ASME B1.20.5-1991

(REVISION OF ANSI B1.20.5-1978)

REAFFIRMED 2009

FOR CURRENT COMMITTEE PERSONNEL
PLEASE E-MAIL CS@asme.org

GAGING FOR DRYSEAL PIPE THREADS (INCH)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

AN AMERICAN NATIONAL STANDARD

GAGING FOR DRYSEAL PIPE THREADS

(INCH)

ASME B1.20.5-1991

(REVISION OF ANSI B1.20.5-1978)

The American Society of
Mechanical Engineers

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

Date of Issuance: March 15, 1991

This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment which provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable Letters Patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations issued in accordance with governing ASME procedures and policies which preclude the issuance of interpretations by individual volunteers.

FOREWORD

(This Foreword is not part of ASME B1.20.5-1991.)

In 1973, the American National Standards Committee B2, which had formerly been responsible for pipe thread standards, was absorbed by ANSI Standards Committee B1 and reorganized as subcommittee 20. A complete rewrite of the B2.2-1968 Standard on Dryseal Pipe Threads was completed with the publication of ANSI B1.20.3-1976 for product threads and the ANSI B1.20.5-1978 Standard for Gaging.

The product thread standard ANSI B1.20.3 establishes two classes of dryseal pipe threads: Class 1 and Class 2. The classes differ only in inspection requirements. With Class 1 threads, inspection of root and crest truncation is not specified. Class 2 threads are identical to Class 1 threads except that inspection of root and crest truncation is required. This gaging standard includes 6-step crest and root check gages, which, within their limitations, should be helpful in establishing the degree of conformance of product threads.

When 6-step crest or root check gages are to be used, it is necessary to classify the product thread size into a size range (minimum, basic, or maximum) as shown in Fig. 1. The use of 3-step L1 thread gages for NPTF threads requires estimating the one third of a turn, plus or minus, from the basic notch on the gage to classify the thread as basic. Use of this same one third turn estimation is required to determine minimum and maximum ranges. This Standard includes 4-step taper thread gages to eliminate the need for estimating the one third turn deviation from basic necessary with 3-step or basic step gages. 3-step taper thread gages are included in Appendix A for those who may prefer to use them.

Crest and root check gages for NPTF threads are also covered in this Standard. Prior to the publication of ANSI B1.20.5-1978 many gage manufacturers had calculated diameters for and made such gages based on methods used for ANPT (MIL-P-7105) 6-step gages, which were calculated to the extremes of the minimum and maximum zones, where most product threads should never be, and which, further, is not the same logic used in calculating the pair of basic steps. The NPTF 6-step gages tabulated herein are based on the mid-point of each range as determined by the L_1 plug gage (minimum, basic, or maximum) for calculation of the truncation limits where most of the product threads should be (see Fig. 2).

It should be noted that all references to the turns of engagement method for inspection of product threads have been withdrawn from this Standard. Results obtained by that method were found to quite often disagree with those obtained by the step limit method described here within. Also, inconsistencies in the end threads on the product and gages do not provide for a constant disengagement point between the two. This does not however preclude the use of this method in any way as an acceptable means of inspecting taper pipe threads. When this method is chosen, customer and vendor should agree on gaging procedures and minimum/maximum acceptance limits on the turns of engagement. Information on this method can be found in Appendix D for reference.

The gaging data in this Standard supersedes that given in ANSI B1.20.5-1978. The proposed standard was submitted by Standards Committee B1 to the Secretariat and the American National Standards Institute. It was approved and formally designated as an American National Standard on January 22, 1991.

This page intentionally left blank.

ASME STANDARDS COMMITTEE B1
Standardization and Unification of Screw Threads

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

OFFICERS

D. Emanuelli, *Chairman*
H. W. Ellison, *Vice Chairman*
R. McGinnis, *Secretary*

COMMITTEE PERSONNEL

R. Anderson
J. Bein
A. Breed
R. Browning
R. Byrne
D. Cadieux
F. Cantrell
R. Chamerda
F. Ciccarone, *Alternate*
R. Dodge
P. Drake
H. W. Ellison
D. Emanuelli
C. Erickson
W. Farrell
G. Flannery
J. Heinz
W. Jatho, *Alternate*
F. Jones, *Alternate*
S. Johnson
S. Kanter
R. Lamport
R. LaNier
J. Levy
K. McCullough
J. McMurray
A. Painter
G. Russ
R. Sabatos
D. Satava
M. Schuster
E. Schwartz
R. Searr
R. Seppey
A. Shepherd
B. Shook
A. Strang
J. Sullivan
R. Tennis
A. Thibodeau
J. Trilling
M. Van Derwerken
C. Wilson

SUBCOMMITTEE B1.20 — PIPE THREADS

D. P. Cadieux, *Chairman*
A. F. Thibodeau, *Secretary*
C. F. Banks
M. J. Bibeau
P. F. Braun
J. A. Casner
W. O. Clinedinst
F. Dallas Jr.
D. M. Davidson
R. Dodge
W. C. Farrell Jr.
L. S. Feldheim
A. C. Flanders
G. Flannery
H. D. Goldberg
S. I. Kanter
W. A. Keaton
M. W. Rose
G. A. Russ
A. D. Shepherd
A. G. Strang

This page intentionally left blank.

CONTENTS

Appendices

Figures

Tables

GAGING FOR DRYSEAL PIPE THREADS (INCH)

1 GAGING

1.1 Scope

The scope of this Standard is to provide information regarding practical dryseal thread inspection methods and commonly used gages for production evaluation purposes. All dimensions are in inches unless otherwise specified.

1.1.1 Federal Government Use. When this Standard is approved by the Department of Defense and the Federal agencies and is incorporated into FED-STD-H28/8, Screw-Thread Standards for Federal Services, Section 8, the use of this Standard by the Federal Government is subject to all the requirements and limitations of FED-STD-H28/8.

1.2 How Dryseal Works

The principle of dryseal threads is based on crest and root contact at handtight engagement at both major and minor diameters. Conformance to L_1, L_2, and L_3 functional size gages alone will not assure that the threads will be drysealed to ANSI B1.20.3 design specfications. In addition to functional size, the dryseal crest and root truncations must be held on both external and internal threaded products in order to be dryseal. This applies to both straight and taper dryseal threads.

1.3 Limitations

Industry has developed gaging practices over many years which have resulted in the common use of L_1, L_2, L_3, and plain taper plug and ring gages to evaluate dryseal pipe threads. These are functional gages intended to aid the manufacturer in the control of threading operations. It must be recognized that conformance to a functional gage or series of gages is not conclusive evidence of conformance to the design requirements of ANSI B1.20.3. For critical applications more extensive inspection and testing, not covered in this Standard, may be required in order to insure an acceptable seal.

1.3.1 These gaging practices used with proper tool configuration control, sound manufacturing and part support practices, and visual inspection have provided pipe threads that sealed acceptably for many producers of pipe threads.

1.3.2 These gages and gaging practices are intended to evaluate unused pipe threads. Once a thread joint is made up wrench tight, metal is deformed by design and may not be found acceptable using these described gages and methods. It is the user's responsibility to determine if the used thread will perform satisfactorily in its intended application.

1.4 Product Thread Designations

Dryseal pipe threads are designated by specifying in sequence the nominal size, threads per inch, thread symbol, and class where required.

EXAMPLES:
1/8-27 NPTF-1
1/8-27 NPTF-2
1/8-27 PTF-SAE SHORT
1/8-27 NPSF
1/8-27 NPSI

Each of the letters in the symbols has a definite significance as follows:

N = National (American) Standard
P = Pipe
T = Taper
S = Straight
F = Fuel and Oil
I = Intermediate

For further information see ANSI B1.20.3.

1.4.1 Reference Documents. The latest issues of the following documents form a part of this Standard to the extent specified herein.

