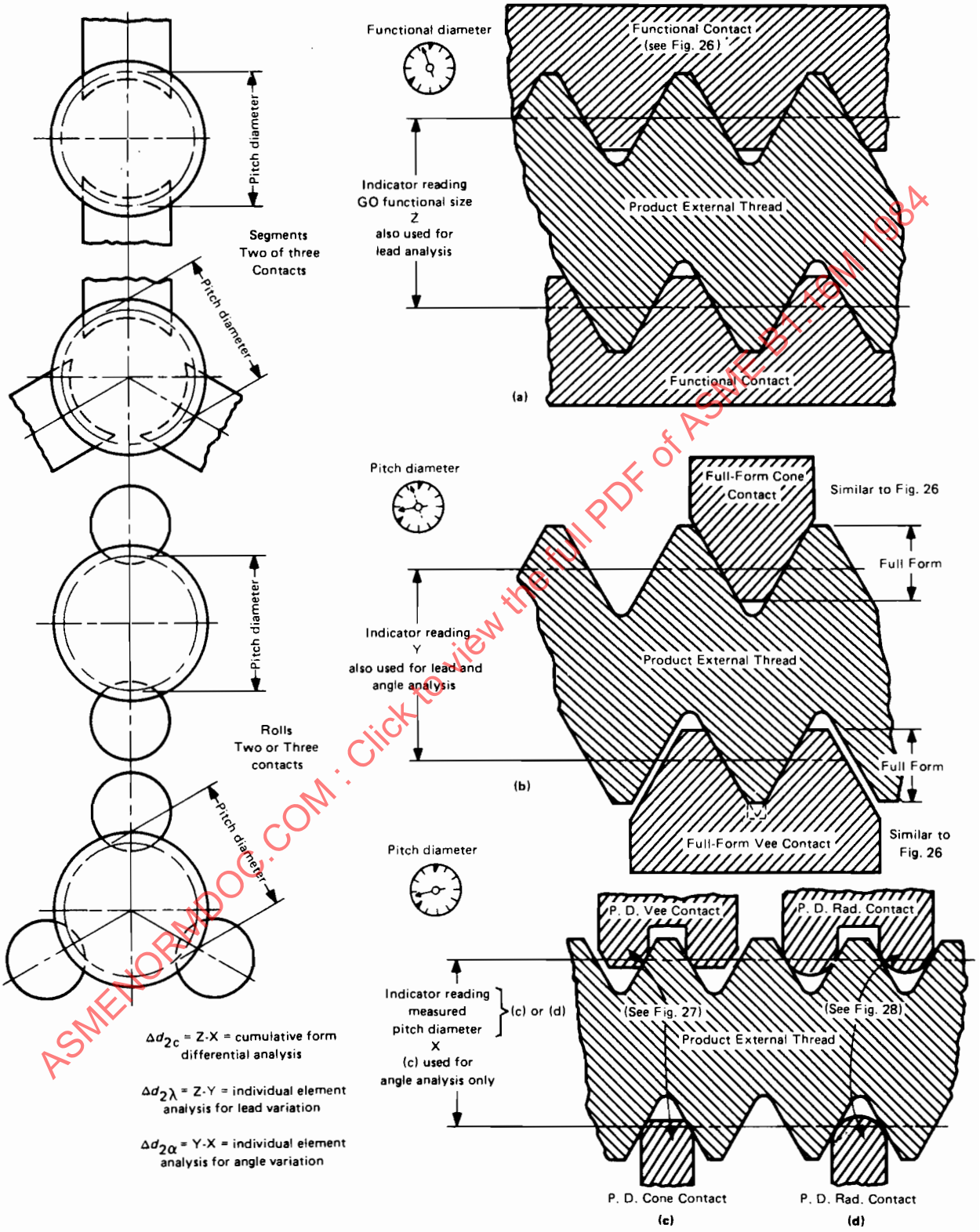


FIG. 30 INDICATING THREAD GAGES — DIFFERENTIAL GAGING

segments or rolls, similar to Figs. 26 and 30, sketch (b). Both designs have one thread pitch engagement. The difference between the measured values, Y − X, is the flank angle differential reading which corresponds approximately to the pitch diameter equivalent, $\Delta d_2 \propto$, for the combined flank angle variation on product thread.

5.12.3.3 Roundness and Taper Differential Readings. By the use of full-form thread segments or rolls with one thread pitch engagement, similar to Figs. 26 and 30, sketch (b), cone and vee segments or rolls, Figs. 27 and 30, sketch (c), or thread groove diameter type, Figs. 28 and 30, sketch (d), the roundness and taper of pitch cylinder is checked. Rotate the product between contacts at different axial locations on thread for maximum differences in roundness and taper readings. Two contacts spaced 180 deg. apart give even lobing out-of-round measurement. Three contacts spaced 120 deg. apart give odd lobing out-of-round measurements.

5.12.4 Thread Form. The functional segments or rolls, Fig. 30, sketch (a), are described in 5.9. The full-form, one thread vee segment or roll, Figs. 26 and 30, sketch (b) lower contact, has a depth of thread equivalent to the functional type, but relieved on the outside thread flanks. The full-form cone segment or roll, Figs. 26 and 30, sketch (b) upper contact, has a $P/8$ flat on outside diameter. The cone and vee segments or rolls, Fig. 30, sketch (c), are described and shown in Fig. 27. Thread groove diameter type, Fig. 30, sketch (d), is described and shown in Fig. 28.

5.12.5 Identification. The gaging elements (segments or rolls) should be marked by metric nominal size and pitch. Indicating gages, assembled with proper contacts, should be marked with metric nominal size, pitch-tolerance class, and the type of differential reading specified above.

EXAMPLE:
M8 × 1-6g Flank Angle Differential Variation

5.13 W Tolerance Thread-Setting Plug Gages

5.13.1 Purpose and Use. Thread-setting plug gages are used to set adjustable thread ring gages, check solid thread ring gages, set thread snap limit gages, and set indicating thread gages. Thread-setting plug gages are also applied to detect wear on gages and gaging elements in use. GO thread-setting plug gages are made to the maximum-material limit of the external thread specification, while LO thread-setting plug gages are made to the minimum-material limit of the thread specification.

5.13.2 Basic Design. Thread-setting plug gages are of two standard designs which are designated as full-form and truncated setting plugs. The full-form GO setting plug is one having a width of flat at the crest equal to $P/8$. The truncated GO setting plug is the same as the full-form setting plug except that it is longer and the crest of the thread is truncated a greater amount for one-half the length of the gage giving a full-form portion and a truncated portion. See Figs. 31 and 32 and Tables 5, 7, 11, and 13.

5.13.3 Gage Blanks. For practical and economic reasons, the lengths of setting plug gages have been standardized for various size ranges and pitches (see ANSI/ASME B47.1aM or Table C2). The length of the full form and the length of the truncated sections are each at least equal in length to the thickness of the corresponding thread ring gage.

5.13.4 Thread Form. The specifications for thread form of setting plug gages are stated in detail below and are summarized in Table 5 and Figs. 31 and 32.

5.13.5 Thread Crests

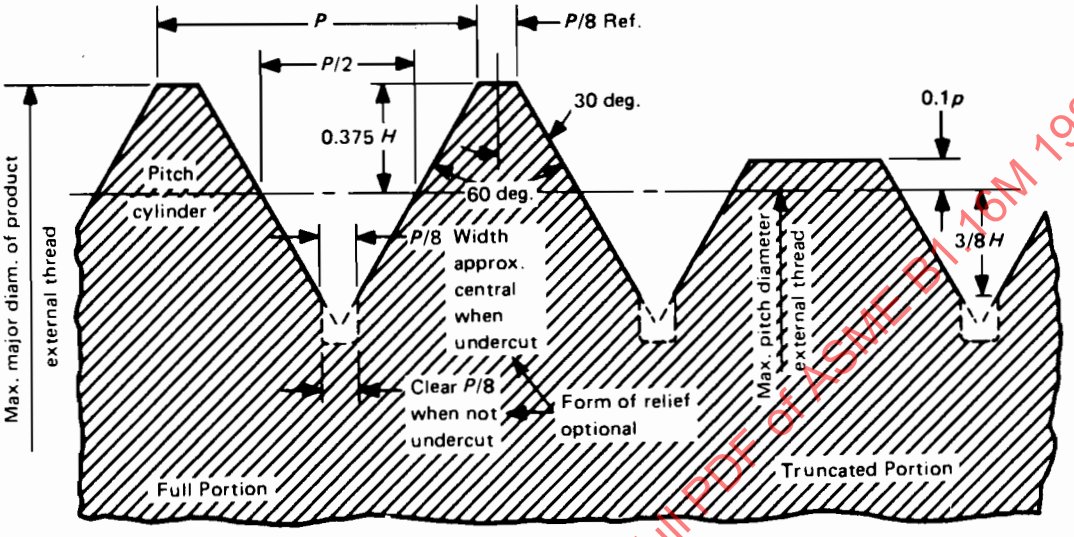
5.13.5.1 The major diameter of the GO full-form setting plug and of the full-form portion of the truncated GO thread-setting plug is equal to the maximum major diameter of the product external thread.

5.13.5.2 The major diameter of the truncated portion of the truncated GO thread-setting plug is equal to the maximum pitch diameter of the product external thread plus $0.2p$.

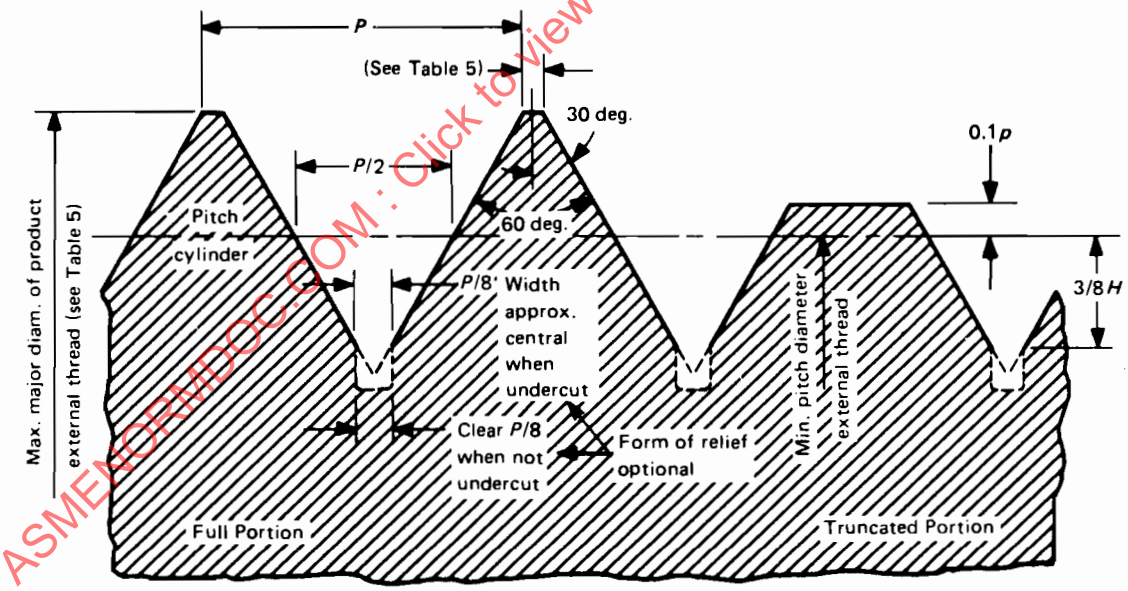
5.13.5.3 The major diameter of the LO full-form setting plug and of the full-form portions of the truncated LO thread-setting plug is equal to the maximum major diameter of the product external thread (same as GO thread-setting plug). The maximum major diameter of any gage must correspond to a truncation that is not less than 0.022 mm (equivalent to a crest width of 0.0254 mm flat). See Table 5.

5.13.5.4 The major diameter of the truncated portion of the truncated LO thread-setting plug is equal to the minimum pitch diameter of the product external thread plus $0.2p$.

5.13.6 Thread Roots. The minor diameter of thread-setting plug gages shall be cleared beyond a $P/8$ width of flat either by an extension of the sides of the thread toward a sharp vee or by an undercut no wider than $P/8$.

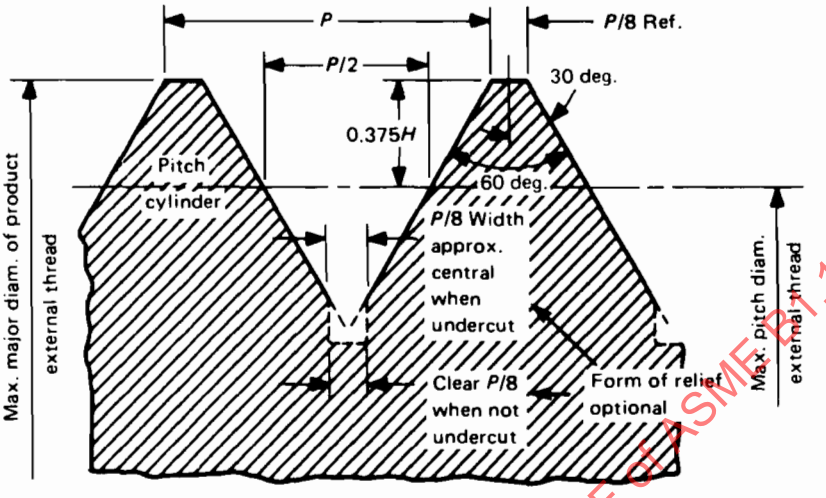


(a) Thread-Setting Plug for Maximum-Material Functional Limit and Functional Size GO Thread Gages

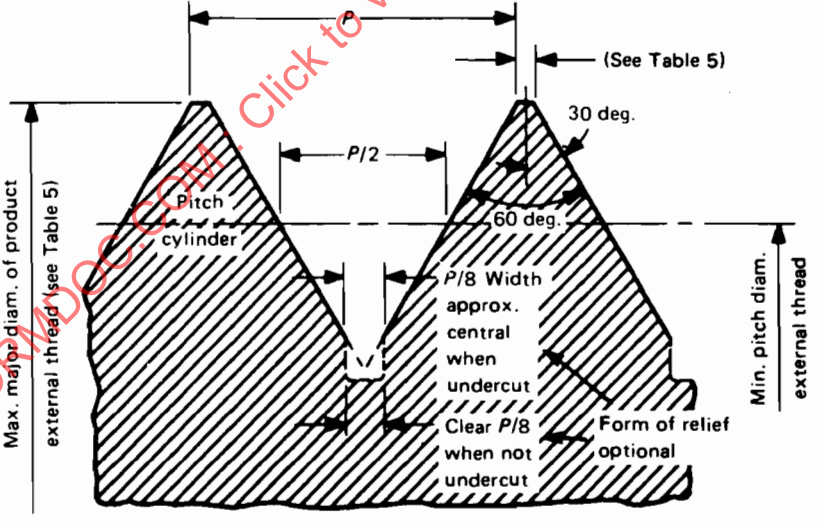


(b) Thread Setting Plug for Minimum-Material Gages and LO Functional Diameter Gages

FIG. 31 THREAD FORM OF TRUNCATED THREAD-SETTING PLUG GAGES



(a) Thread-Setting Plug for Maximum-Material Functional Limit and Functional Size GO Thread Gages



(b) Thread-Setting Plug for Minimum-Material Gages and LO Functional Diameter Gages

FIG. 32 THREAD FORM OF FULL-FORM THREAD-SETTING PLUG GAGES

5.13.7 Pitch Diameter Limitation of Taper. The permissible taper shall be back taper (largest diameter at entering end) and shall be confined within the gage pitch diameter limits.

5.13.8 Incomplete Thread. The feather edge at both ends of the threaded section of the setting plug shall be removed. On pitches coarser than 0.8 mm not more than one complete turn of the end threads shall be removed to obtain a full-thread blunt start. See Fig. 2. On pitches 0.8 mm and finer, a 60 deg. chamfer from the axis of the gage is acceptable in lieu of the blunt start.

5.13.9 Lead Variations. In the case of truncated setting plugs, the lead variations present on the full-form portion and the truncated portion of an individual gage shall not differ from each other by more than 0.003 mm over any portion equivalent to the length of the thread ring gage, or nine pitches, whichever is less. The specified tolerance shall be applicable to the thread length in the mating ring gage or nine pitches, whichever is smaller. The tolerance on lead establishes the width of a zone, measured parallel to the axis of the thread, within which the actual helical path must lie for the specified length of the thread. Measurements will be taken from a fixed reference point, located at the start of the first full thread, to a sufficient number of positions along the entire helix to detect all types of lead variations. The amounts that these positions vary from their basic (theoretical) positions will be recorded with due respect to sign. The greatest variation in each direction [plus or minus (±)] will be selected, and the sum of their values, disregarding sign, shall not exceed the tolerance limits specified in Table 7.

5.13.10 Half-Angle Variations. Variations in half-angle shall be within the limits specified in Table 7.

5.13.11 Identification. The GO thread-setting plug gage shall be marked with metric nominal size, pitch-tolerance class, GO, SETTING, PD, and GO pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g GO SETTING PD7.324

The LO thread-setting plug gage shall be marked with metric nominal size, pitch-tolerance class, LO, SETTING, PD, and LO pitch diameter in millimeters.

EXAMPLE:
M8 × 1-6g LO SETTING PD7.212

5.14 Plain Check Plug Gages for Thread Ring Gages

5.14.1 Purpose and Use. GO and NOT GO plain check plug gages verify the minor diameter limits of thread ring gages after the thread rings have been properly set with the applicable thread-setting plug gages.

5.14.2 Basic Design. The direction of the gage tolerances on GO and NOT GO plain plug gages for GO ring minor diameter and GO and NOT GO plain plug gages for NOT GO ring minor diameter is as follows: GO — tolerance plus; NOT GO — tolerance minus. Class X tolerance is used on gages up to 5 mm size, class Y tolerance above 5 mm size (see Table 8).

5.14.3 Gage Blanks. For standardization and economic reasons the gaging members and handles have been standardized for various size ranges (see ANSI/ASME B47.1aM).

5.14.4 Identification. The GO and NOT GO plain check plug gages for the GO thread ring gage should be marked with metric nominal size, pitch-tolerance class, GO and NOT GO diameters in millimeters, and GO MINOR DIAMETER CHECK PLUG. The GO and NOT GO plain check plug gages for the LO thread ring gage should be marked with metric nominal size, pitch-tolerance class, GO and NOT GO diameters in millimeters, and LO MINOR DIAMETER CHECK PLUG.

EXAMPLES:

For GO ring: M8 × 1-6g GO 6.878 NOT GO 6.891
GO MINOR DIAMETER CHECK PLUG
For LO ring: M8 × 1-6g GO 7.012 NOT GO 7.025
LO MINOR DIAMETER CHECK PLUG

5.15 Indicating Plain Diameter Gages — Major Diameter of Product External Threads (Table 1 — Gage 5.1)

5.15.1 Purpose and Measuring Procedures. The indicating plain diameter gage inspects the major diameter, J_1 and J_2, of the external thread. After the plain contacts of the indicating gage are set to a plain diameter setting plug and the dial is read, the gage is placed on the product thread major diameter for a second reading. The difference in readings is applied to the value of the set master to obtain the major diameter size.

5.15.2 Basic Design. Indicating gages have three plain contacts at 120 deg. or two plain contacts at 180 deg. The dimensions of segments or rolls are to manufacturer's standard. See Fig. 33.

5.15.3 Identification. Indicating gages, assembled with proper contacts, should be marked with metric nominal size, pitch-tolerance class, major diameter limits in millimeters, and MAJOR DIAMETER.

EXAMPLE:
M8 × 1-6g 7.974–7.794 MAJOR DIAMETER

5.16 Indicating Gages to Check Minor Diameter of External Thread (Table 1 — Gage 5.2)

5.16.1 Purpose and Use. The maximum minor diameter limit , K_1 and K_2, of product external thread is considered acceptable if the product accepts GO thread gages. If further checking is required, the indicating gage with 55 deg. maximum included angle thread contacts is used to check the minor diameter.

5.16.2 Basic Design. A thread indicating gage with segments or rolls has a thread form of 55 deg. maximum. There are usually three threads in segments and three ribs on rolls. See Fig. 34.

5.16.3 Identification. Indicating gages, assembled with proper rolls or segments, should be marked with metric nominal size, pitch-tolerance class, minor diameter limits (customer's specifications) in millimeters, and MINOR DIAMETER EXTERNAL.

EXAMPLE:
M8 × 1-6g (Minor diameter limits as specified by customer)
MINOR DIAMETER EXTERNAL

5.17 Thread Micrometers (Table 1 — Gages 6, 7, and 14)

5.17.1 Purpose and Use. Thread micrometers with cone and vee anvils are used to inspect the minimum-material pitch diameter limit and size of external thread. Micrometer can check 180 deg. ovality of pitch diameter and taper of pitch diameter. Modified vernier calipers are used similarly.

5.17.2 Basic Design. The depth of thread on cone and vee is either approximately pitch diameter contact or the LO limit profile. Measurements are made in 0 mm to 25 mm and 25 mm to 50 mm diameter ranges. The smallest graduation is 0.01 mm.

5.18 Thread-Measuring Wires (Table 1 — Gage 8)

5.18.1 Purpose and Use. Using a measuring machine, product thread can be checked using three measuring wires between product thread and parallel flat anvils of measuring machine. Wires are "best size" thread wire contacting at the thread groove diameter, with two wires on one side and one wire 180 deg. around. This type of measurement checks the minimum-material groove diameter limit and size. By rotating the product thread between wires, the 180 deg. ovality of groove diameter is checked. Measuring at different locations axially, the taper of the groove diameter is checked. It should be recognized that the measuring force shown for measuring hardened thread gages with wires may not be appropriate for softer product thread materials due to the possibility of the wires being forced into the surface of the thread flanks. This would indicate a smaller thread size than what actually exists. See Appendix B.

5.19 Optical Comparator and Toolmaker's Microscope (Table 1 — Gage 9)

5.19.1 Purpose and Use. The optical comparator magnifies and projects the thread profile on a screen. For best profile image, the threaded item is positioned so that the light is aligned with the thread lead angle. Since the thread profile is defined in a plane including the axis, a correction factor may be added to the measured flank angle observed normal to the lead angle. For most standard single lead threads, the correction factor is less than 0 deg. 5 min. See A2.6.1.

Optical comparators are generally fitted with lenses providing various magnifications between 10X and 100X. Profile dimensions are checked using appropriate linear and angular scales on the machine and by the application of thread profile, radius, and other overlay charts. Other groove and ridge dimensions, and axial plane pitch and lead may be checked. Major, minor, and pitch diameters are identified, then measured using table traverse readouts.

5.19.2 The toolmaker's microscope is similar in function to the optical comparator but does not include screen projection or overlay charts. Magnifications are generally lower than those of optical comparators. Some microscopes have thread profile and radius templates which are inserted in the eyepiece.