ANSI/ASME B1.7
Nomenclature, Definitions and Letter Symbols for Screw Threads

ANSI B1.20.3
Dryseal Pipe Threads

ANSI B47.1
Gage Blanks

TABLE 1 GAGES AND TOLERANCES

Thread to be Gaged	Gaged With	Product Thread Tolerance Applied to Basic Size [Note (1)]		Limit Method of Gaging [Note (1)] Tolerance
NPTF, external	L_1 or L_1 short and [Note (2)] L_2 or L_2 short ring gages	Plus (small) 1 turn	Minus (large) 1 turn	Threads are within the allowable tolerance when the product reference point is on or between the maximum and minimum step of the L_1 gage
PTF-SAE SHORT, external		Plus (small) 0 turn	Minus (large) 1.5 turn	
NPTF, internal	L_1 or L_1 short and [Note (3)] L_3 or L_3 short plug gages	Plus (large) 1 turn	Minus (small) 1 turn	
PTF-SAE SHORT, internal		Plus (large) 0 turn	Minus (small) 1.5 turn	
NPSF, internal	L_1 or L_1 short plug gage	Plus (large) 0 turn	Minus (small) 1.5 turn	
NPSI, internal		Plus (large) 1 turn	Minus (small) 0.5 turn	

NOTES:
(1) Step limit gages with 4 (or 3) steps should be used.
(2) The difference in engagement of the L_1 versus L_2 ring gages shall not exceed 0.5 turn. See para. 1.8.4.
(3) The difference in engagement of the L_1 versus L_3 plug gages shall not exceed 0.5 turn. See para. 1.8.4.

1.5 Inspection of Product Threads

1.5.1 Inspection of NPTF Class 1 Threads and PTF-SAE Short Threads. Acceptability is determined by coordinated use of L_1 and L_2 gages for external product threads and L_1 and L_3 gages for internal product threads. Crest and root truncation is generally considered to be controlled by tooling or other means.

1.5.2 Inspection of NPTF Class 2 Threads. Acceptability is determined, in part, by coordinated use of L_1 and L_2 gages for external product threads and L_1 and L_3 gages for internal product threads. Direct measurement of crest and root truncation is a method that ensures a high degree of accuracy in determining compliance with this Standard for both external and internal threads, but may not be necessary or practicable. It does not preclude the use of other gaging methods or inspection techniques such as L_1 and L_2 snap or indicating gages, 6-step crest or root check gages and in-process control of tooling. This Standard covers the 6-step crest check gages and 6-step root check gage for NPTF threads. (See para. 1.8.6.)

1.5.3 Inspection of NPSF and NPSI Internal Threads. Functional size is determined by use of the applicable L_1 taper thread gage (see Table 1) since these product threads are intended to assemble with taper dryseal external threads. Crest and root truncation is generally considered to be controlled by tooling or other means and can be verified by direct measurement.

1.6 Methods of Gaging Product Threads

1.6.1 The method of gaging dryseal pipe threads described in this Standard is commonly called the limit method. The limit method is intended for L_1 and L_2 ring gages and L_1 and L_3 plug gages of the corresponding 4(or 3)-step design. Basic step plug and ring gages may also be used. The 4-step design facilitates the use of the 6-step crest and root check gages.

1.6.2 When the limit method is used NPTF external and internal threads should be gaged with NPTF length gages with steps to indicate the size range to which the product thread qualifies (minimum range, basic range, or maximum range). PTF-SAE short product threads should be gaged with NPTF gages modified with steps to indicate the short length of hand tight engagement for that application. Both L_1 and L_2 gages for the external threads and L_1 and L_3 gages for internal threads are used to inspect these types of dryseal pipe threads.

When the turns engagement method of gaging is used, the NPTF length and short length gages can be used interchangeably, since the pitch diameter size at the small end of the gage is the same in both cases, and the step location is not used for the turns location method of gaging.

NPSF and NPSI straight internal threads should be gaged with NPTF gages modified with steps to indicate the minimum and maximum pitch diameters assigned to the respective type of thread. Only the L_1 type gages are used on NPSF and NPSI straight internal threads (GO and NOT GO straight gages are not recommended for size acceptance).

1.7 Coordination of Gages

As described in paragraphs under 2.1 the L_1 and L_2 ring gages and the L_1 and L_3 plug gages provide a check of the functional diameter (excluding crest and root truncation) of the product threads. Additionally, the coordinated use of these gages provides a check on the taper of the product thread. Proper use of the 6-step crest and root check gages also requires coordination with the L_1 ring or L_1 plug gage.

1.7.1 Order of Gaging. The L_1 gage is always used first. The L_2 or L_3 gage is used second and if root and/or crest check gages are used, they are applied last.

1.7.2 Gage and Product Thread Reference Points. Since dryseal pipe threads (except NPSF and NPSI) and the gages covered by this Standard are tapered, the gages will only engage the product thread a finite amount. Consequently, gaging is based on the relative position of the gage to the product thread.

1.7.2.1 For the limit method of gaging, the reference points of the gages are the steps. In order to provide a common reference point and eliminate variations due to chamfer or uneven surface, the reference point of external and internal product threads is the end of the pipe or fitting, provided the chamfer does not exceed the major diameter of the internal thread or be less than the minor diameter of the external thread. Allowance must be made for excessive chamfer at the small end of the external thread and the large end of the internal thread. When this condition exists customer and vender should agree upon a common reference point to be used in inspection.

1.7.3 Classification of Product Thread Size (NPTF). When 6-step crest and/or root check gages are used, it is necessary that the product thread be classified either as a "maximum thread," "basic thread," or "minimum thread." Classification is based on the position of the L_1 ring or L_1 plug gages.

1.7.3.1 For the limit method of gaging, the product thread reference point may not directly coincide with the L_1 ring or L_1 plug reference points (maximum, basic, or minimum step). Therefore, the distance between the maximum step and minimum step is divided into three equal ranges as shown in Fig. 1. The ranges may be determined by use of 4-step L_1 taper thread gages or may be approximated by eye or by turns of the gage on the product thread. If the reference point of the product thread lies in the minimum range, basic range or maximum range, it is termed a "minimum thread," "basic thread," or "maximum thread" respectively.

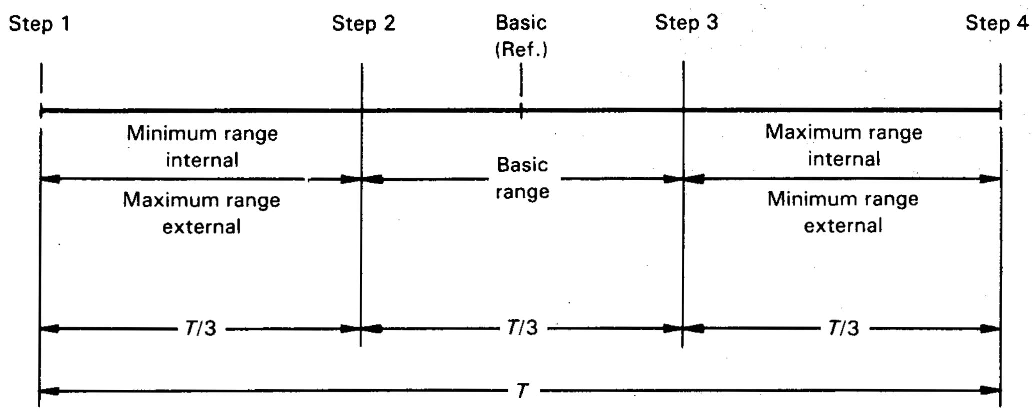
1.8 Use of Gages

1.8.1 Prior to gaging threads, it is important that the gage and product threads are clean and free from burrs.

1.8.2 In all cases when a gage is used, it is inserted or screwed handtight onto or into the product thread. The next steps of the gaging procedure are detailed in the following paragraphs, and unless noted otherwise, L_1, L_2, and L_3 are synonymous with L_1 Short, L_2 Short, and L_3 Short. An outline of the gages and gaging tolerances are given in Table 1.