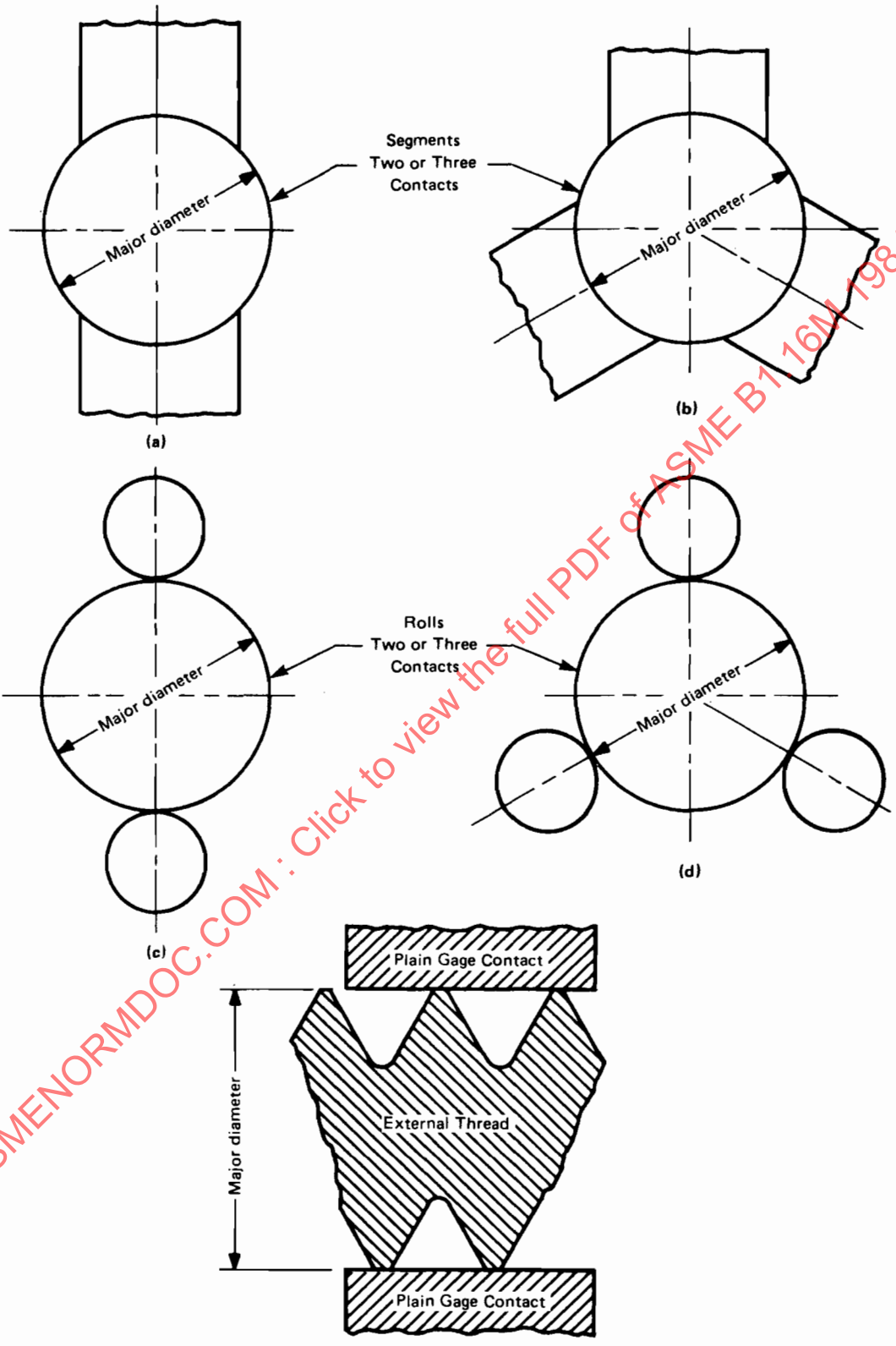


FIG. 33 INDICATING PLAIN DIAMETER GAGE — MAX.-MIN. MAJOR DIAMETER LIMIT AND SIZE

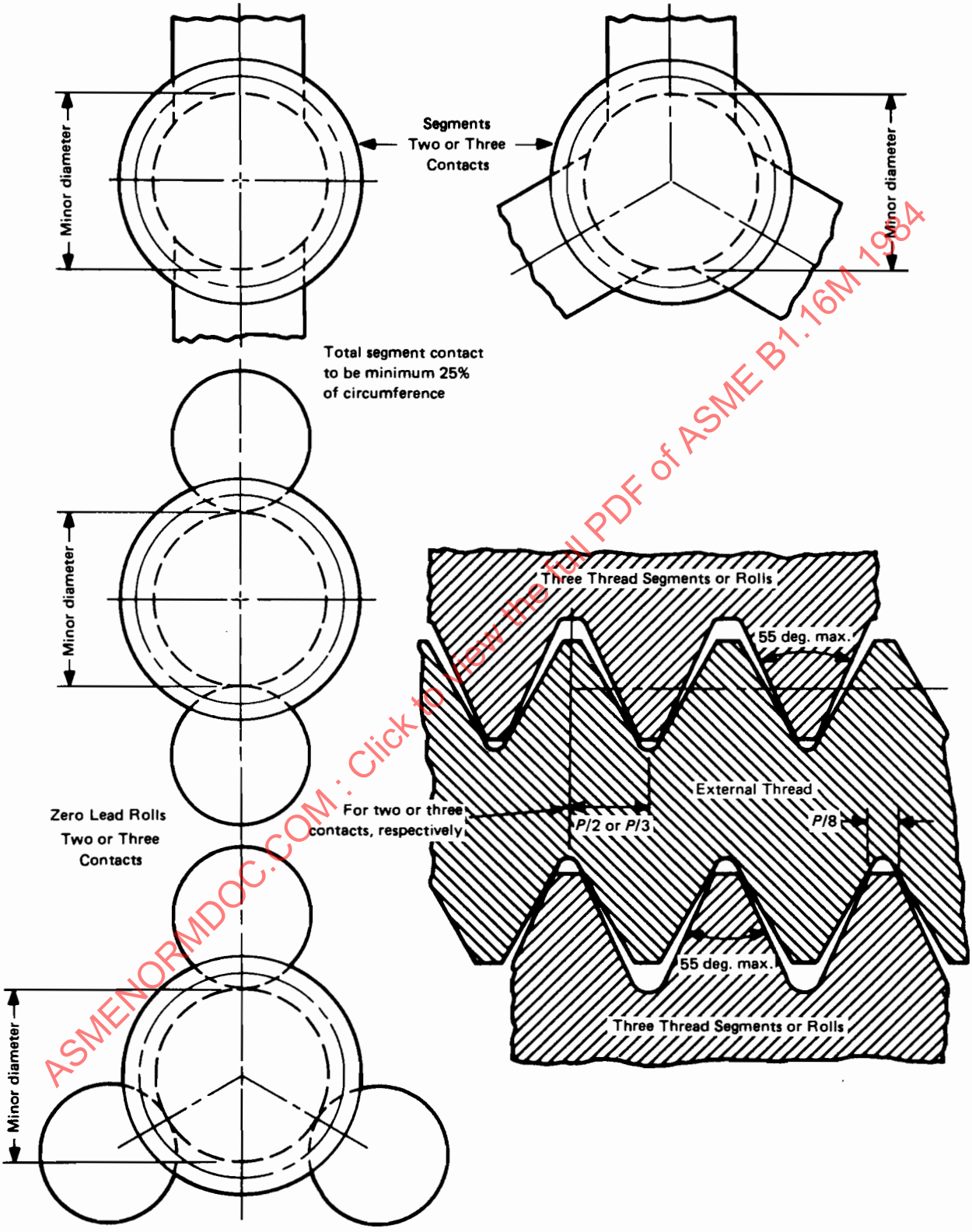


FIG. 34 INDICATING DIAMETER GAGES — MAX.-MIN. MINOR DIAMETER LIMIT AND SIZE

TABLE 14 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREADS

	Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards (Note 7)
1	Thread rings (ANSI/ASME B47.1aM)		
1.1	GO ring	Pitch (also helical offset at split; see A3.4), flank angles, minor diameter, pitch diameter, taper of pitch cylinder, straightness, roundness, clearance at root (Note 6)	W thread-setting plug for GO; X tolerance plain plug for minor diameter for small thread sizes
1.2	LO ring	Pitch (also helical offset at split; see A3.4), flank angles, minor diameter, pitch diameter, taper of pitch cylinder, straightness, roundness, clearance at root (Note 6)	W thread-setting plug for LO; X tolerance plain plug for minor diameter for small thread sizes
2	Thread snap gages		
2.1	GO segments	Pitch, flank angles, minor diameter, pitch diameter, taper, straightness, clearance at root (Notes 4–6)	W thread-setting plug for GO (Note 7)
2.2	LO segments	Pitch, flank angles, minor diameter pitch diameter, clearance at root (Notes 4–6)	W thread-setting plug for LO (Note 7)
2.3	GO rolls (zero lead)	Pitch, flank angles, width of flat at crest, taper of pitch cylinder on each roll, parallelism of axes of rolls, clearance at root (Notes 4–6)	W thread-setting plug for GO (Notes 7, 8)
2.4	LO rolls (zero lead)	Pitch, flank angles, width of flat at crest, clearance at root (Notes 4–6)	W thread-setting plug for LO (Notes 7, 8)
2.5	Minimum material, pitch diameter type, cone and vee	Pitch of vee, width of flat at crest, height of thread (Notes 4–6)	W thread-setting plug for LO (Notes 7, 8)
2.6	Minimum material, thread groove diameter type, cone only, "best size" thread wire	Radius of contacts corresponding to "best size" thread wire size (Notes 4–6)	W thread-setting plug for LO (Notes 7, 8)
3	Plain diameter gages		
3.1	Maximum plain cylindrical GO ring for major diameter	Taper, straightness, roundness, diameter	Series of plain plug gages in 0.0025 mm steps or direct diameter measurement with internal measuring equipment using gage blocks equal to the maximum major diameter
	Plain cylindrical NOT GO ring for major diameter	Taper, straightness, roundness, diameter	Series of plain plug gages in 0.0025 mm steps or direct diameter measurement with internal measuring equipment using gage blocks equal to the minimum major diameter

TABLE 14 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREADS (CONT'D)

Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards (Note 7)
3.2 Major diameter snap type	Parallelism, flatness of contacts, distance between contacts	Plain Z tolerance plug gage or gage blocks with roll corresponding to maximum major diameter or direct measurement
3.3 Minor diameter snap type (55 deg. maximum included angle)	Pitch, diameter, included angle of thread form, clearance form at tips of snap contacts	Plain Z tolerance plug gage or gage blocks equal to the maximum minor diameter or direct measurement
3.4 Maximum and minimum major diameter snap type	Parallelism, flatness of contacts, distance between contacts	Plain Z tolerance plug gage or gage blocks with roll corresponding to maximum or minimum major diameter or direct measurement
3.5 Maximum and minimum minor diameter snap type (55 deg. maximum included angle)	Pitch, diameter, 55 deg. maximum included angle of thread form, clearance form at tips of snap contacts	Plain Z tolerance plug gage or gage blocks equal to the maximum or minimum minor diameter or direct measurement
4 Indicating thread gages having either two contacts at 180 deg. or three contacts at 120 deg.		
4.1 GO segments	Pitch, flank angles, minor diameter, pitch diameter, taper, straightness, clearance at root, minor cylinder to pitch cylinder relationship of segments for coaxiality (Notes 4–6)	W thread-setting plug for GO (Note 7)
4.3 GO rolls (zero lead)	Pitch, flank angles, minor diameter, taper, straightness, parallelism of axes of rolls to each other, clearance of root (Notes 4–6)	W thread-setting plug for GO (Notes 7, 8)
4.5 Minimum material, pitch diameter type, cone and vee	Pitch, width of flat at crest, height of thread (Notes 4–6)	W thread-setting plug for GO or for basic pitch diameter or for LO (Notes 7, 8)
4.6 Minimum material, thread groove diameter type, cone only "best size" thread wire size)	Radius of contact (Notes 4–6)	W thread-setting plug for LO (Notes 7, 8)
4.7 Major diameter and pitch diameter runout gage	Pitch and flank angles of thread segments, straightness of plain gages, major cylinder to pitch cylinder, relationship of segments for coaxiality (Notes 4–6)	None

TABLE 14 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREADS (CONT'D)

Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards (Note 7)
4.8 Differential segments and rolls	GO profile of one pitch segment or roll requires flank angles checked GO full-form segments (see 4.1 above) GO full-form rolls (see 4.3 above) Minimum-material, pitch diameter type, cone and vee (see 4.5 above) Minimum-material, thread groove diameter type, cone only "best size" thread wire size (see 4.6 above)	Not required: special lead standards and flank angle standards with generated variation portion and near perfect portion
5 Indicating plain diameter gages		
5.1 Major diameter type	Parallelism and flatness of contacts (Note 5)	Plain Z tolerance plug gage for GO or basic major diameter or gage blocks
5.2 Minor diameter type	Pitch, diameter, 55 deg, maximum included angle of thread form, width of flat on crests	Plain Z tolerance plug gage for basic minor diameter at radiused root
6 Pitch micrometer with standard contacts [approximately LO profile] cone and vee	Pitch, flank angles. Maximum error in indicated measurements up to 25 mm shall not exceed 0.003 mm for pitches up to 0.6 mm, 0.004 mm for pitches greater than 0.6 mm and up to 1.75 mm, and 0.005 mm for pitches greater than 1.75 mm. For measurements greater than 25 mm, error may be increased by 0.001 mm.	W thread-setting plug for basic pitch diameter, or GO pitch diameter standard or LO (Note 7)
7 Pitch micrometer with modified contacts (approximately pitch diameter contact) cone and vee	Pitch, flank angles, width of flat at crest, height of thread. Maximum error in indicated measurements up to 25 mm shall not exceed 0.003 mm for pitches up to 0.6 mm, 0.004 mm for pitches greater than 0.6 mm and up to 1.75 mm, and 0.005 mm for pitches greater than 1.75 mm. For measurements greater than 25 mm, error may be increased by 0.001 mm.	W thread-setting plug for basic pitch diameter, or GO, or LO (Note 7)
8 Thread measuring wires ("best size" thread wire size) with suitable measuring means	Flatness and parallelism of spindle and anvil faces, screw calibration, measuring force	Calibrated "best size" thread wire size measuring wires and gage blocks
9 Optical comparator or toolmaker's microscope with suitable fixturing	Micrometer stage, magnification, radius chart, protractor head (Note 4)	Gage blocks, plug gages, sine bar

TABLE 14 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR EXTERNAL PRODUCT THREADS (CONT'D)

	Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards (Note 7)
10	Profile tracing equipment with suitable fixturing	Use manufacturer's instructions to test stylus traverse and electronic amplification	Special angle block supplied with instrument
11	Lead measuring machine with suitable fixing	Traversing system, straightness of ways, stylus radius	Lead standard, gage blocks
12	Helical path attachment used with GO type indicating gage	Lead, flank angles, taper, straightness, clearance at root (Notes 4, 5)	Lead standard
13	Helical path analyzer	Use manufacturer's instructions to test the mechanical and electronic features	Lead standard
14	Plain micrometer and calipers, modified as required	Maximum error in indicated measurements up to 25 mm shall not exceed 0.003 mm for pitches up to 0.6 mm, 0.004 mm for pitches greater than 0.6 mm and up to 1.75 mm, and 0.005 mm for pitches greater than 1.75 mm. For measurements greater than 25 mm, error may be increased by 0.001 mm.	Gage blocks, or calibrated plain plug gages
15	Surface measuring equipment	Use manufacturer's instructions for calibration procedures	Precision roughness standard
16	Roundness equipment	Use manufacturer's instructions for calibration procedures	Precision glass sphere, roundness magnification standard

NOTES:
(1) See Table 1.
(2) Use applicable X, W, or Z gage tolerance.
(3) Taper, straightness including bellmouth barrel shape and hourglass shape, and roundness shall be within the X, W, or Z tolerance depending on the element measured. In other words, if these features are measured at pitch cylinder, the tolerance for pitch diameter applies.
(4) Use manufacturer's recommended procedures for gage for checking the thread features and alignment of indicating gage components.
(5) New rolls and segments shall be within X tolerance. Worn rolls or segments shall be replaced when a single thread element wears outside of X tolerance.
(6) Pitch diameter is usually transferred from thread-setting gages.
(7) When the gage is set by adjustment based upon actual measured pitch diameter of the setting master, the master shall meet all W tolerances except for pitch diameter, which may have a tolerance increased to X.
(8) Pitch diameter size on some adjustable thread snap gages and indicating thread gages may be set from one or more of the following:
  (a) Z tolerance plain cylindrical plug gage
  (b) gage blocks
  (c) direct measurement
  (d) specially designed transfer standards
  Rolls must be qualified for setting from their outside diameters.

TABLE 15 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREADS

	Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards
1	Thread plug (ANSI/ASME B47.1aM)		
1.1	GO plug	Lead, flank angles, major diameter, pitch diameter, taper, straightness, roundness, clearance at root	Three "best size" thread wires, gage blocks
1.2	HI plug	Lead, flank angles, major diameter, pitch diameter, taper, straightness, roundness, clearance at root	Three "best size" thread wires, gage blocks
2	Thread snap gages		
2.1	GO segments	Lead, flank angles, major diameter, pitch diameter, taper, straightness, clearance at root (Notes 4, 5)	Solid W thread-setting ring for GO (if direct measurement of pitch diameter is not made) (Notes 6, 8)
2.2	HI segments	Pitch, flank angles, major diameter, pitch diameter, clearance at root (Notes 4, 5)	Solid W thread-setting ring for HI (if direct measurement of pitch diameter is not made) (Notes 6, 8)
2.3	GO rolls (zero lead)	Pitch, flank angles, width of flat at crest, taper of pitch cylinder on each roll, straightness, parallelism of assembled rolls, clearance at root (Notes 4, 5)	Solid W thread-setting ring for GO (Notes 6, 8)
2.4	HI rolls (zero lead)	Pitch, flank angles, width of flat at crest, clearance at root (Notes 4, 5)	Solid W thread-setting ring for HI (Notes 6, 8)
2.5	Minimum material, pitch diameter type, cone and vee	Pitch, width of flat at crest, height of thread (Notes 4, 5)	Solid W thread-setting ring for HI (Notes 6, 8)
2.6	Minimum material, thread groove diameter type, cone only ("best size" thread balls)	Radius of contacts (Notes 4, 5)	Solid W thread-setting ring for HI (Notes 6, 8)
3	Plain diameter gages		
3.1	Minimum plain cylindrical plug for minor diameter	Taper, straightness, roundness, diameter	Gage blocks
3.2	Minimum major diameter snap type (55 deg. maximum included angle)	Pitch, included angle, dimension over segments or rolls, width of flat at crests (Note 4)	Plain Z tolerance ring gage for GO major diameter or gage blocks between jaws
3.3	Minimum minor diameter snap type	Taper, straightness or coaxiality of cylindrical segments or rolls, dimension over segments or rolls (Note 4)	Plain Z tolerance ring gage for GO minor diameter or gage blocks between jaws

TABLE 15 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREADS (CONT'D)

Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards
3.4 Maximum and minimum major diameter snap type (55 deg. maximum included angle)	Pitch, included angle, dimension over segments or rolls, width of flat at crests (Note 4)	Plain Z tolerance ring gage for GO major diameter; plain Z tolerance ring gage for HI major diameter or gage blocks between jaws
3.5 Maximum and minimum minor diameter snap type	Taper, straiaghtness, coaxiality of cylindrical segments or rolls, dimension over segments or rolls (Note 4)	Plain Z tolerance ring gage for GO minor diameter; plain Z tolerance ring gage for HI minor diameter or gage blocks between jaws
4 Indicating thread gages having either two contacts at 180 deg. or three contacts at 120 deg.		
4.1 GO segments	Lead, flank angles, major diameter, pitch diameter, taper, straightness, clearance at root, major cylinder to pitch cylinder; relationship of segments for coaxiality (Notes 4, 5)	Solid W thread-setting ring for GO or basic pitch diameter (Notes 6–8)
4.3 GO rolls (zero lead)	Pitch, flank angles, major diameter, taper, straightness, clearance at root, parallelism of axes of rolls to each other (Notes 4, 5)	Solid W thread-setting ring for GO (Notes 6, 9)
4.5 Minimum material, pitch diameter type, cone and vee	Pitch, width of flat at crest, height of thread (Notes 4, 5)	Solid W thread-setting ring for GO or HI or basic pitch diameter (Notes 6, 9)
4.6 Minimum material, thread groove type, cone only	Radius of contacts (Notes 4, 5)	W thread-setting ring for HI (Notes 6, 9)
Minimum material, thread groove type, three "best size" thread balls, two ball contact spaced four pitches	Ball diameter (Notes 4, 5)	Plain Z tolerance ring gages whose diameter is basic pitch diameter plus ½ the "best size" thread ball size
4.7 Minor diameter and pitch diameter runout gage	Straightness of plain gage segment, pitch, flank angle, straightness of thread segment, minor cylinder to pitch cylinder, relationship of segments for coaxiality (Notes 4, 5)	None