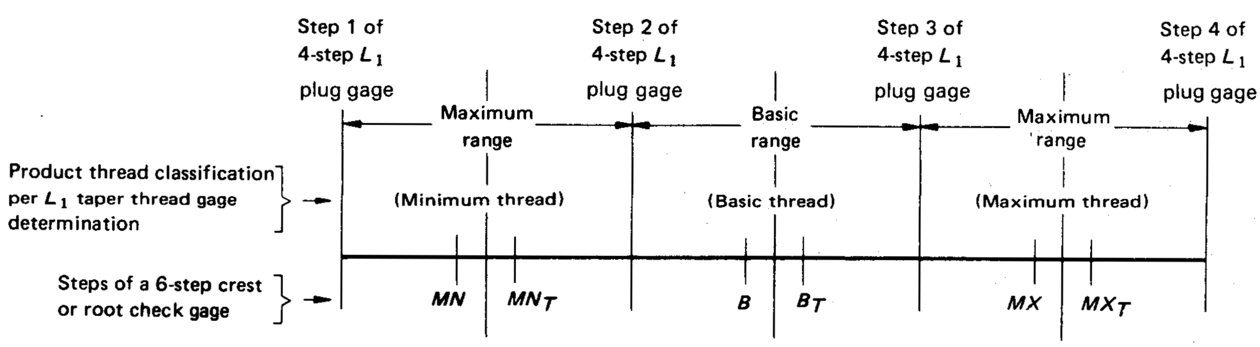
1.8.3 L_1 Gages. For the limit method of gaging using 4(or 3)-step gages, the product thread reference point must lie between the appropriate steps. If the 6-step crest and/or root gages are to be used, the product thread must be classified to be either a "maximum thread," "basic thread," or "minimum thread" (see para. 1.7.3).

1.8.4 L_2 Gage or L_3 Gage. The L_1 gage is the sizing gage and L_2 and L_3 gages are relationship gages. When assembled with the L_2 or L_3 gage the position of the product thread reference point may not vary more



GENERAL NOTE: T = 2 turns

FIG. 1 CLASSIFICATION OF NPTF PRODUCT THREAD SIZE USING 4-STEP GAGES



GENERAL NOTE:
Example shown is for the inspection of internal product thread.

Step	Corresponds to:
MN	Minimum thread with minimum truncation
MN_T	Minimum thread with maximum truncation
B	Basic thread with minimum truncation
B_T	Basic thread with maximum truncation
MX	Maximum thread with minimum truncation
MX_T	Maximum thread with maximum truncation

FIG. 2 IDENTIFICATION OF STEPS ON 6-STEP CREST OR ROOT CHECK GAGE

than ±½ turn from the position as established when assembled with the L_1 gage. When using 4(or 3)-step L_2 or L_3 gages the product thread reference point is not required to lie between the same set of steps as when assembled with the L_1 gage and may lie beyond the maximum and minimum steps. Steps on L_2 and L_3 gages are for reference only.

1.8.5 6-Step Crest Check Gage or 6-Step Root Check Gage. When using the limit method of gaging, the gage must correlate to the product thread classification as determined by the L_1 gage. Specifically, if the product thread is classified as a "maximum thread," the product thread reference point must lie between the two steps of the gage marked MX and MX_T. If the product thread is classified as a "basic thread," the product thread reference point must lie between the steps of the gage marked B and B_T. If the product thread is classified as a "minimum thread," the product thread reference point must lie between the steps of the gage marked MN and MN_T. An identification of the six steps is shown in Fig. 2.

1.8.6 Limitations on Reliability of 6-Step Gages for Establishing Truncation and Width of Flats on Product Threads. Use of the 6-step gage in conjunction with the L_1 thread gage presumes a perfect thread flank contact of the gage to product thread which can never exist except on a thread with perfect flank angles, lead, and taper. The product thread groove is always wider than the gage thread ridge which fits into it. The product thread root flat is therefore always wider than indicated by the position of the 6-step gage while the crest flat is always narrower. (See para. 1.5.2.)

1.9 Direct Measurement of Crest and Root Truncation

One method of direct measurement of truncation is by optical projection. With this method, it is difficult to measure truncation as defined. Therefore, measurement of the equivalent width of flat is a common practice. External threads can be directly projected, but internal threads must either be sectioned and projected by reflection or cast[1] and the cast used for direct projection. Magnification should not be less than 20X and may need to be greater for accurate resolution of small size threads.

[1] Some silicon rubber molding compounds have been found to be good casting material.

1.10 Inspection of Gages

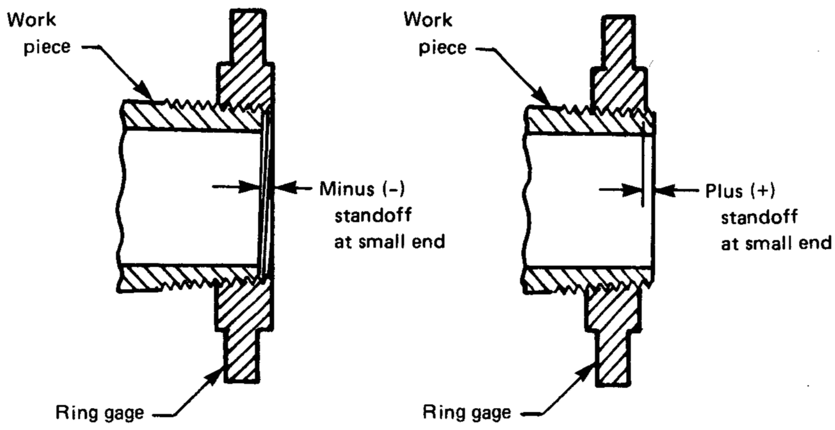
1.10.1 Periodic inspection of gages is necessary in order to detect gages worn beyond the limits specified in para. 2.4. Since gage wear is directly related to gage use, frequency of inspection must be determined by each user.

1.10.2 Working gages are generally inspected by using master gages. Master gages provide a functional check of all thread elements (except crest and root truncation) but will not detect uneven wear. Consequently, the individual thread elements (pitch diameter, lead, taper, half angle, truncation, and major or minor diameter) of working gages should be measured occasionally. Measurement of these thread elements can be made by the user but because of the relatively elaborate equipment and procedures required, it may be most economical to send the gages to a gage manufacturer or to a measurement laboratory.

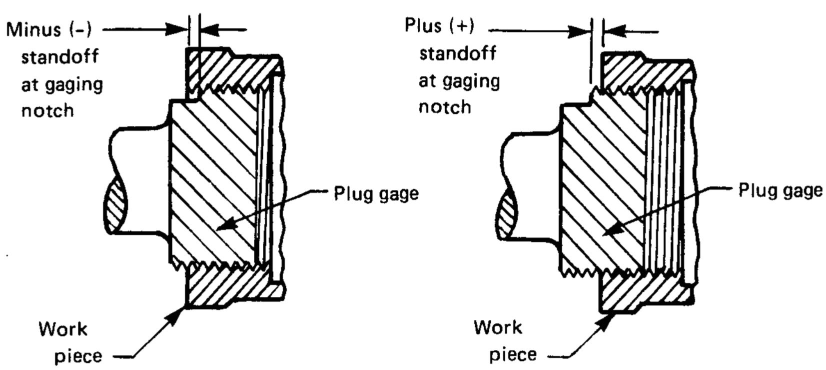
1.10.3 Methods of Measuring Externally Threaded Gages. Two-wire, three-wire, and four-wire methods described in Appendix B, are used for measuring pitch diameter for taper threads. The choice from these methods is a matter of preference and more often depends on the availability of fixtures and measuring equipment. Lead and taper can be measured on measuring machines, half angle, and truncation (width of flat), by optical projection.

1.10.4 Methods of Measuring Internally Threaded Gages. Internal threads are generally much more difficult to measure directly than external threads. There are no standard methods for measuring pitch diameter although it is generally determined by mating the ring gage to a master taper thread plug gage as described in Appendix B. Measurement of pitch diameter can also be made by using the ball probe method described in Appendix B. Lead and taper can be measured on measuring machines, half angle, and truncation, by optical projection of a cast.

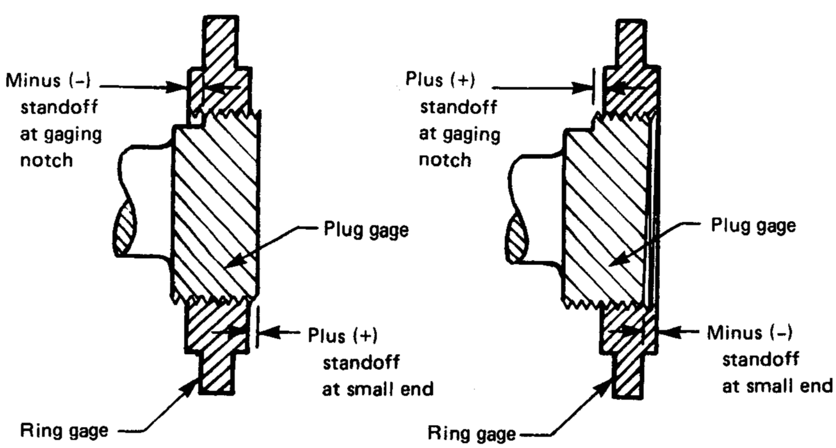
1.10.5 Standoff. The relative position of a gage when mated to another gage or workpiece (see Fig. 3). It is recommended that the standoff of each working gage from its respective master be determined and that the value be taken into consideration when the working gage is used. Working gages should be replaced when the standoff is more than one-half turn from basic size.



(a) L_1 Ring Gage With Work Piece



(b) L_1 Plug Gage With Work Piece



(c) L_1 Plug Gage With L_1 Ring Gage

FIG. 3 RELATIVE POSITION PLUS AND MINUS STANDOFF

TABLE 2 FUNCTION AND APPLICATION OF GAGES COVERED IN ASME B1.20.5-1991

WORKING GAGES

NPTF

L_1 ring	4-step	Table 7
L_1 ring	Basic step	Table 7
L_1 ring	3-step	Table A1
L_2 ring	4-step	Table 9
L_2 ring	Basic step	Table 9
L_2 ring	3-step	Table A2
Crest ring	6-step	Table 11
Root ring	6-step	Table 12
L_1 plug	4-step	Table 13
L_1 plug	Basic step	Table 13
L_1 plug	3-step	Table A3
L_3 plug	4-step	Table 16
L_3 plug	Basic step	Table 16
L_3 plug	3-step	Table A4
Crest plug	6-step	Table 18
Root plug	6-step	Table 19

PTF-SAE SHORT

L_1 short ring	3-step	Table 8
L_2 short ring	3-step	Table 10
L_1 short plug	3-step	Table 14
L_3 short plug	3-step	Table 17

NPSF

L_1 short plug	3-step	Table 14

NPSI

L_1 plug	3-step	Table 15

MASTER GAGES

Ring for L_1 and L_3 taper plug	Table 20
Plug for L_1 and L_2 taper ring	Table 21
Ring for 6-step crest plug	Table 22
Plug for 6-step crest ring	Table 22
Ring for 6-step root plug	Table 23
Plug for 6-step root ring	Table 23

2 GAGES

2.1 Types and Functions of Gages

Although inspection of dryseal pipe threads may involve instruments for direct measurement as well as gages, this section covers only gages. The types of gages listed below are ring and plug gages; however, snap or indicating gages may be used provided that the functions listed below are satisfied. It should be noted, however, that standard thread gages for dryseal pipe threads are designed to provide a functional check rather than to measure individual thread elements. The gages covered in this Standard are listed according to function and application in Table 2.

2.1.1 Gages for Checking External Threads

2.1.1.1 L_1 Taper Thread Ring Gage or L_1 Short Taper Thread Ring Gage. Checks the functional diameter and minimum height of thread form (excluding root and crest truncation) of that portion of the thread engaged when mating dryseal pipe threads are assembled handtight.

2.1.1.2 L_2 Taper Thread Ring Gage or L_2 Short Taper Thread Ring Gage. Checks the functional diameter (excluding root and crest truncation) of the threads provided for wrench make-up beyond the L_1 length, and in relation to the position of the L_1 ring, provides an indication of taper deviation, or excessive root truncation.

2.1.1.3 Crest Check Ring Gage. Checks the major diameter (crest truncation) of the external thread.

2.1.1.4 Boot Check Ring Gage. Checks the minor diameter (root truncation) of the external thread.

2.1.2 Gages for Checking Internal Threads

2.1.2.1 L_1 Taper Thread Plug Gage or L_1 Short Taper Thread Plug Gage. Checks the functional diameter and minimum height of thread form (excluding root and crest truncation) of that portion of the thread engaged when mating dryseal pipe threads are assembled handtight.

2.1.2.2 L_3 Taper Thread Plug Gage or L_3 Short Taper Thread Plug Gage. Checks the functional diameter, (excluding root and crest truncation) of the threads provided for wrench make-up beyond the L_1 length, and in relation to the position of the L_1 plug, provides an indication of taper deviation, or excessive root truncation.

2.1.2.3 Crest Check Plug Gage. Checks the minor diameter (crest truncation) of the internal thread.

2.1.2.4 Root Check Plug Gage. Checks the major diameter (root truncation) of the internal thread.

2.1.3 All dimensions in this Standard, including all tables are in inches unless otherwise specified.

2.2 Taper Thread Gages

There are two kind of gages: working gages and master gages.

2.2.1 Working gages are used to check product threads during manufacture and for acceptance. Each set of working gages consists of L_1 and L_2 ring gages and L_1 and L_3 plug gages. For Class 2 product threads, crest check and root check gages should also be included in a set of working gages.

2.2.2 Master gages are used as a reference to check new working gages and for surveillance of used working gages and classification of them as to standoff. However, it is not necessary to have master gages if other methods of inspecting working gages are employed. Each set of master gages consists of an L_1/L_3 master ring gage and an L_1/L_2 master plug gage. (See Fig. 4.)

2.3 Thread Form

2.3.1 L_1 and L_2 Taper Thread Ring Gages and L_1 and L_3 Taper Thread Plug Gages. L_1 and L_2 ring gages and L_1 and L_3 plug gages have a triangular thread form with truncated crests and cleared roots. The angle between the flanks of the threads is 60 degrees when measured on an axial plane and the line bisecting this angle is perpendicular to the axis of the threads making each half angle equal to 30 degrees. L_1 ring and plug gages have a truncation parallel to the pitch line, equal to the maximum root truncation of the product thread, while crests of L_2 ring and L_3 plug gages have a truncation of $0.20p$. The form of the thread root is optional, but must clear a $0.042p$ flat ($0.036p$ truncation).

NOTE: The maximum width of root relief permissible equals the maximum product root width (see ANSI B1.20.3).

2.3.2 Root Check Ring and Plug Gages. Root check ring and plug gages have a triangular thread form with truncated crests and cleared roots. The angle between the flanks of the threads is 50 degrees when measured on an axial plane and the line bisecting this angle is perpendicular to the axis of the threads. (The 50 degree thread angle enables the gage to contact only at the root of the product thread so that root truncation can be checked.) Crests are truncated to provide a gage maximum flat width that is 0.001 inch smaller than the minimum flat width of the product thread root. The form of the thread root is optional, but must clear a $0.15p$ flat.

2.3.3 Crest Check Ring and Plug Gages. Crest check ring and plug gages are plain (cylindrical) taper gages.

2.3.4 Optical Projection of Thread Form. Visual method of inspection may be used in lieu of the root check and crest check ring and plug gages. The threads of tools and the threads of a percentage of the product external threads, or casts in the case of internal threads, may be visually checked by optical comparator projection (at least 20X) for thread form and truncation.