TABLE 15 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREADS (CONT'D)

Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards
4.8 Differential segment or roll	GO profile of one pitch in length, segment or roll, requires flank angles checked GO full-form segment (see 4.1 above) GO full-form roll (see 4.3 above) Minimum material, pitch diameter type, cone and vee, (see 4.5 above) Minimum material, thread groove type, cone only, (see 4.6 above)	Not required: special internal lead standard and internal flank angle standard with generated errors portion and near perfect portion
5 Indicating plain diameter gages		
5.1 Major diameter type (55 deg. maximum included angle)	Pitch, included angle of flanks, width of flat on crests	Plain Z tolerance ring gage for basic major diameter or GO major diameter, gage blocks, direct measurement
5.2 Minor diameter type	Straightness, parallelism of contacts (Note 5)	Plain Z tolerance ring gage for basic minor diameter, gage blocks, direct measurement
6 Internal pitch micrometer with standard contacts (approximately HI profile) cone and vee	Pitch, flank angles, maximum error in indicated measurement in the micrometer head shall not exceed 0.005 mm	Solid W thread-setting ring gage for basic pitch diameter, measurement over wires (Note 6)
7 Internal pitch micrometer with modified contacts (approximately pitch diameter contact) cone and vee	Pitch, flank angles, width of flat at crest, height of thread. Maximum error in indicated measurement in the micrometer head shall not exceed 0.005 mm	Solid W thread-setting ring gage for basic pitch diameter (Note 6)
8 Thread measuring ball with suitable measuring means	Flatness and parallelism of internal anvils, screw calibration, measuring force	Gage blocks, calibrated "best size" thread balls
9 Optical comparator or tool-maker's microscope with suitable fixturing and cast replica	Micrometer stage, magnification, radius chart, protractor head (Note 4)	Gage blocks, plug gages, sine bar, stage micrometer
10 Profile tracing equipment with suitable fixturing	Use manufacturer's instructions to test stylus traverse and electronic amplification	Special angle block supplied with instrument
11 Lead measuring machine with suitable fixturing	Traversing system, straightness of ways, stylus radius	Lead standard gage blocks

TABLE 15 CALIBRATION REQUIREMENTS AND STANDARDS FOR X TOLERANCE THREAD GAGES, INDICATING GAGES, PLAIN GAGES, AND MEASURING EQUIPMENT FOR INTERNAL PRODUCT THREADS (CONT'D)

	Thread Gages and Measuring Equipment (Note 1)	Calibration Requirements for Gages and Measuring Equipment (Notes 2, 3)	Setting Gages and Standards
12	Helical path analyzer	Use manufacturer's instructions to test the mechanical and electronic features	Lead standard
13	Plain internal micrometer and calipers modified as required	Maximum error in indicated measurement in the micrometer head shall not exceed 0.005 mm	Gage blocks, or calibrated plain plug gages
14	Surface measuring equipment	Use manufacturer's instructions for calibration procedures	Precision roughness standard
15	Roundness equipment	Use manufacturer's instructions for calibration procedures	Precision glass sphere, roundness magnification standard

NOTES:
(1) See Table 2.
(2) Use applicable X, W, or Z gage tolerance.
(3) Taper, straightness, including bellmouth barrel shape and hourglass shape, and roundness shall be within the X, W, or Z tolerance depending on the element measured. In other words, if these features are measured at pitch cylinder, the tolerance for pitch diameter applies.
(4) Use manufacturer's recommended procedures for gage for checking the thread features and alignment of indicating gage components.
(5) New rolls and segments shall be within X tolerance. Worn rolls or segments shall be replaced when a single thread element wears outside of X tolerance.
(6) Pitch diameter is usually transferred from thread-setting gage.
(7) When the gage is set by adjustment based on actual measured pitch diameter of the setting master, the master shall meet all W tolerances except for pitch diameter, which may have a tolerance increased to X.
(8) Pitch diameter size on some types of adjustable gages may be set from Z tolerance plain ring gages or direct measurement. Rolls must qualify for setting from their outside diameters.
(9) Pitch diameter size may be set by direct measurement over wires on 180 deg. segments, with specially designed transfer standards or by Z tolerance plain ring gages when rolls are qualified for setting from their outside diameters.

TABLE 16 CALIBRATION REQUIREMENTS FOR THREAD- AND PLAIN-SETTING GAGES

Setting Gage	Calibration Requirements
GO, LO and W thread-setting plug gage, truncated and full form	Lead, flank angles, major diameter, pitch diameter, taper, straightness and roundness of major and pitch cylinders, clearance at root, coaxiality of major cylinder with pitch cylinder
GO, HI and solid W thread-setting ring gage	Lead, flank angles, minor diameter, pitch diameter (Note 1), taper, straightness and roundness of minor and pitch cylinders, clearance at root, coaxiality of minor cylinder with pitch cylinder
Plain Z tolerance plug and ring gages	Diameter, taper, straightness, and roundness

NOTE:
(1) Pitch diameter of an internal thread, measured by "best size" thread ball contacts, will be 0.0025 mm to 0.005 mm larger than the pitch diameter, gaged indirectly by a snug-fitting master thread plug gage or locked segments of an indicating gage which have been measured by "best size" thread wire method. This difference is due to the functional size of the master thread plug gage or locked segments which unavoidably have small deviations in lead, flank angle, taper, and roundness.

5.20 Profile Tracing Instrument (Table 1 — Gage 10)

5.20.1 Purpose and Use. The instrument checks thread contours to an accuracy of 0.005 mm for 25 mm of horizontal and 2.5 mm vertical travel at 100X magnification. The chart paper trace may be analyzed for elements of the thread profile, including depth, crest width, lead angle, and radius at root of thread.

5.21 Electromechanical Lead Tester (Table 1 — Gage 11)

5.21.1 Purpose and Use. The electromechanical lead tester consists of a precision, direct-reading headstock in combination with an axially movable carriage supporting a sine bar, two work-mounting centers, electronic thread locating head with a ball point, and a milliammeter for registering the center position of the ball probes in the thread groove. Ball point stylus approximates the "best size" thread wire radius. To extend lead measurements beyond 25 mm, gage blocks in 25 mm steps are used to displace the screw thread. Lead measurements accurate to 0.0006 mm are read directly from micrometer scales on headstock.

5.22 Helical Path Attachment Used With GO Type Thread Indicating Gage (Table 1 — Gage 12)

5.22.1 Purpose and Use. To observe the presence of helical path variation with a GO type indicating gage, Fig. 35, the following procedure is used:

(*a*) a suitable means is used to lock (restrict) axially the lower gaging element;

(*b*) the top gaging element is allowed to float freely (axially) on its own stud and at least one full pitch away from the frame;

(*c*) the product to be inspected is inserted into the gaging elements so that the conditions described in (a) and (b) above are met;

(*d*) an indicator (usually attached to the comparator) is positioned so that the indicator contact point locates at the face of the free floating (top) gaging element;

(*e*) the product is turned one full revolution. The presence of helical path variation causes the top gaging element to displace itself axially on its own stud.

(*f*) the full-indicator movement is observed.

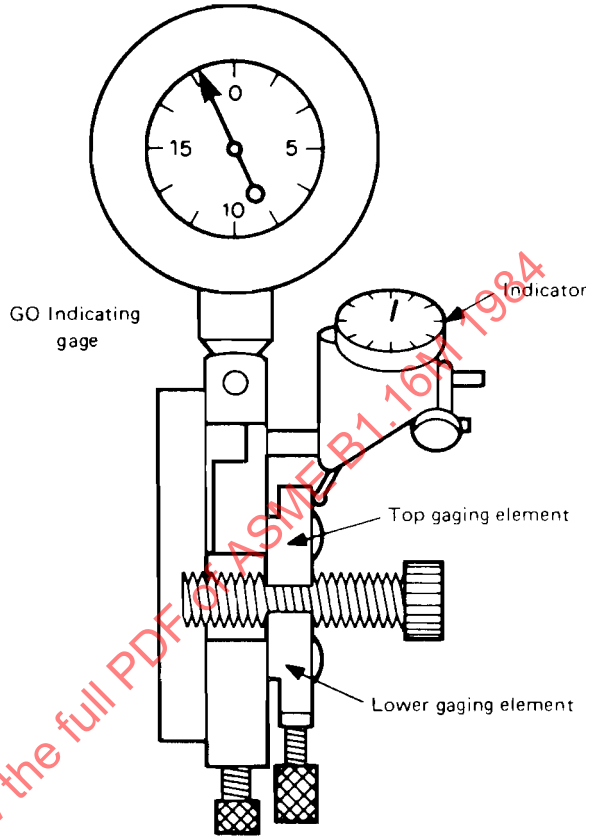


FIG. 35 INDICATING GAGES — HELICAL PATH ATTACHMENT USED WITH GO TYPE INDICATING GAGE

5.23 Helical Path Analyzer (Table 1 — Gage 13)

5.23.1 Purpose and Use. A helical path analyzer is a self-contained unit consisting of a motor-driven headstock, tailstock, electronic gaging head, sine bar, follower, pitch blocks, selsyn transmitter for chart recorder, and operator control panel.

The external workpiece to be measured is mounted between centers. The motor-driven headstock rotates the part through three revolutions at one setting. At the same time, this rotary motion is transmitted to the chart drive of the recorder. Simultaneously, the driving ribbon running off the headstock actuates the sine bar laterally on a ball slide in direct proportion to the spindle rotation. The sine bar is set previously to the proper angle for the particular pitch using the applicable pitch block. The electronic gage head floats axially on ball slides, the movement being controlled

by constant spring pressure of the sine bar follower against the sine bar.

The chart gives readings in lead variation and so-called drunken thread variation. Chart division is equal to 0.0005 mm per division.

5.24 Surface Roughness Equipment (Table 1 — Gage 15)

5.24.1 Purpose and Use. Measurement of surface roughness on screw thread flanks is usually made with an instrument which traverses a radiused stylus across the lay. The stylus displacement due to the surface irregularities is electronically amplified and the meter reading displays the arithmetical average roughness height in micrometers (see ANSI B46.1, Surface Texture: Surface Roughness, Waviness, and Lay). Some instruments produce a chart of the traced path which shows the peak-to-valley heights of the surface irregularities. Special fixturing is required to position and guide stylus over thread surface.

5.25 Roundness Equipment (Table 1 — Gage 16)

5.25.1 Purpose and Use. There are two types of precision roundness measuring instruments; precision rotary tables and precision spindles. A special stylus coupled to an electric unit records the out-of-roundness on a circular chart as it traces around the cylindrical surface of the workpiece. The instrument provides a series of magnifications for stylus displacement, a filtering system for isolating lobing from surface irregularities, various means for centering the amplified stylus trace on the polar chart, and a selection of rotating speeds. For details on measuring and for other methods for checking roundness, see ANSI B89.3.1, Measurement of Out-of-Roundness.

5.26 Miscellaneous Gages and Gaging Equipment

5.26.1 The description of the external gages, as noted in 5.1 through 5.25, is definitely not a complete catalog of the various types available for inspection purposes. The gages not described above may be used provided they adhere to the standard thread practice noted in this Standard (i.e., truncation, form of thread, tolerances, etc.) and have producer and consumer agreement.

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APPENDIX A
CALIBRATION AND INSPECTION OF LIMIT GAGES, SNAP GAGES, INDICATING GAGES, AND MEASURING INSTRUMENTS

(This Appendix is not part of ANSI/ASME B1.16M-1984, and is included for information purposes only.)

A1 GENERAL

There are more ways to calibrate gages than those briefly described herein. Since this Appendix covers only the most commonly used designs of limit, snap, and indicating gages, the inspector may have to modify the method described for it to become applicable. Special fixturing may be necessary for the small and large gages.

Specially designed screw thread indicating gages may at times be more practical for making measurements on thread gage elements than the cumbersome all-purpose laboratory instruments which may lack adequate fixturing to do an efficient job.

Before one calibrates, sets, or uses limit, snap, and indicating gages, they should be cleaned and examined visually for nicks, burrs, and foreign matter, using a minimum of 10X magnification. Defects must be corrected.

A2 THREAD PLUG GAGE CALIBRATION

GO and HI	Thread Plug Gages
GO and LO	Truncated Setting Plug Thread Gages
GO and LO	Full-Form Thread-Setting Plug Gages

A2.1 External Pitch Diameter Measurement

The formula and method of measuring pitch diameter on thread plug gages are described in Appendix B.

A2.2 Pitch Variation Measurement

Only those thread plug gages that have their centers intact can be mounted on centers for evaluation. The measurements are made on a pitch-testing machine by using a hardened steel stylus with a radius matching the "best size" thread ball. The stylus, which contacts both the leading and following flanks, engages selected complete threads at the pitch line in a direction parallel to the axis of the gage.

The measurements are made at both ends of the gage and one or more positions in between along one line; then they are repeated along another line at 180 deg. around the gage. The mean of the two sets of readings is taken in order to eliminate the effect of any misalignment of the measuring axis with respect to the gage axis. The importance of pitch measurement is to estimate its effect on functional size. The diameter equivalent of a pitch variation of 0.002 mm is 0.0035 mm.

Since gages have very small pitch tolerances, the measurement of pitch by optical projection is not recommended.

A2.3 Helix Variation Measurement

Helical variation may be measured with helix measuring machines or on special fixtured indicating gages. Manufacturer's instructions should be used.

A2.4 Major Diameter Measurement

The measuring instrument is set with gage blocks, cylindrical standards, or cylindrical standards and gage block combination which approximate the major diameter size. Then the outside diameter of the thread is placed between parallel anvils of a measuring machine or micrometer. The measuring faces are brought into contact with the threads using the specified measuring force. Additional readings are taken along the axis and around the gage to verify that the variations in roundness and taper are within the major diameter tolerance.