2.4 Gage Tolerance

In the manufacture of gages, variations from basic dimensions are unavoidable. Furthermore, gages will wear in use. In order to fix the maximum allowable variations of gages, tolerances have been established and are applied to the basic dimensions given in Section 2.5.

2.4.1 Working Gage Tolerance. Manufacturing tolerances for working gages are given in Table 3. The maximum wear on a working gage shall not be more than the equivalent of one-half turn as determined by the master gage.

2.4.2 Master Gage Tolerance. Master gage tolerances are shown in Table 4. Master gages should be a matched set (plug and ring) and accompanied by a record of the amount they vary from being flush to basic in terms of standoff specified in three decimal places.

2.4.3 Relationship of Lead and Angle Variations to Pitch Diameter Tolerance

2.4.3.1 Functional size of pitch diameter is affected by variations in lead and angle and the effect of these variations can be expressed as an equivalent variation in diameter. Diameter equivalents of variations in lead and half angle are given in Tables 4 and 5 respectively.

2.4.3.2 These corrections are always added to the pitch diameter in the case of external threads and subtracted in the case of internal threads regardless of whether the lead or angle variations are plus or minus.

2.4.3.3 The diameter equivalent for lead and angle variations plus the pitch diameter variation multiplied by 16 gives the longitudinal variation from basic at the gaging notch.

2.5 Working Gage Dimensions

The basic dimensions given in the following paragraphs pertain to working gages. Both 4-step and basic notch gage designs are covered for L_1 and L_2 ring gages and L_1 and L_3 plug gages. Only the 6-step design is covered for crest and root check gages. The 4-step gages are included because they facilitate the use of the 6-step crest and root gages. Although the basic notch gage is more difficult to use in conjunction with the 6-step crest and root gages, it is more economical to manufacture and may be used for checking both NPTF threads, and PTF-SAE SHORT threads.

2.5.1 L_1 Ring Gage (for checking NPTF threads). The 3-step design is included in Appendix A for reference. (See Table 7.)

2.5.2 L_1 Short Ring Gage (for checking PTF-SAE SHORT threads). See Table 8.

2.5.3 L_2 Ring Gage (for checking NPTF threads). The 3-step design is included in Appendix A for reference. (See Table 9.)

2.5.4 L_2 Short Ring Gage (for checking PTF-SAE SHORT threads). See Table 10.

2.5.5 Crest Check Ring Gage (for checking NPTF threads). See Table 11.

2.5.6 Root Check Ring Gage (for checking NPTF threads). See Table 12.

2.5.7 L_1 Plug Gage (for checking NPTF threads). See Table 13. The 3-step design is included in Appendix A for reference.

2.5.8 L_1 Short Plug Gage (for checking PTF-SAE SHORT and NPSF threads). See Table 14.

2.5.9 L_1 Plug Gage, NPSI (for checking NPSI threads). See Table 15.

2.5.10 L_3 Plug Gage (for checking NPTF threads). See Table 16.

2.5.11 L_3 Short Plug Gage (for checking PTF-SAE SHORT threads). See Table 17.

2.5.12 Crest Check Plug Gage (for checking NPTF threads). See Table 18.

2.5.13 Root Check Plug Gage (for checking NPTF threads). See Table 19.

2.6 Master Gage Dimensions

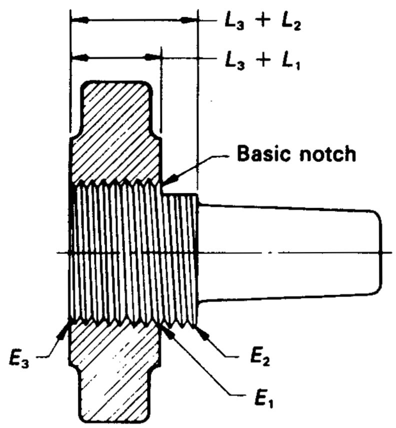
The basic dimensions given in the following tables pertain to master gages for NPTF threads.

2.6.1 Master Ring Gage (for checking NPTF Working Plug Gages). See Table 20.

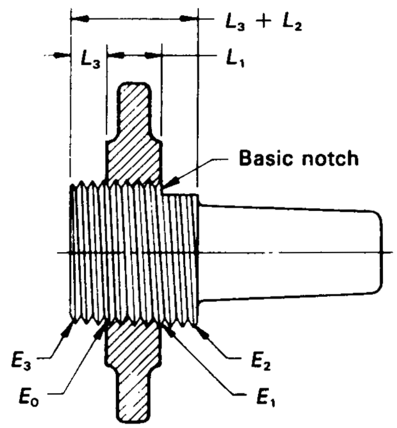
2.6.2 Master Plug Gage (for checking NPTF Working Ring Gages). See Table 21.

2.6.3 Master Ring and Plug Gages (for checking NPTF 6-Step Working Crest Ring and Plug Gages). See Table 22.

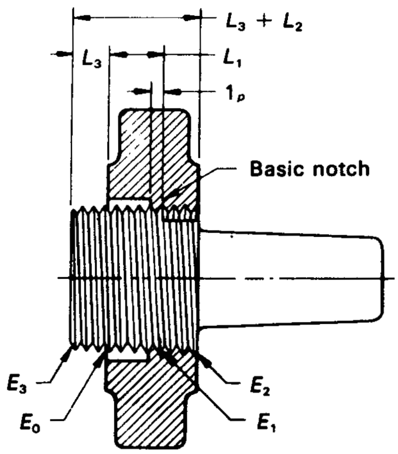
2.6.4 Master Ring and Plug Gages (for checking NPTF 6-Step Working Root Ring and Plug Gages). See Table 23.



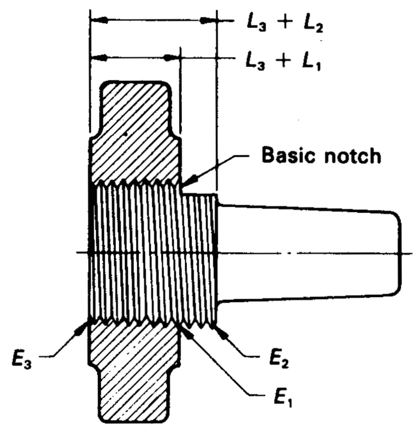
(a) L_1/L_2 Master Plug With L_1/L_3 Master Ring



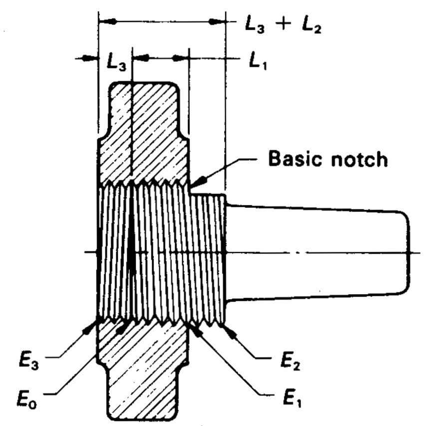
(b) L_1/L_2 Master Plug With L_1 Ring



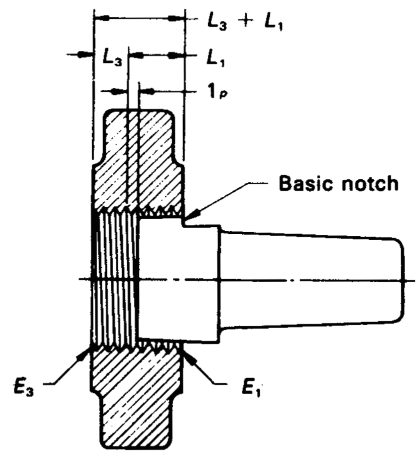
(c) L_1/L_2 Master Plug With L_2 Ring



(d) L_1/L_3 Master Ring With L_1/L_2 Master Plug



(e) L_1/L_3 Master Ring With L_1 Plug



(f) L_1/L_3 Master Ring With L_3 Plug

GENERAL NOTE:
Master gage set consists of one full-form L_1/L_2 master taper thread plug gage and one full-form L_1/L_3 master taper thread ring gage.

FIG. 4 RELATIVE POSITION OF MASTER PLUGS AND RINGS TO WORKING GAGES

TABLE 3 TOLERANCES FOR WORKING PLUG AND RING GAGES

Nominal Size	Tolerance [Note (1)] on Pitch Diam. (±)	Tolerance on Lead [Notes (2), (3)]		Tolerance [Note (4)] on Half-Angle, Minutes		Tolerance on Taper [Notes (3), (5)]		Tolerance on Major Diam.	Tolerance on Minor Diam.	Total Cumulative [Note (6)] Tolerances on Pitch Diam.		Standoff [Notes (7), (8)]
		Plugs	Rings	Plugs (±)	Rings (±)	Plugs (+)	Rings (−)	Plugs (−)	Rings (+)	Plugs	Rings	
1	2	3	4	5	6	7	8	9	10	11	12	13
1/16-27	0.0002	0.0002	0.0003	15	20	0.0003	0.0006	0.0012	0.0012	0.00080	0.00105	0.030
1/8-27	0.0002	0.0002	0.0003	15	20	0.0003	0.0006	0.0012	0.0012	0.00080	0.00105	0.030
1/4-18	0.0002	0.0002	0.0003	15	20	0.0004	0.0007	0.0012	0.0012	0.00092	0.00122	0.034
3/8-18	0.0002	0.0002	0.0003	15	20	0.0004	0.0007	0.0012	0.0012	0.00092	0.00122	0.034
1/2-14	0.0003	0.0002	0.0003	10	15	0.0006	0.0009	0.0015	0.0015	0.00097	0.00130	0.036
3/4-14	0.0003	0.0002	0.0003	10	15	0.0006	0.0009	0.0015	0.0015	0.00097	0.00130	0.036
1-11 1/2	0.0003	0.0003	0.0004	10	15	0.0008	0.0012	0.0015	0.0015	0.00121	0.00157	0.044
1 1/4-11 1/2	0.0003	0.0003	0.0004	10	15	0.0008	0.0012	0.0015	0.0015	0.00121	0.00157	0.044
1 1/2-11 1/2	0.0003	0.0003	0.0004	10	15	0.0008	0.0012	0.0015	0.0015	0.00121	0.00157	0.044
2-11 1/2	0.0003	0.0003	0.0004	10	15	0.0008	0.0012	0.0015	0.0015	0.00121	0.00157	0.044
2 1/2-8	0.0005	0.0004	0.0005	7	10	0.0010	0.0014	0.0019	0.0019	0.00158	0.00193	0.056
3-8	0.0005	0.0004	0.0005	7	10	0.0010	0.0014	0.0019	0.0019	0.00158	0.00193	0.056

GENERAL NOTES:

(a) The tolerances for the length from small end to gaging notch of the L_1 and L_3 plug gages shall be +0.000 and −0.001 for sizes 1/16 to 2 inclusive and +0.000 and −0.002 for sizes 2 1/2 and larger.

(b) The tolerances for the overall thread length L_2 of the plug gage shall be +1/64 and −0 for sizes 1/16 to 2 inclusive and +1/32 and −0 for sizes 2 1/2 and larger.

(c) Tolerance for the thickness of the L_1 and L_2 ring gages shall be −0.000 and +0.001 for sizes 1/16 to 2 inclusive and −0.000 and +0.002 for sizes 2 1/2 and larger.

(d) The tolerances for step lengths of all 4-step gages is as follows:

Step 1, +0.002 and −0.000
Step 2, ±0.001
Step 3, ±0.001
Step 4, +0.000 and −0.002

NOTES:

(1) To be measured at the gaging notch of plug gage.

(2) Allowable variation in lead between any two threads in L_1 length of gage.

(3) The lead and taper on plug and ring gages shall be measured along the pitch line omitting the incomplete threads at each end.

(4) In solving for the correction in diameter for angle variation the average variation in half angle for the two sides of thread regardless of their signs, should be taken.

(5) Allowable variation in taper in L_1 length of gage.

(6) *Total cumulative tolerance on pitch diameter* = PD tolerance + diameter equivalent of lead variation + diameter equivalent of half angle variation.

(7) Between the plug gage gaging notch and the large end of the ring gage when dimensions are at opposite extremes of the tolerance limits.

(8) Maximum possible interchange standoff, any ring against any plug other than its master plug, may occur when taper variations are zero and all other dimensions are at opposite extreme tolerance limits. Actual standoff should be well within these maximum limits. Refer to Tables 5 and 6 for diameter equivalents of lead and half angle variations respectively.

TABLE 4 TOLERANCES FOR MASTER PLUG AND RING GAGES

Nominal Size	Tolerance [Note (1)] on Pitch Diam. (±)	Tolerance [Notes (2), (3)] on Lead		Tolerance [Note (4)] on Half Angle, min		Tolerance [Notes (3), (5)] on Taper		Tolerance on Major Diam.	Tolerance on Minor Diam.	Total Cumulative [Note (6)] Tolerances on Pitch Diam.		Standoff [Notes (7), (8)] (±)
		Plugs	Rings	Plugs (±)	Rings (±)	Plugs (+)	Rings (−)	Plugs (−)	Rings (+)	Plugs	Rings	
1	2	3	4	5	6	7	8	9	10	11	12	13
1/16–27	0.0001	0.0001	0.00015	8	12	0.00015	0.0003	0.0006	0.0006	0.0004	0.00056	0.002
1/8 –27	0.0001	0.0001	0.00015	8	12	0.00015	0.0003	0.0006	0.0006	0.0004	0.00056	0.002
1/4 –18	0.0001	0.0001	0.00015	8	12	0.0002	0.0003	0.0006	0.0006	0.00047	0.00066	0.002
3/8 –18	0.0001	0.0001	0.00015	8	12	0.0002	0.0003	0.0006	0.0006	0.00047	0.00066	0.002
1/2 –14	0.00015	0.0001	0.00015	6	10	0.0003	0.0004	0.0007	0.0007	0.00051	0.00073	0.002
3/4 –14	0.00015	0.0001	0.00015	6	10	0.0003	0.0004	0.0007	0.0007	0.00051	0.00073	0.002
1 –11 1/2	0.00015	0.00015	0.0002	6	10	0.0004	0.0005	0.0007	0.0007	0.00064	0.00089	0.002
1 1/4 –11 1/2	0.00015	0.00015	0.0002	6	10	0.0004	0.0005	0.0007	0.0007	0.00064	0.00089	0.002
1 1/2 –11 1/2	0.00015	0.00015	0.0002	6	10	0.0004	0.0005	0.0007	0.0007	0.00064	0.00089	0.002
2 –11 1/2	0.00015	0.00015	0.0002	6	10	0.0004	0.0005	0.0007	0.0007	0.00064	0.00089	0.002
2 1/2 – 8	0.00025	0.0002	0.00025	5	7	0.0005	0.0006	0.0009	0.0009	0.00088	0.00107	0.003
3 – 8	0.00025	0.0002	0.00025	5	7	0.0005	0.0006	0.0009	0.0009	0.00088	0.00107	0.003

GENERAL NOTES:

(a) The tolerances for the length L_1 from small end to gaging notch of the plug gage shall be +0.000 and −0.0005 for sizes 1/16 to 2 inclusive and +0.000 and −0.001 for sizes 2 1/2 and larger.

(b) The tolerances for the overall thread length L_2 of the plug gage shall be +0.000 and −0.001 for sizes 1/16 to 2 inclusive and +0.000 and −0.002 for sizes 2 1/2 and larger.