A2.5 Thread Form

Thread form is checked by either optical projection or toolmaker's microscope. After the recommended magnification is selected, the profile may be compared to thread templates, and the root radius may be compared to a series of radii on a chart. The truncation, width of flat, and root clearance can be measured by using the micrometer screws to translate the image of the thread feature with respect to cross lines in the projector of hairlines in the microscope.

A2.6 Flank Angle Measurement

A2.6.1 If both centers are available, the flank angles may be measured by optical projection or toolmaker's microscope using magnifications shown in Table A1.

The plug gage is mounted on the centers in a fixture which can be tilted to the helix so that both flanks are in focus. See corrective angles shown in Table A2.

The leading and following 30 deg. angles are each measured with respect to the major cylinder or axial to the thread axis. The protractor head should read out to 1 min of arc. The cross line or hairline is set parallel to the thread feature permitting a very narrow slit of light between. If the thread flank is not straight, the inspector may either position the line to average out the flank irregularities or measure both the addendum and dedendum flank angles.

A2.6.2 Profile tracing equipment is available for making profile charts of each flank on 2.5 mm and larger pitches.

A2.7 Runout Between Major Cylinder and Pitch Cylinder

The fixed anvil of the measuring instrument or micrometer engages the major cylinder of the gage, and the movable anvil straddles two thread-measuring wires which are pressed against the pitch cylinder with a force appropriate for pitch diameter measurement. This reading is taken and is followed by a series of readings obtained by rotating the threaded gage until the maximum and minimum values are found. The maximum difference in measurements shall be within the runout tolerance between the major cylinder and pitch cylinder.

A2.8 Minor Diameter Measurement

Minor diameter can be measured with measuring machine or micrometer, provided special 55 deg. maximum conical contacts with radius or small flat tips are used. Gage axis must be mounted normal to the measuring screw axis. A gage block combination corresponding to the basic minor diameter should be used to set the measuring screw. Optical projection may be used also.

TABLE A1 MINIMUM MAGNIFICATION

Pitch, mm	Minimum Magnification
More than 1.75	20X
1.75–0.6	50X
0.6 and less	100X

A3 THREAD RING GAGE INSPECTION

GO and LO Thread Ring Gages
GO and HI Thread-Setting Ring Gages

A3.1 Internal Pitch Diameter Measurement

A3.1.1 Measurement of internal pitch diameter has seldom been practiced in the United States because instrumentation has not been readily available. Thus, the pitch cylinder is transferred to split ring gages from the GO and LO thread-setting plugs by adjustment. Solid working and setting ring gages are sized by lapping until a light drag is noticed as they are screwed on the setting plugs. Sizes under 5 mm can only be gaged with plug gages.

A3.1.2 The measured pitch diameter on rings fitted to a setting plug may be 0.0025 mm to 0.005 mm larger than the measured pitch diameter on the plug because the pitch diameter equivalents from permissible pitch, lead, and flank angle tolerances on matched plug and ring cause some unavoidable discrepancy.

A3.1.3 Measurement of internal pitch diameter using "best size" thread ball is restricted to sizes from 5 mm and larger. It is measured with ball contacts mounted to caliper jaws and coupled to an indicating gage. One jaw has a fixed ball and the other jaw a pair of floating balls with center spacing of two or more pitches. The caliper jaws are usually set to zero on an X tolerance plain ring whose diameter is the sum of the basic pitch diameter of the gage plus one-half the "best size" thread ball diameter. The ball contacts are brought in contact with the flanks of the internal thread. A series of measurements are made around the gage at both ends and in the middle. The indicator

TABLE A2 60 deg. INCLUDED THREAD ANGLE

Helix Angle		Correction		Helix Angle		Correction	
deg.	min.	deg.	min.	deg.	min.	deg.	min.
2		0	54	9		18	23
2	10	1	4	9	10	19	4
2	20	1	14	9	20	19	46
2	30	1	24	9	30	20	29
2	40	1	36	9	40	21	12
2	50	1	48	9	50	21	57
3		2	2	10		22	42
3	10	2	16	10	10	23	28
3	20	2	31	10	20	24	15
3	30	2	47	10	30	25	2
3	40	3	4	10	40	25	50
3	50	3	21	10	50	26	38
4		3	38	11		27	28
4	10	3	56	11	10	28	19
4	20	4	16	11	20	29	11
4	30	4	35	11	30	30	2
4	40	4	56	11	40	30	55
4	50	5	18	11	50	31	47
5		5	40	12		32	42
5	10	6	2	12	10	33	37
5	20	6	27	12	20	34	33
5	30	6	31	12	30	35	29
5	40	7	17	12	40	36	27
5	50	7	43	12	50	37	25
6		8	10	13		38	23
6	10	8	37	13	10	39	23
6	20	9	5	13	20	40	25
6	30	9	35	13	30	41	25
6	40	10	5	13	40	42	26
6	50	10	35	13	50	43	30
7		11	6	14		44	33
7	10	11	38	14	10	45	37
7	20	12	11	14	20	46	42
7	30	12	46	14	30	47	47
7	40	13	20	14	40	48	55
7	50	13	55	14	50	50	2
8		14	31	15		51	10
8	10	15	8				
8	20	15	46				
8	30	16	24				
8	40	17	2				
8	50	17	42				

reading gives the variation from the size to which the gage was set.

A3.2 Internal Pitch Variation Measurement

The ground face of the thread ring gage is clamped to a face plate and mounted normal to the measuring axis of the pitch-testing machine. A modified stylus with "best size" thread ball radius is needed to contact the internal threads. Measurements are made along one line parallel to thread axis at two or more intervals, and then these same intervals are measured on another line after rotating the gage 180 deg. The means of the variations of corresponding intervals are taken to eliminate the effect of misalignment of measuring axis with gage axis.

A3.3 Helix Variation Measurement

Helical variations are measured on a special fixtured indicating gage. Manufacturer's instructions should be used.

A3.4 Helix Offset Measurement on Adjustable Thread Ring Gages

When an adjustable thread ring gage is reset, the helix offset at the split line must be checked and may not exceed the X tolerance for pitch. One way to measure the misalignment is to screw the adjustable ring partially onto its setting plug, which is clamped to a vee block on a surface plate. With the face of the ring gage parallel to the surface plate, allow the spherical probe of an electronic height gage to contact the exposed thread flank near the edge of the slit. Note the reading. Next, slowly rotate the ring so that the probe crosses the slit and rests on the thread flank again and note the reading. The difference in readings shall not exceed X tolerance for lead. Sometimes the offset can be realigned by resetting and gently tapping it into alignment and relocking the gage.

A3.5 Minor Diameter

There are varieties of internal gages with plain cylindrical segments coupled to mechanical and electronic indicators which are suitable for the measurement. The indicating gages are set to a master gage made with parallel jaws attached to gage block combinations corresponding to the basic minor diameter. Measurements are made to locate the maximum and minimum diameters to prove that the ring minor diameter is within tolerance.

A3.6 Thread Form

Casts made of nonshrinking and nondeforming material such as dental plaster, selected resins, and silicone are necessary to evaluate thread form. The profiles are examined by optical projection or by toolmaker's microscope. Thread form templates are used for comparison purposes. Also, truncation, width of flat, and root clearance can be measured with the micrometer-driven table.

A3.7 Flank Angle Measurements

Casts are required. They are mounted with plasticine to a fixture which can be tilted in the field of the optical projector or toolmaker's microscope. Further details are given in A2.6. Profile tracing equipment is available for making profile charts of each flank angle on 2.5 mm pitch and larger. Manufacturer's instructions describe the process.

A3.8 Major Diameter Measurement

Threaded segments with 55 deg. maximum included angles and slightly truncated at the crests are used with an internal indicating gage. The segments are set to a plain ring gage or to the inner sides of parallel jaws attached to a gage block combination equivalent to the basic major diameter of the ring gage. The thread ring gage is explored for maximum and minimum diameter.

A3.9 Runout Between Minor Cylinder and Pitch Cylinder

Horizontally clamp handle end of setting plug in vee block which is clamped on a surface plate. Next, screw thread ring gage part way onto plug. Lubricate threads if there is a snug fit. Position ball contact of electronic height gage on the exposed minor cylinder of the ring gage. Next, slowly rotate ring to obtain the full-indicator reading for the runout.

A4 PLAIN PLUG GAGE CALIBRATION

GO and NOT GO	Plain Plug Gages, Z Tolerance
GO and NOT GO	Plain Setting and Check Plug Gages, X and Y Tolerances

A4.1 Outside Diameter Measurement

A4.1.1 The Z tolerance plug gage is measured between flat parallel contacts of a micrometer which has a resolution of 0.001 mm. The micrometer is set

with a tolerance Grade 3 gage block close to the size of the plug to minimize error in micrometer screw. Readings around and along the plug are taken to verify that the gage is within Z tolerance.

A4.1.2 The X or Y tolerance plug gage is measured between flat parallel anvils of a measuring machine which has a resolution to 0.00025 mm or less, with a measuring force of 4.5 N. The flatness and parallelism of the anvils should be within 0.00025 mm. The calibration history of the measuring screw should not exceed 0.00075 mm. The measuring machine anvils are set with a tolerance Grade 3 gage block combination which corresponds to the marked diameter of the plug gage. Measurements are made around the plug near the ends and middle to determine that ovality, out-of-roundness, barrel shape, and taper are within tolerance. Also, one measured diameter is marked, and this mark is used as the starting position for generating a roundness chart on a roundness testing instrument for compliance to tolerance. Roundness is assessed by the minimum circumscribed circle method on the chart. The out-of-roundness is the radial separtion between the minimum circumscribed circle and the maximum inscribed circle. Refer to ANSI B89.3.1, Measurement of Out-of-Roundness, for details on roundness measurement.

A5 PLAIN RING GAGE CALIBRATION

GO and NOT GO	Plain Ring Gages, Z Tolerance
GO and NOT GO	Plain Setting Ring Gages, X Tolerance

A5.1 Diameter Measurement

A5.1.1 The Z tolerance ring gage is measured with internal indicating gage or measuring instrument which has a resolution of 0.001 mm. The measuring device is usually set with a master gap produced by clamping jaws to the selected gage block combination. Measurements are taken around the bore near ends and in the middle.

A5.1.2 The X tolerance ring gage is measured over two radius contacts on an internal measuring instrument. Internal measuring procedure is given in ANSI B89.1.6, Measurement of Qualified Plain Internal Diameters for Use as Master Rings and Ring Gages. The measuring device is set with a master gap produced by clamping flat parallel jaws on the gage block combination corresponding to the ring gage dimension. The gage blocks and the jaws which are accessories to gage block sets must meet the requirements specified in ANSI/ASME B89.1.9M-1984, Precision Gage Blocks for Length Measurement (Through 20 in. and 500 mm). The small displacement between ring gage diameter and master gap is read on the meter. Measurements are taken around the gage, near the ends, and in the middle. The measuring instrument should have a readout of at least 0.00025 mm. A referenced position at the middle of the bore is used to index the out-of-roundness check as described in A4.1.2.

A6 PLAIN SNAP GAGES

GO and NOT GO plain snap gages for external major diameter check are set with plain Z tolerance plug gages. When the adjustable anvil is locked, there should be a very light drag felt when plug gage or roll is pushed between anvils for its entire travel. If this does not occur, anvils are worn out of parallel and should be relapped. The snap may be set with gage blocks and roll whose combined thickness equals the major diameter limit. When the adjustable anvil is locked, the small roll should have a very light drag when moved across the anvil.

A7 ROLLS WITH ZERO LEAD THREAD FORM USED ON SNAP AND INDICATING GAGES

Rolls may be checked for thread form and size by optical projection (see A2.5 and A2.6). Pitch is measured as described in A2.2. New rolls should be manufactured to X tolerances. Worn rolls should be replaced when a single thread element wears outside of X tolerance.

A8 INSPECTING PERIPHERAL CONTACTING SEGMENTS ON INDICATING GAGES

A8.1 Inspection of the Threaded Section Used on External Product Threads

A8.1.1 Straightness (Taper, Bellmouth, and Barrel Shape)

(*a*) Using the last three threads of the *full-form* portion of the truncated type setting plug (handle end on taperlock blanks), engage the *first* three threads on *one* end of the segments. Note the reading.

(*b*) Using the same procedure, engage the *last* three threads on the *other* end of the segments. Note the reading.

(*c*) Repeat step (a) using *first* three threads of the *truncated* portion of the plug (opposite the handle end on taperlock blanks). Note the reading.

(*d*) Repeat step (b) using the first three threads of the *truncated* portion of the plug. Note the reading.

Indicated differences exceeding X tolerance for pitch diameter between reading (a) and (b) or (c) and (d) reveal the segments as having an end-to-end straightness deviation.

NOTE: More definitive analysis for bellmouth or barrel shape can be made by using a check plug (full-form or truncated) having a maximum length of three pitches, rotating the plug through the full length of the segments, and noting the plus and minus (±) indicator variation at specific points in the segments.

A8.1.2 Flank Angle Wear

(*a*) Indicated differences exceeding X tolerance for pitch diameter values obtained by A8.1.1 procedure (a) and (c), or (b) and (d), reveal that the segments have excessive flank angle wear; or

(*b*) Indicated differences exceeding X tolerance for pitch diameter values obtained between the full-form portion and the truncated portion of the setting plug when engaging the segments over their full length also reveal that the segments have excessive flank angle wear.

A8.1.3 Lead Error. Should the preceding checks for straightness and flank angle wear fall within X tolerance, the check for lead error is performed as follows.

(*a*) Using the last three threads of the *full-form* portion of the setting plug (handle end on taperlock blanks), engage the *first* three threads on one end of the segments. Note the reading.

(*b*) With the three thread engagement above, rotate the *full-form* portion of the plug through the segments to full length engagement. Note the reading.

An indicated difference exceeding X tolerance for pitch diameter between the first and second readings above reveals that the segments have excessive lead error.

(*c*) Repeat steps (a) and (b) with the *truncated* portion of the plug. Note the reading.

An indicated difference exceeding X tolerance for pitch diameter between the first and second readings reveals that the segments have a lead error.

A8.1.4 Thread Form and Cylindrical Form Continuity. For checking continuity of threaded and plain surfaces (helical profile uniformity, continuous thread flank contact with setting plug, and cylindrical contacts), the conventional bluing procedure is used.

A8.1.5 Minor Cylinder to Pitch Cylinder Relationship of Each Segment

(*a*) With each like coded segment, measure from its mounting hole over the outside diameter of a plain plug whose diameter is that of the specified maximum minor diameter and which is resting on the minor diameter of the segment. Note the two readings.

(*b*) With each like coded segment, measure from its mounting hole over the outside diameter of the W tolerance GO thread plug — full-form section — as it rests in the segment thread. Note the readings.