(c) Tolerances for the thickness of the ring gage shall be −0.000 and +0.001 for sizes 1/16 to 2 inclusive and −0.000 and +0.002 for sizes 2 1/2 and larger.

(d) Refer to Tables 6 and 7 for diameter equivalents of lead and half angle variations respectively.

NOTES:

(1) To be measured at the gaging notch of plug gage.

(2) Allowable variation in lead between any two threads in L_1 length of gage.

(3) The lead and taper on plug and ring gages shall be measured along the pitch line omitting the incomplete threads at each end.

(4) In solving for the correction in diameter for angle variations, the average variation in half angle for the two sides of thread regardless of their signs, should be taken.

(5) Allowable variation in taper in L_1 length of gage.

(6) Total cumulative tolerance on pitch diameter = PD tolerance + diameter equivalent of lead variation + diameter equivalent of half angle variation.

(7) Between master plug at gaging notch and the large end of the *master* ring gage.

(8) Tolerances listed are standoff limits for master ring to its original master plug gage. Master plug to working ring or master ring to working plug standoff may exceed the standoff shown but should not exceed one-half extreme standoff listed in Table 3, column 13.

TABLE 5 DIAMETER EQUIVALENT OF VARIATION IN LEAD FOR TOOLS AND GAGES

First 4 Decimal Places of Variation δp	*Use appropriate column below for 5th Decimal Place of Variation									
	0.00000	0.00001	0.00002	0.00003	0.00004	0.00005	0.00006	0.00007	0.00008	0.00009
1*	2	3	4	5	6	7	8	9	10	11
0.0000*	0.00000	0.00002	0.00003	0.00005	0.00007	0.00009	0.00010	0.00012	0.00014	0.00016
0.0001*	0.00017	0.00019	0.00021	0.00023	0.00024	0.00026	0.00028	0.00029	0.00031	0.00033
0.0002*	0.00035	0.00036	0.00038	0.00040	0.00042	0.00043	0.00045	0.00047	0.00048	0.00050
0.0003*	0.00052	0.00054	0.00055	0.00057	0.00059	0.00061	0.00062	0.00064	0.00066	0.00068
0.0004*	0.00069	0.00071	0.00073	0.00074	0.00076	0.00078	0.00080	0.00081	0.00083	0.00085
0.0005*	0.00087	0.00088	0.00090	0.00092	0.00094	0.00095	0.00097	0.00099	0.00100	0.00102
0.0006*	0.00104	0.00106	0.00107	0.00109	0.00111	0.00113	0.00114	0.00116	0.00118	0.00120
0.0007*	0.00121	0.00123	0.00125	0.00126	0.00128	0.00130	0.00132	0.00133	0.00135	0.00137
0.0008*	0.00139	0.00140	0.00142	0.00144	0.00145	0.00147	0.00149	0.00151	0.00152	0.00154
0.0009*	0.00156	0.00158	0.00159	0.00161	0.00163	0.00165	0.00166	0.00168	0.00170	0.00171
0.0010*	0.00173	0.00175	0.00177	0.00178	0.00180	0.00182	0.00184	0.00185	0.00187	0.00189
0.0011*	0.00191	0.00192	0.00194	0.00196	0.00197	0.00199	0.00201	0.00203	0.00204	0.00206
0.0012*	0.00208	0.00210	0.00211	0.00213	0.00215	0.00217	0.00218	0.00220	0.00222	0.00223
0.0013*	0.00225	0.00227	0.00229	0.00230	0.00232	0.00234	0.00236	0.00237	0.00239	0.00241
0.0014*	0.00242	0.00244	0.00246	0.00248	0.00249	0.00251	0.00253	0.00255	0.00256	0.00258
0.0015*	0.00260	0.00262	0.00263	0.00265	0.00267	0.00268	0.00270	0.00272	0.00274	0.00275
0.0016*	0.00277	0.00279	0.00281	0.00282	0.00284	0.00286	0.00288	0.00289	0.00291	0.00293
0.0017*	0.00294	0.00296	0.00298	0.00300	0.00301	0.00303	0.00305	0.00307	0.00308	0.00310
0.0018*	0.00312	0.00313	0.00315	0.00317	0.00319	0.00320	0.00322	0.00324	0.00326	0.00327
0.0019*	0.00329	0.00331	0.00333	0.00334	0.00336	0.00338	0.00339	0.00341	0.00343	0.00345
0.0020*	0.00346	0.00348	0.00350	0.00352	0.00353	0.00355	0.00357	0.00359	0.00360	0.00362

GENERAL NOTE:
Diameter equivalent = $1.732\delta p$ where δp = variation in lead between any two threads.

TABLE 6 DIAMETER EQUIVALENT OF VARIATIONS IN HALF INCLUDED ANGLE FOR TOOLS AND GAGES

Variation [Note (1)] $\delta\alpha$ Min.	8 Threads/ in.	11½ Threads/ in.	14 Threads/ in.	18 Threads/ in.	27 Threads/ in.
1	0.00006	0.00004	0.00003	0.00002	0.00002
2	0.00011	0.00008	0.00006	0.00005	0.00003
3	0.00017	0.00012	0.00010	0.00007	0.00005
4	0.00022	0.00016	0.00013	0.00010	0.00007
5	0.00028	0.00019	0.00016	0.00012	0.00008
6	0.00034	0.00023	0.00019	0.00015	0.00010
7	0.00039	0.00027	0.00022	0.00017	0.00012
8	0.00045	0.00031	0.00026	0.00020	0.00013
9	0.00050	0.00035	0.00029	0.00022	0.00015
10	0.00056	0.00039	0.00032	0.00025	0.00017
11	0.00062	0.00043	0.00035	0.00027	0.00018
12	0.00067	0.00047	0.00038	0.00030	0.00020
13	0.00073	0.00051	0.00042	0.00032	0.00022
14	0.00078	0.00054	0.00045	0.00035	0.00023
15	0.00084	0.00058	0.00048	0.00037	0.00025
16	0.00089	0.00062	0.00051	0.00040	0.00027
17	0.00095	0.00066	0.00054	0.00042	0.00028
18	0.00101	0.00070	0.00058	0.00045	0.00030
19	0.00106	0.00074	0.00061	0.00047	0.00031
20	0.00112	0.00078	0.00064	0.00050	0.00033
21	0.00117	0.00082	0.00067	0.00052	0.00035
22	0.00123	0.00086	0.00070	0.00055	0.00036
23	0.00129	0.00089	0.00074	0.00057	0.00038
24	0.00134	0.00093	0.00077	0.00060	0.00040
25	0.00140	0.00097	0.00080	0.00062	0.00041
26	0.00145	0.00101	0.00083	0.00065	0.00043
27	0.00151	0.00105	0.00086	0.00067	0.00045
28	0.00157	0.00109	0.00089	0.00070	0.00046
29	0.00162	0.00113	0.00093	0.00072	0.00048
30	0.00168	0.00117	0.00096	0.00075	0.00050
45	0.00252	0.00175	0.00144	0.00112	0.00075
60	0.00336	0.00233	0.00192	0.00149	0.00099

GENERAL NOTES:
(a) In solving for the diameter equivalent of angle variations the average variation in half angle for the two sides of the thread regardless of their signs should be taken.
(b) Diameter equivalent = $1.53812p \tan \delta\alpha$, where $\delta\alpha$ = variation in half included angle of thread expressed in minutes.

NOTE:
(1) Table is based upon an NPT gage with $0.1p$ root/crest truncations with equal half-angle variations. For other gages with equal truncations, multiply by

$$\frac{0.866p - 2(\text{truncation})}{0.6667p}$$

Table 7 begins on next page.

TABLE 7

Range qualification by steps:

- Between Step 1 and Step 2 — maximum range
- Between Step 2 and Step 3 — basic range
- Between Step 3 and Step 4 — minimum range

To facilitate use of 6-step crest and root check gages, qualification of the product thread into one of these ranges is necessary and is best determined with the 4-step L_1 ring gage.