The differences between matching sets of readings from steps (a) and (b) for each segment must be within the X tolerance for minor diameter.

NOTE: Inspection fixtures can be used for the above.

A8.1.6 Minor Cylinder Size Compared to Pitch Cylinder Diameter Size and Minor Diameter Straightness (As a Coded Pair)

(*a*) Using the full-form portion of the W tolerance-setting plug, engage its entire length into the segments and zero-out the indicator.

(*b*) Using a plain cylindrical plug having a size equal to the maximum-material minor diameter of the thread size in question, engage that plug fully into the segments and note the reading.

The difference in reading must be within the X tolerance specified for minor diameter.

(*c*) To verify the taper of the minor diameter, partially engage the plain cylindrical plug from each end of the segments.

(*d*) Measure directly for straightness from the segment mounting hole directly to the minor diameter flats of each thread in the segment.

A8.1.7 Minor Cylinder to Pitch Cylinder Coaxiality Relationship (As a Coded Pair)

NOTE: Even though the size of the minor diameters may be within tolerances, they may not be coaxial.

(*a*) Using the full-form portion of the W tolerance-setting plug, engage the entire length into the segments and zero-out the indicator at the high point. Lock the segments on the studs, with the set screws provided in the backs of the segments to prevent them from pivoting. Lift the pivot arm and back out the plug.

NOTE: The pivot arm will not lift high enough to allow total disengagement. Consequently, the plug must be screwed out.

(*b*) Using the plain cylindrical plug having a size equal to the maximum-material minor diameter of the thread size in question, engage the plug by sliding it in (right to left or left to right) from the end. Note the reading.

(*c*) The indicated difference between steps (a) and (b) above should not exceed X tolerance for minor diameter.

(*d*) Loosen and reverse the top segment 180 deg. (ledge side out) and using the full-form portion of the W tolerance-setting plug, engage the entire length into the segments and zero-out the indicator at the high point. With the bottom segment still locked as in step (a), lock the top segment on the stud with the set screw provided in the back of the segment to prevent it from pivoting. Lift the pivot arm and back out the plug.

NOTE: The pivot arm will not lift high enough to allow total disengagement. Consequently, the plug must be screwed out.

(*e*) Repeat step (b) above.

(*f*) The indicated difference between steps (d) and (e) above should not exceed X tolerance for minor diameter.

A9 INSPECTION OF THREADED CONTACT SEGMENTS USED ON INTERNAL PRODUCT THREAD

The coded pairs of segments are locked or clamped when engaging the plain ring gage or thread-setting ring. Then thread form, pitch diameter, major diameter, pitch, and straightness can be inspected by methods described in A2.1 through A2.8.

A10 CHECK FOR MAGNIFICATION DISCREPANCIES DUE TO INDICATING SYSTEM LINKAGE

Two X tolerance plain plug gages for the external thread indicating gages and two X tolerance plain ring gages for the internal thread indicator gages, whose diameter difference corresponds with the working range of the indicator dial, are required. When they are applied to the cluster of rolls or segments, the difference in indicator dial readings should not vary by more than ± 1 least graduation from the calibrated difference between the two gages.

A11 CALIBRATION OF DIAL AND ELECTRONIC INDICATORS

Calibration of the indicator may be done by displacing the spindle with a calibrated micrometer screw or with tolerance Grade 3 gage blocks inserted between a fixed anvil and the spindle. The accuracy of the micrometer screw should be 0.0007 mm and is used for calibrating indicators with resolution of 0.002 mm and larger. The zero setting for calibrating dial indicators is at the 12 o'clock position. A minimum of four equally spaced increments per revolution is calibrated. On electronic indicators each numbered division is calibrated.

A12 ASSESSMENT OF SURFACE QUALITY

Product threads which exhibit torn or rough surface may be assessed with indicating gages. The rapid fluctuation of the indicating needle when the part is rotated slowly between the gage contacts may not exceed 0.0025 mm. For external threads, a roll type indicating gage with "best size" thread radius rolls is used.

For internal threads, a gage with "best size" thread ball contacts is used.

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APPENDIX B
METROLOGY OF 60 deg. SCREW THREADS

(This Appendix is not part of ANSI/ASME B1.16M-1984, and is included for information purposes only.)

B1 WIRE METHOD OF MEASUREMENT OF PITCH DIAMETER (THREAD GROOVE DIAMETER)

This Section presents specifications and techniques for the measurement of screw thread plug gages and setting plugs by measuring over accurate cylinders or wires inserted in the thread grooves. The purpose is to make available a standard United States method for making such measurements. The practices described measure groove diameter, which is equal to pitch diameter only on a thread with perfect pitch spacing.

B2 SIZE OF WIRES

In the three-wire method of measuring pitch diameter, hardened steel cylinders or wires of appropriate size are placed in the thread groove, two on one side of the screw and one on the opposite side, as shown in Fig. B1. The contact face of the comparator, measuring machine, or micrometer anvil or spindle which is over the two wires must be sufficiently large in diameter or width to touch both wires; that is, it must be greater than the pitch of the thread. It is best to select wires of such a size that they touch the sides of the thread at points where the groove is equal to $0.5p$ (groove diameter). This is done so that the measurement of pitch diameter is least affected by any error in thread angle. The size of wire which touches exactly at the groove diameter of a perfect thread of a given pitch is termed the "best size" thread wire for that pitch.

The depth at which a wire of given diameter will rest in a thread groove depends primarily on the pitch and included angle of the thread; and, secondarily, on the angle made by the helix at the point of contact of the wire and the thread, with a plane perpendicular to the axis of the screw. Variation in the lead angle has a very small effect in the measurement of groove diameter with wires. It is desirable to use one size of wire to measure all threads of a given pitch and included angle.

The "best size" thread wire is taken as that size which will touch at the groove diameter of a groove cut around a cylinder perpendicular to the axis of the cylinder. The size of the "best size" thread wire, resting in a zero lead angle 60 deg. vee thread, is given by the formula:

$$w = 0.5p \times \sec \alpha \qquad (1)$$

where

w = diameter of wire
p = pitch
α = half-angle of thread

Reduce this formula to

$$w = 0.57735 \times p \qquad (2)$$

for 60 deg. threads.

On occasion, it may be necessary when a "best size" thread wire is not available to measure pitch diameter by means of wires of other than the "best size." The minimum size which may be used is limited to that permitting the wire to project above the crest of the thread, and the maximum, to that permitting the wire to rest on the flanks of the thread just below the crest and not ride on the crest of the thread. The diameters of the best size, maximum, and minimum wires for 60 deg. threads are given in Table B1.

B3 METHODS OF MEASURING WIRES CONSIDERING THE EFFECT OF DEFORMATION

Measurement of the pitch diameter of a thread gage by means of the three-wire method is most conveniently made when sufficient force is applied to the wires by the measuring instrument to properly align the wires

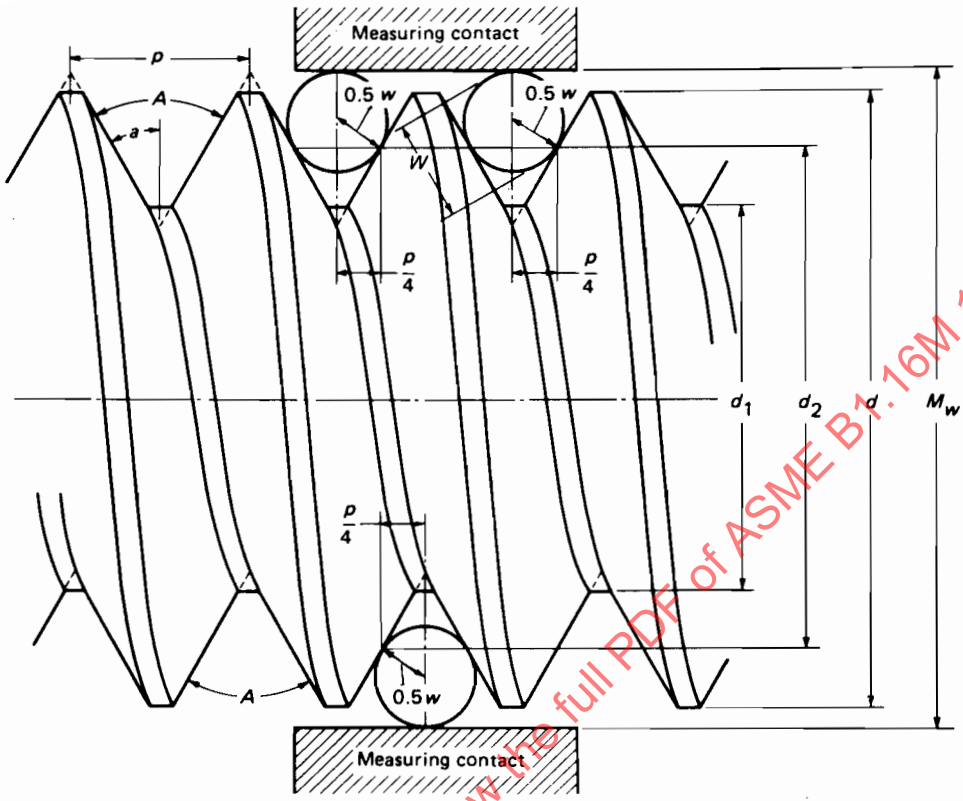

FIG. B1 A THREE-WIRE METHOD OF MEASURING PITCH (THREAD GROOVE) DIAMETER OF THREAD PLUG GAGES

and gage. Since a wire touches a minute area on each thread flank, the deformation of the wire and thread will be sufficiently large to require some type of correction and the measuring force must be limited to avoid permanent deformation of the wire and gage. As an indication of the need for compensation for the deformations, it can be shown that the total effect on pitch diameter of the deformations of three wires and an M12 × 1.25 thread gage is 0.005 mm when measured under 11.1 N. It is practical to compensate for the major portion of this deformation by a simple procedure described in the following paragraphs.

(*a*) It would be possible to prepare tables of the deformation of all standardized sizes of gages, but this would not take care of special combinations of pitch and diameter. Another method of compensating for the deformations is to measure the thread wires under conditions which provide deformations equivalent to those which occur when the wires are used to measure a thread. This can be accomplished by the measurement of the thread wires between a flat anvil and a cylinder with the axes of cylinder and wire at 90 deg. to each other if an appropriate selection of cylinder diameter and the measuring force is made. Optimum compensation for the deformations which occur in the measurement of pitch diameter would require the calibration of wires with a different cylinder or force for every thread diameter–pitch combination. Calibration of wires involving such a variety of conditions is neither practical nor necessary, as the measurement procedure which is generally followed will assure uniformity of values. It is desirable to keep the effects of deformation small.

(*b*) It can be shown, for example, that all sizes of threads from 3.5 mm to 50 mm can be measured with wires calibrated against a 20 mm diameter cylinder using the forces recommended for pitch diameter measurements in Table B2 with variations from true pitch diameter (neglecting the effect of lead angle) not in excess of 0.0009 mm. Slightly larger discrepancies in the 50 mm to 100 mm size range are relatively unimportant because these sizes have larger tolerances. For sizes smaller than 3.5 mm it is necessary to calibrate wires

TABLE B1 METRIC THREAD-MEASURING WIRES FOR 60 deg. SCREW THREADS

Pitch	Wire Sizes, W			C, "Best Size" Thread Wire Constant,[3] 0.866025p
	Best[1] 0.577350p	Minimum[2] 0.505182p	Maximum[2] 1.010363p	
mm	mm	mm	mm	mm
0.2	0.1155	0.1010	0.2021	0.1732
0.25	0.1443	0.1263	0.2526	0.2165
0.3	0.1732	0.1516	0.3031	0.2598
0.35	0.2021	0.1768	0.3536	0.3031
0.4	0.2309	0.2021	0.4041	0.3464
0.45	0.2598	0.2273	0.4547	0.3897
0.5	0.2887	0.2526	0.5052	0.4330
0.6	0.3464	0.3031	0.6062	0.5196
0.7	0.4041	0.3536	0.7073	0.6062
0.75	0.4330	0.3789	0.7578	0.6495
0.8	0.4619	0.4041	0.8083	0.6928
1	0.5774	0.5052	1.0104	0.8660
1.25	0.7217	0.6315	1.2630	1.0825
1.5	0.8660	0.7578	1.5155	1.2990
1.75	1.0104	0.8841	1.7681	1.5155
2	1.1547	1.0104	2.0208	1.7321
2.5	1.4434	1.2630	2.5259	2.1651
3	1.7321	1.5155	3.0311	2.5981
3.5	2.0207	1.7681	3.5363	3.0311
4	2.3094	2.0207	4.0415	3.4641
4.5	2.5981	2.2733	4.5466	3.8971
5	2.8868	2.5259	5.0518	4.3301
5.5	3.1754	2.7785	5.5570	4.7631
6	3.4641	3.0311	6.0622	5.1962

NOTES:
(1) The diameters of "best size" thread balls are the same as the diameters of the "best size" thread wires.
(2) Measured PD = $M_w + 0.866025p - 3W$
(3) If "best size" thread wire is used, PD = $M_w - C$.

TABLE B2 MEASURING FORCE FOR OVER-WIRE MEASUREMENTS OF EXTERNAL PITCH DIAMETER AND WIRE CALIBRATION, AND CYLINDRICAL DIAMETER FOR WIRE CALIBRATION

Pitch Range, mm	Measuring Force (±10%)		Cylinder Diameter, mm
	N[1]	lb (Ref.)	
0.2–0.35	1.1	0.25	1.25
0.35–0.6	2.2	0.50	3
0.6–1.25	4.5	1.00	20
1.25 and larger	11.1	2.50	20

NOTE:
(1) 1N = 0.2248 lbf

against a 3 mm cylinder which has a radius more nearly equal to the radius of curvature of the thread flank.

(*c*) As previously noted, the force applied by the measuring device must be limited to avoid permanent deformation of the wires or gage, or both. Even for large diameter threads having coarse pitches, the maximum compressive stress at the points where a wire touches the thread flanks is high, and it increases to a point where permanent deformation may occur for the small diameter threads. It therefore becomes necessary to reduce the measuring force progressively as the sizes of threads decrease. See Table B2.

B4 METHODS OF MEASUREMENT USING WIRES

The computed value for the pitch diameter of a screw thread gage obtained from readings over wires will depend upon the accuracy of the measuring instrument used, the measuring force, and the value of the diameter of the wires used in the computations. In order to measure the pitch diameter of a screw thread gage to an accuracy of 0.0025 mm, strict adherence to the methods specified is required.

(*a*) The "best size" thread wires shall comply with the specifications listed in B2. The diameter of the wires must be known to within 0.0005 mm.

(*b*) The measurement over wires should be made with a measuring instrument which reads directly to 0.00025 mm and has flat parallel contacts within 0.0001 mm.

(*c*) A wire presses on the flanks of a 60 deg. thread with the force that is applied to the wire by the measuring instrument. Inasmuch as the wire and thread deform at the contact areas, it is desirable to determine the size of the wire under conditions which will compensate for this deformation. It is recommended for standard practice that diameters of wires be measured between a flat contact and a hardened and accurately ground and lapped steel cylinder having a diameter in accordance with Table B1 with the measuring force specified in Table B2. The plane of the flat contact should be parallel to the contact element of the cylinder within 0.0001 mm.

To avoid a permanent deformation of the material of the wire or gages, it is necessary to limit the contact force and, for consistent results, a uniform practice as to contact force in making wire measurements of hardened screw threads gages is necessary. The recommended force for external pitch diameter measurements is given in Table B2.

The use of other contact forces will cause a difference in the reading over the wires, and to completely compensate for such errors is impractical. Variations in diameter around the wire should be determined by rotating the wire between a spherical or flat measuring contact and an anvil having the form of a 60 deg. vee groove. Variations in diameter along the wire should be determined by measuring between a spherical or flat contact and a cylindrical anvil.

(*d*) The wires should be free to assume their positions in the thread grooves without restraint. (The practice of holding wires in position with elastic bands can introduce errors in measurement.)

(*e*) To assure accurate values for pitch diameter measurement, the measured value should be given to three decimal places.

(*f*) Measurements shall be standard at 20°C.

B5 STANDARD SPECIFICATION FOR WIRES AND STANDARD PRACTICE IN MEASUREMENT OF WIRES OF 60 deg. THREADS

The following specifications represent present practice relative to thread-measuring wires.

(*a*) *Composition.* The wires shall be accurately finished steel cylinders, the hardness of which shall not be less than that corresponding to a Knoop indentation number of 776 minimum. The surface texture shall not exceed the equivalent of 0.05 μm R_a max.

(*b*) *Length of Wires.* The working surface shall be at least 25 mm in length. The wire may be provided with a suitable means of suspension.

(*c*) *Diameter of Wires.* One set of wires shall consist of three wires which shall have the same diameter within 0.00025 mm, and this common diameter shall be within 0.0005 mm of that corresponding to the "best size" for the pitch for which the wires are to be used. Wires shall be measured between a flat contact and a hardened and accurately finished cylinder having a surface texture not over 0.05 μm R_a max. The measuring forces and cylinder diameter shall be per Table B2.

(*d*) *Variation in Diameter.* Variations in diameter along a wire (taper) over the 25 mm interval at the center of its length shall not exceed 0.00025 mm as determined by measuring between a spherical or flat contact and a cylindrical contact.

Variations from true cylindrical contour of a wire (out-of-roundness, or noncircular cross section) over its 25 mm central interval shall not exceed 0.00025 mm as determined by measuring between a spherical or flat

measuring contact and a well-finished 60 deg. vee groove.

(*e*) *Container and Marking.* A suitable container shall be provided for each set of wires. The pitch for which the wires are the "best size" and the diameter of the 25 mm central interval of the wires, as determined by measurements under standard conditions as specified, shall be marked on the container. The measuring force and C corrections shall be marked in the container.

B6 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:

$$d_2 = M_w + \left(\frac{\cot \alpha}{2}\right)(p) - w[1 + (\operatorname{cosec}^2 \alpha + \cot^2 \alpha \tan^2 \lambda')^{1/2}]$$

where

d_2 = pitch diameter
M_w = measurement over wires
α = half-angle of thread
p = pitch
$\tan \lambda' = \dfrac{\text{lead}}{3.1416 d_2}$ = lead angle (angle between axis of wire and plane perpendicular to axis of thread)
W = mean diameter of wires

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

Formula (3) can be converted to the following simplified form, which is particularly useful when measuring threads of large lead angle:

$$d_2 = M_w + \left(\frac{\cot \alpha}{2}\right)(p) - W(1 + \operatorname{cosec} \alpha') \qquad (4)$$

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

When formula (3) 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:

$$d_2 = M_w + \left(\frac{\cot \alpha}{2}\right)(p) - W\left(1 + \operatorname{cosec} \alpha + \frac{\tan^2 \lambda \cos \alpha \cot \alpha}{2}\right) \qquad (5)$$

B7 SIMPLIFIED FORMULA FOR PITCH DIAMETER

In the measurement of pitch diameter, the term

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

is neglected, as its value is small, being in all cases less than 0.0038 mm for standard single lead fastening screws of M2 and larger when the "best size" thread wire is used. Formula (5) takes the simplified form:

$$d_2 = M_w + \left(\frac{\cot \alpha}{2}\right)(p) - W(1 + \operatorname{cosec} \alpha) \qquad (6)$$

The practice of using formula (6) for such threads is permissible in order to maintain uniformity of practice in the United States and thus avoid confusion.

For a 60 deg. thread of correct angle and thread form, formula (6) simplifies to

$$d_2 = M_w + 0.866025p - 3W \qquad (7)$$

For a given set of "best size" thread wires

$$d_2 = M_w - C$$

where

$$C = W\left[1 + \operatorname{cosec} \alpha - \left(\frac{\cot \alpha}{2}\right)(p)\right]$$

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" thread 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.

With the exception of large pitch screws, it has been shown that variation in angle from the basic size causes no appreciable change in the quantity C for the "best size" thread wires. (For angle variation of 2 deg., C increases by 0.001 mm for a pitch of 1.5 mm and 0.002 mm for a pitch of 3 mm.) 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 the 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 value C for pitches as shown in Table B1 should be used.

B8 SETTING MEASURING INSTRUMENTS WITH VARIABLE MEASURING FORCE

Recommended practice for setting measuring instruments using gage blocks is as follows.

(*a*) Wipe anvils and gage blocks free from dirt and dust.

(*b*) Wring the gage blocks to both anvils at maximum measuring force setting, or press with fingers the tailstock spindle against the gage blocks while wringing them to the anvils.

(*c*) With the gage blocks still in the instrument, reduce the measuring force to that which will be used and reset the instrument at this working measuring force. This procedure provides adequate force for wringing gage blocks in with relatively large areas of anvil faces. The final setting at the working measuring force to be used compensates for any instrument deflection variation that may occur at the higher measuring forces.

B9 THREAD BALLS

B9.1 "Best Size" Thread Balls Specifications

Thread balls shall meet the following requirements:

(*a*) for a 60 deg. thread, the "best size" thread ball sizes are identical to the "best size" thread wire sizes and are given in Table B1;

(*b*) one set of "best size" thread balls consists of three hardened steel balls that have the same diameter within 0.00025 mm, and their common diameter should be within 0.0005 mm of the corresponding "best size" thread ball for the specified pitch. The sphericity should not exceed 0.00025 mm.

TABLE B3 MEASURING FORCE OVER BALLS FOR INTERNAL PITCH DIAMETER MEASUREMENT AND BALL CALIBRATION

Pitch Range, mm	Measuring Force (±10%) N	lb (Ref.)
0.8–1.25	1.1	0.250
1.25–3	1.7	0.375
3 and larger	2.2	0.500

B9.2 Method of Measuring Thread Balls

The following procedures shall be used when measuring pitch diameter thread balls.

(*a*) In order to measure the pitch diameter of a 60 deg. thread ring gage to an accuracy of within 0.0025 mm by means of thread balls, it is necessary to know the thread ball diameters to within 0.0005 mm. Thus, it is necessary to use a measuring instrument that reads accurately to 0.0003 mm.

(*b*) The thread ball presses on the flanks of a 60 deg. thread with the force that is applied to the thread ball by the measuring instrument. Since the thread ball and thread deform at the contact areas, the size of the thread ball should be determined under conditions which nearly compensate for this deformation. The thread ball should be measured between parallel, flat, hardened steel contacts which are set with calibrated gage blocks. The contact should be parallel within 0.0001 mm.

(*c*) To avoid exceeding the elastic limit of the thread balls and thread gages and to prevent excessive deformation compensation, it is necessary to recommend a uniform practice for measuring force for the calibration of thread balls and for their use in measuring internal pitch diameter. Table B3 gives the recommended measuring forces.

(*d*) Variations in diameter around the thread ball should be determined by rotating the thread ball between parallel measuring contacts.

B10 INTERNAL PITCH DIAMETER MEASUREMENT

Indicating gages with "best size" thread ball contacts are set to either a calibrated plain ring gage or a gage

block gap which is larger than the basic pitch diameter of the product thread by one-half of the diameter of the "best size" thread ball. The measured internal pitch diameter is obtained by adding the indicator reading change directly to the basic pitch diameter size. Setting to a plain ring gage permits less uncertainty in deformation compensation. The recommended measuring force over thread balls for internal pitch diameter measurement is given in Table B3.

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APPENDIX C
METRIC TABLES FOR GAGE LENGTHS

(This Appendix is not part of ANSI/ASME B1.16M-1984, and is included for information purposes only.)

TABLE C1 LENGTHS OF TAPERLOCK AND TRILOCK THREAD PLUG GAGE BLANKS (SI) SELECTED FROM ANSI/ASME B47.1aM

Thread Sizes		Thread Lengths					
Range		Thread Plug Gages				Fine Pitch Instrument Thread Plug Gages	
Above	To and Including	GO			HI	GO	HI
1	2	3			4	5	6
mm	mm	mm			mm	mm	mm
1.50	2.67	6.4			4.8	4.8	3.2
2.67	3.81	7.9			5.6	5.6	4.0
3.81	5.84	10.3			7.1	7.1	5.6
5.84	9.27	12.7			7.9	7.9	6.4
9.27	12.95	19.0			9.5	9.5	7.9
12.95	20.96	22.2			12.7	12.7	9.5
20.96	28.83	25.4			15.9	15.9	11.1
		Pitches 2.0 and smaller		Pitches larger than 2.0			
28.83	38.35	25.4		31.8	19.0	19.0	12.7
		Pitches 3.5 and larger	Pitches between 3.5 and 1.5	Pitches 1.5 and smaller			
38.35	51.05	47.6	31.8	22.2	22.2	19.0	15.9
51.05	63.75	50.8	34.9	22.2	22.2	19.0	15.9
63.75	76.45	50.8	38.1	25.4	25.4	. . .	. . .
76.45	89.15	50.8	38.1	25.4	25.4	. . .	. . .
89.15	203.45	54.0	38.1	25.4	25.4	. . .	. . .
203.45	305.05	57.2	38.1	25.4	25.4	. . .	. . .

GENERAL NOTE:
For trilock plug blanks above 19.3 mm and including 38.35 mm, and wire type plug blanks in sizes below 25.65 mm, see ANSI/ASME B47.1aM.

TABLE C2 LENGTHS OF THREAD RING GAGE BLANKS AND TOTAL THREAD LENGTHS OF STANDARD TRUNCATED SETTING PLUG GAGE BLANKS (SI) SELECTED FROM ANSI/ASME B47.1aM

Thread Sizes		Lengths of Thread Ring Gages			Total Thread Lengths of Truncated Thread-Setting Plugs		
Above	To and Including	Thin Ring	Thick Ring	Fine Pitch Instrument Ring	For Thin Ring	For Thick Ring	For Fine Pitch Instrument Ring
1	2	3	4	5	6	7	8
mm	mm	mm	mm	mm	mm	mm	mm
1.50	2.29	2.4	. . .	. . .	5.6	. . .	. . .
2.29	3.81	4.0	. . .	. . .	9.5	. . .	. . .
3.81	5.84	4.8	. . .	. . .	10.3	. . .	. . .
5.84	9.27	8.7	. . .	6.4	19.0	. . .	14.3
9.27	12.95	11.1	. . .	7.9	25.4	. . .	17.5
12.95	20.96	14.3	19.0	11.9	31.8	47.6	25.4
20.96	28.83	17.5	23.8	13.5	38.1	54.0	28.6
28.83	38.35	19.0	28.6	15.9	41.3	60.3	33.3
38.35	51.05	20.6	31.8	15.9	47.6	73.0	33.3
51.05	63.75	22.2	33.3	17.5	50.8	76.2	36.5
63.75	76.45	22.2	34.9	. . .	50.8	79.4	. . .
76.45	89.15	23.8	36.5	. . .	50.8	79.4	. . .
89.15	101.85	23.8	38.1	. . .	54.0	82.6	. . .
101.85	159.00	25.4	38.1	. . .	54.0	82.6	. . .

GENERAL NOTES:

(a) Thin gage blanks are used for all LO thread ring gages, recessing sides as applicable.

(b) For GO thread ring gages:

(1) 0.0 mm to 5.84 mm, use thin blanks for all pitches, recessing sides as applicable;

(2) above 5.84 mm to 12.95 mm, use thin blanks for pitches 0.75 mm and larger; fine pitch instrument blanks for pitches finer than 0.75 mm;

(3) above 12.95 mm to 28.83 mm, use thick blanks for pitches larger than 2 mm, thin blanks for pitches 1 mm to 2 mm, and fine pitch instrument blanks for pitches finer than 1 mm;

(4) above 28.83 mm to 152.65 mm, use thick blanks for pitches larger than 2.5 mm, thin blanks for pitches 1 mm to 2 mm, and fine pitch instrument blanks for pitches finer than 1 mm;

(5) above 152.65 mm, use thick blanks for all pitches.

APPENDIX D
CUSTOMARY EQUIVALENTS

(This Appendix is not part of ANSI/ASME B16.1M-1984, and is included for information purposes only.)

This Appendix presents the customary equivalents of the metric tables in this Standard, as follows. Data appearing here are for reference only.

Metric Table	*Description*	*Inch Table*
6	X Gage Tolerance	D1
7	W Gage Tolerance	D2
8	Cylindrical Gage Tolerance	D3
10	Gages for Standard Thread Series 6g and 6H	D5
11	Setting Gages for Standard Thread Series 6g and 6H	D6
12	Gages for Standard Thread Series 4g6g and 6H	D7
13	Setting Gages for Standard Thread Series 4g6g and 6H	D8
B1	Thread-Measuring Wires	D4
C1	Lengths of Plug Gage Blanks	D9
C2	Lengths of Ring Gage and Set Plug Blanks	D10

TABLE D1 X GAGE TOLERANCES FOR THREAD GAGES

Pitch, mm	Tolerance on Lead, in. (Notes 1, 3)	Tolerance on Half-Angle of Thread, deg. ± min.	Tolerance on Major or Minor Diameters (Note 4)		Tolerance on Pitch Diameter (Notes 2, 4)			
			To and Including 100 mm	Above 100 mm	To and Including 39 mm	Above 39 mm to 100 mm	Above 100 mm to 200 mm	Above 200 mm to 300 mm
1	2	3	4	5	6	7	8	9
0.2	0.00020	0 40	0.00031	. . .	0.00020	. . .	. . .	. . .
0.25	.00020	0 40	.00031	. . .	.00020	. . .	. . .	. . .
0.3	.00020	0 30	.00031	. . .	.00020	. . .	. . .	. . .
0.35	.00020	0 30	.00031	. . .	.00020	. . .	. . .	. . .
0.4	.00020	0 30	.00039	. . .	.00020	. . .	. . .	. . .
0.45	.00020	0 30	.00039	. . .	.00020	0.00031	. . .	. . .
0.5	.00020	0 30	.00039	. . .	.00020	.00031	. . .	. . .
0.55	.00020	0 30	.00039	. . .	.00020	.00031	. . .	. . .
0.6	.00020	0 20	.00039	. . .	.00020	.00031	. . .	. . .
0.65	.00020	0 20	.00039	. . .	.00020	.00031	. . .	. . .
0.7	.00020	0 20	.00039	. . .	.00020	.00031	. . .	. . .
0.75	.00020	0 20	.00039	. . .	.00020	.00031	. . .	. . .
0.8	.00031	0 15	.00051	0.00071	.00031	.00039	0.00051	0.00051
1	.00031	0 15	.00051	.00071	.00031	.00039	.00051	.00051
1.25	.00031	0 15	.00051	.00071	.00031	.00039	.00051	.00051
1.5	.00031	0 10	.00051	.00091	.00031	.00039	.00059	.00071
1.75	.00031	0 10	.00051	.00091	.00031	.00039	.00059	.00071
2	.00031	0 10	.00051	.00091	.00031	.00039	.00059	.00071
2.5	.00031	0 10	.00051	.00091	.00039	.00039	.00059	.00071
3	.00031	0 10	.00071	.00110	.00039	.00051	.00059	.00071
3.5	.00039	0 5	.00071	.00110	.00039	.00051	.00059	.00071
4	.00039	0 5	.00071	.00130	.00039	.00051	.00059	.00071
4.5	.00039	0 5	.00079	.00130	.00039	.00051	.00059	.00079
5	.00039	0 5	.00079	.00130	.00039	.00051	.00059	.00079
5.5	.00039	0 5	.00079	.00130	.00039	.00051	.00059	.00079
6	.00039	0 5	.00091	.00150	.00039	.00051	.00059	.00079
8	.00039	0 5	.00091	.00150	.00039	.00051	.00059	.00079

GENERAL NOTE: Equivalent to metric table. Does not agree with ANSI B1.2.

NOTES:

(1) Allowable variation in lead between any two threads shall not be farther apart than the length of the standard gages that are shown in ANSI/ASME B47.1aM.

(2) Above M300, the tolerance is directly proportional to the tolerance in col. 9, in the ratio of the diameter to 300 mm.

(3) See 5.13.9.

(4) Tolerances apply to designated size of thread. Apply tolerances in accordance with Table 4.

TABLE D2 W GAGE TOLERANCES FOR THREAD GAGES

Pitch, mm	Tolerance on Lead[1,3]		Tolerance on Half-Angle of Thread, deg. ± min.	Tolerance on Major or Minor Diameters[4]			Tolerance on Pitch Diameters[2,4]				
	To and Including 12 mm	Above 12 mm		To and Including 12 mm	Above 12 mm to 100 mm	Above 100 mm	To and Including 12 mm	Above 12 mm to 39 mm	Above 39 mm to 100 mm	Above 100 mm to 200 mm	Above 200 mm to 300 mm
1	2	3	4	5	6	7	8	9	10	11	12
0.2	0.00012	. . .	0 30	0.00031	. . .	. . .	0.00012	. . .	. . .	. . .	. . .
0.25	.00012	. . .	0 30	.00031	. . .	. . .	.00012	. . .	. . .	. . .	. . .
0.3	.00012	. . .	0 30	.00031	. . .	. . .	.00012	. . .	. . .	. . .	. . .
0.35	.00012	0.00016	0 20	.00031	.00031	. . .	.00012	.00016	. . .	. . .	. . .
0.4	.00012	.00016	0 20	.00031	.00031	. . .	.00012	.00016	. . .	. . .	. . .
0.45	.00012	.00016	0 20	.00031	.00039	. . .	.00012	.00016	. . .	. . .	. . .
0.5	.00012	.00016	0 20	.00031	.00039	. . .	.00012	.00016	.00020	. . .	. . .
0.55	.00012	.00016	0 18	.00031	.00039	. . .	.00012	.00016	.00020	. . .	. . .
0.6	.00012	.00016	0 18	.00031	.00039	. . .	.00012	.00016	.00020	. . .	. . .
0.65	.00012	.00016	0 15	.00031	.00039	. . .	.00012	.0016	.00020	. . .	. . .
0.7	.00012	.00016	0 15	.00031	.00039	. . .	.00012	.00016	.00020	. . .	. . .
0.75	.00012	.00016	0 12	.00031	.00039	. . .	.00012	.00016	.00020	. . .	. . .
0.8	.00012	.00016	0 12	.00031	.00051	0.00071	.00012	.00016	.00020	0.00024	0.00031
1	.00016	.00016	0 8	.00051	.00051	.00071	.00012	.00016	.00020	.00024	.00031
1.25	.00016	.00016	0 8	.00051	.00051	.00071	.00012	.00016	.00020	.00024	.00031
1.5	.00016	.00016	0 8	.00051	.00051	.00071	.00012	.00016	.00020	.00024	.00031
1.75	.00016	.00016	0 8	.00059	.00059	.00091	.00012	.00020	.00024	.00031	.00039
2	.00020	.00020	0 6	.00059	.00059	.00091	.00016	.00020	.00024	.00031	.00039
2.5	. . .	.00020	0 6	. . .	.00059	.00091	. . .	.00020	.C0024	.00031	.00039
3	. . .	.00024	0 6	. . .	.00059	.00091	. . .	.00020	.00024	.00031	.00039
3.5	. . .	.00024	0 5	. . .	.00071	.00110	. . .	.00020	.00024	.00031	.00039
4	. . .	.00031	0 5	. . .	.00071	.00110	. . .	.00020	.00024	.00031	.00039
4.5	. . .	.00031	0 4	. . .	.00079	.00130	. . .	.00020	.00024	.00031	.00039
5	. . .	.00031	0 4	. . .	.00079	.00130	. . .	.00020	.00024	.00031	.00039
5.5	. . .	.00031	0 4	. . .	.00079	.00130	. . .	.00020	.00024	.00031	.00039
6	. . .	.00031	0 4	. . .	.00091	.00130	. . .	.00020	.00024	.00031	.00039
8	. . .	.00031	0 4	. . .	.00091	.00150	. . .	.00020	.00024	.00031	.00039

GENERAL NOTE: Equivalent to the metric table. Does not agree with ANSI B1.2.

NOTES:

(1) Allowable variation in lead between any two threads shall not be farther apart than the length of the standard gage that is shown in ANSI/ASME B47.1aM.

(2) Above M300, the tolerance is directly proportional to the tolerance in col. 12, in the ratio of the diameter to 300 mm.

(3) See 5.13.9.

(4) Tolerances apply to designated size of thread. Apply tolerance in accordance with Table 5.

TABLE D3 GAGE TOLERANCES FOR PLAIN CYLINDRICAL GAGES

Size Range		Tolerances, in. (Note 1)				
Above	To and Including	XX	X	Y	Z(Note 2)	ZZ
1	2	3	4	5	6	7
mm	mm	in.	in.	in.	in.	in.
1	21	0.00002	0.00004	0.00007	0.00010	0.00020
21	38	.00003	.00006	.00009	.00012	.00024
38	64	.00004	.00008	.00012	.00016	.00032
64	115	.00005	.00010	.00015	.00020	.00040
115	165	.000065	.00013	.00019	.00025	.00050
165	230	.00008	.00016	.00024	.00032	.00064
230	300	.00010	.00020	.00030	.00040	.00080

NOTES:
(1) Tolerances apply to actual diameter of plug or ring. Apply tolerances in accordance with Table 4. Symbols XX, X, Y, Z, and ZZ are standard gage tolerance classes.
(2) Used as tolerance on plain cylindrical plug and ring gages to check minor diameter for internal threads and outside diameter for external threads. Also used for masters for setting indicating thread gages where design permits.

TABLE D4 METRIC THREAD-MEASURING WIRES FOR 60 deg. SCREW THREADS

Pitch	Wire Sizes, W			C, "Best Size" Thread Wire Constant (Note 3), $0.866025p$
	Best (Note 1) $0.577350p$	Minimum (Note 2) $0.505182p$	Maximum (Note 2) $1.010363p$	
mm	in.	in.	in.	in.
0.2	0.00455	0.00398	0.00796	0.00682
0.25	0.00568	0.00497	0.00994	0.00852
0.3	0.00682	0.00597	0.01193	0.01023
0.35	0.00796	0.00696	0.01392	0.01193
0.4	0.00909	0.00796	0.01591	0.01364
0.45	0.01023	0.00895	0.01790	0.01534
0.5	0.01137	0.00994	0.01989	0.01705
0.6	0.01364	0.01193	0.02387	0.02046
0.7	0.01591	0.01392	0.02784	0.02387
0.75	0.01705	0.01492	0.02983	0.02557
0.8	0.01818	0.01591	0.03182	0.02728
1	0.02273	0.01989	0.03978	0.03410
1.25	0.02841	0.02486	0.04972	0.04262
1.5	0.03410	0.02983	0.05967	0.05114
1.75	0.03978	0.03481	0.06961	0.05967
2	0.04546	0.03978	0.07956	0.06819
2.5	0.05683	0.04972	0.09945	0.08524
3	0.06819	0.05967	0.11933	0.10229
3.5	0.07956	0.06961	0.13922	0.11933
4	0.09092	0.07955	0.15911	0.13638
4.5	0.10229	0.08950	0.17900	0.15343
5	0.11365	0.09945	0.19889	0.17048
5.5	0.12502	0.10939	0.21878	0.18753
6	0.13638	0.11933	0.23867	0.20457

NOTES:
(1) The diameters of "best size" thread balls are the same as the diameters of "best size" thread wires.
(2) Measured PD = $M_w + 0.866025p - 3W$.
(3) If "best size" thread wire is used, PD = $M_w - C$.

TABLE D5 GAGES FOR STANDARD THREAD SERIES CLASSES 6g AND 6H
M PROFILE SCREW THREADS — LIMITS OF SIZE (CUSTOMARY)

Nominal Size and Pitch	Class	Gages for External Threads						Gages for Internal Threads						Class
		X Thread Gages				Z Plain Gages for Major Diam.		X Thread Gages				Z Plain Gages for Minor Diam.		
		GO		LO				GO		HI				
		Pitch Diam.	Minor Diam.	Pitch Diam.	Minor Diam.	GO	NOT GO	Major Diam.	Pitch Diam.	Major Diam.	Pitch Diam.	GO	NOT GO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M1.6 × 0.35	6g	0.05331 0.05311	0.04732 0.04701	0.05083 0.05103	0.04807 0.04838	0.06224 0.06212	0.05890 0.05902	0.06299 0.06330	0.05406 0.05426	0.06016 0.05985	0.05740 0.05720	0.04807 0.04819	0.05201 0.05189	6H
M2 × 0.4	6g	0.06776 0.06756	0.06094 0.06055	0.06512 0.06532	0.06197 0.06236	0.07799 0.07787	0.07425 0.07437	0.07874 0.07913	0.06850 0.06870	0.07520 0.07481	0.07205 0.07185	0.06169 0.06181	0.06610 0.06598	6H
M2.5 × 0.45	6g	0.08614 0.08594	0.07846 0.07807	0.08335 0.08355	0.07980 0.08019	0.09764 0.09752	0.09370 0.09382	0.09843 0.09882	0.08693 0.08713	0.09421 0.09382	0.09067 0.09047	0.07925 0.07937	0.08417 0.08405	6H
M3 × 0.5	6g	0.10453 0.10433	0.09598 0.09559	0.10157 0.10177	0.09764 0.09803	0.11732 0.11720	0.11315 0.11327	0.11811 0.11850	0.10531 0.10551	0.11319 0.11280	0.10925 0.10905	0.09681 0.09693	0.10232 0.10220	6H
M3.5 × 0.6	6g	0.12161 0.12141	0.11138 0.11099	0.11827 0.11807	0.11354 0.11393	0.13697 0.13685	0.13205 0.13217	0.13780 0.13819	0.12244 0.12264	0.13157 0.13118	0.12685 0.12665	0.11220 0.11232	0.11850 0.11838	6H
M4 × 0.7	6g	0.13870 0.13850	0.12677 0.12638	0.13516 0.13536	0.12965 0.13004	0.15661 0.15649	0.15110 0.15122	0.15748 0.15787	0.13957 0.13959	0.14972 0.14933	0.12764 0.12744	0.12764 0.12776	0.13472 0.13460	6H
M5 × 0.8	6g	0.17543 0.17512	0.16181 0.16130	0.17169 0.17200	0.16539 0.16590	0.19591 0.19579	0.19000 0.19012	0.19685 0.19736	0.17638 0.17669	0.18760 0.18709	0.18130 0.18099	0.16276 0.16288	0.17063 0.17051	6H
M6 × 1	6g	0.20961 0.20930	0.19256 0.19205	0.20520 0.20551	0.19732 0.19681	0.23520 0.23508	0.22811 0.22823	0.23622 0.23673	0.21063 0.21094	0.22441 0.22390	0.21654 0.21623	0.19358 0.19370	0.20287 0.20275	6H
M8 × 1.25	6g	0.28189 0.28158	0.26059 0.26008	0.27724 0.27755	0.26740 0.26791	0.31386 0.31374	0.30551 0.30563	0.31496 0.31547	0.28299 0.28330	0.29913 0.29862	0.28929 0.28898	0.26169 0.26181	0.27213 0.27201	6H
M8 × 1	6g	0.28835 0.28804	0.27130 0.27079	0.28394 0.28425	0.27606 0.27657	0.31394 0.31382	0.30685 0.30697	0.31496 0.31547	0.28937 0.28968	0.30315 0.30264	0.29528 0.29497	0.27232 0.27220	0.28161 0.28173	6H

See Notes at end of table.