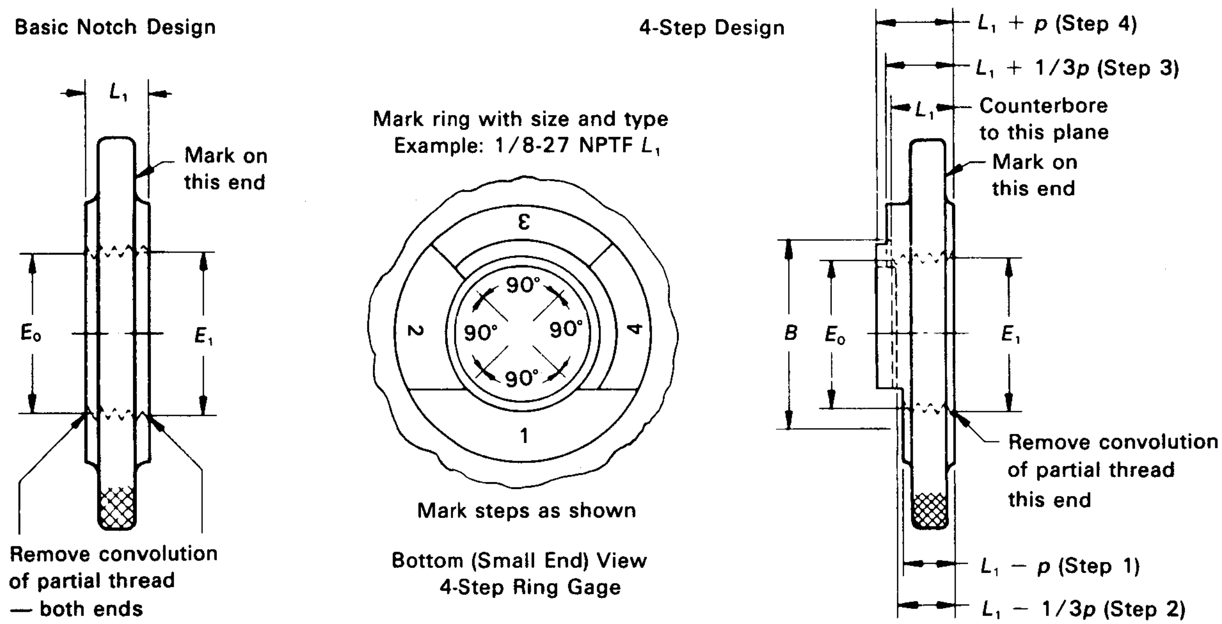


TABLE 7 BASIC DIMENSIONS FOR L_1 RING GAGES

Nominal Size	Basic Length, L_1	Large End		Maximum Range		Basic Range		Minimum Range		Small End		Counterbore Diam. to L_1 Plane, B
		Pitch Diam., E_1	Minor [Note (1)] Diam.	Max. Step 1 $(L_1 - p)$	Min. Step 2 $(L_1 - \frac{1}{3}p)$	Max. Step 2 $(L_1 - \frac{1}{3}p)$	Min. Step 3 $(L_1 + \frac{1}{3}p)$	Max. Step 3 $(L_1 + \frac{1}{3}p)$	Min. Step 4 $(L_1 + p)$	Pitch Diam., E_0	Minor [Note (1)] Diam.	
1/16-27	0.1600	0.28118	0.25947	0.12296	0.14766	0.14766	0.17234	0.17234	0.19704	0.27118	0.24947	0.38
1/8 -27	0.1615	0.37360	0.35189	0.12446	0.14916	0.14916	0.17384	0.17384	0.19854	0.36351	0.34180	0.47
1/4 -18	0.2278	0.49163	0.45563	0.17224	0.20928	0.20928	0.24632	0.24632	0.28336	0.47739	0.44139	0.59
3/8 -18	0.2400	0.62701	0.59101	0.18444	0.22148	0.22148	0.25852	0.25852	0.29556	0.61201	0.57601	0.72
1/2 -14	0.3200	0.77843	0.72871	0.24857	0.29619	0.29619	0.34381	0.34381	0.39143	0.75843	0.70871	0.88
3/4 -14	0.3390	0.98887	0.93915	0.26757	0.31519	0.31519	0.36281	0.36281	0.41043	0.96762	0.91796	1.09
1 -11 1/2	0.4000	1.23853	1.17897	0.31304	0.37102	0.37102	0.42898	0.42898	0.48696	1.21363	1.15397	1.34
1 1/4 -11 1/2	0.4200	1.58338	1.52372	0.33304	0.39102	0.39102	0.44898	0.44898	0.50696	1.55713	1.49747	1.69
1 1/2 -11 1/2	0.4200	1.82234	1.76268	0.33304	0.39102	0.39102	0.44898	0.44898	0.50696	1.79609	1.73643	1.94
2 -11 1/2	0.4360	2.29627	2.23661	0.34904	0.40702	0.40702	0.46498	0.46498	0.52296	2.26902	2.20936	2.50
2 1/2 - 8	0.6820	2.76216	2.67291	0.55700	0.64034	0.64034	0.72366	0.72366	0.80700	2.71953	2.63028	2.94
3 - 8	0.7660	3.38850	3.29925	0.64100	0.72434	0.72434	0.80766	0.80766	0.89100	3.34062	3.25137	3.56

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1 except for extra width of 4-step design.

NOTE:
(1) Minor diameter is based on crest minimum truncation equal to maximum root truncation of product thread (see ANSI B1.20.3).

3-Step Design

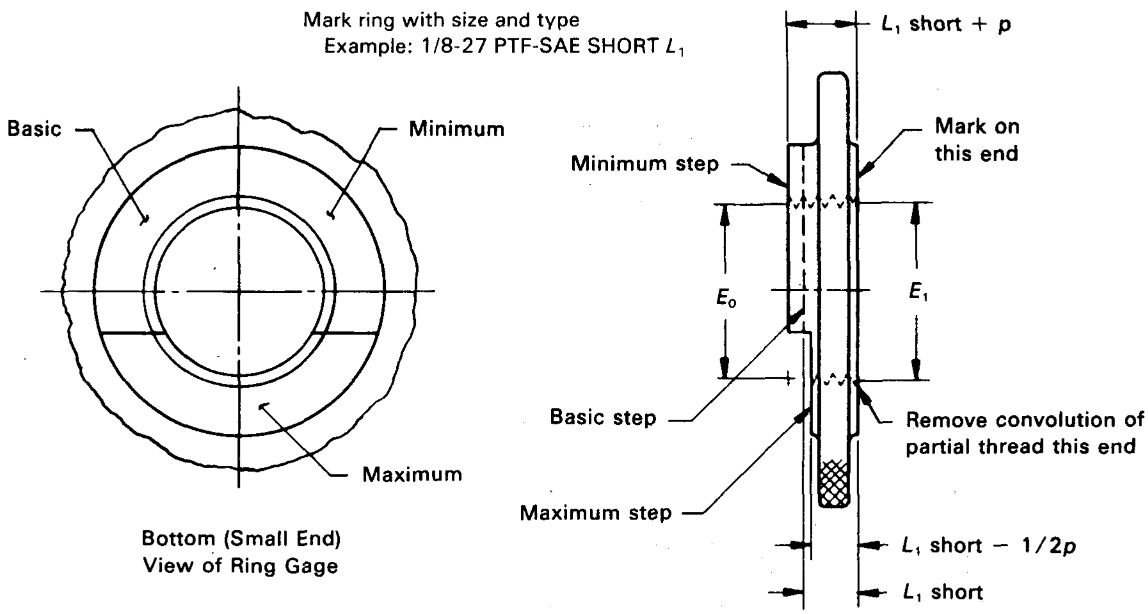


TABLE 8 BASIC DIMENSIONS FOR L_1 SHORT RING GAGES

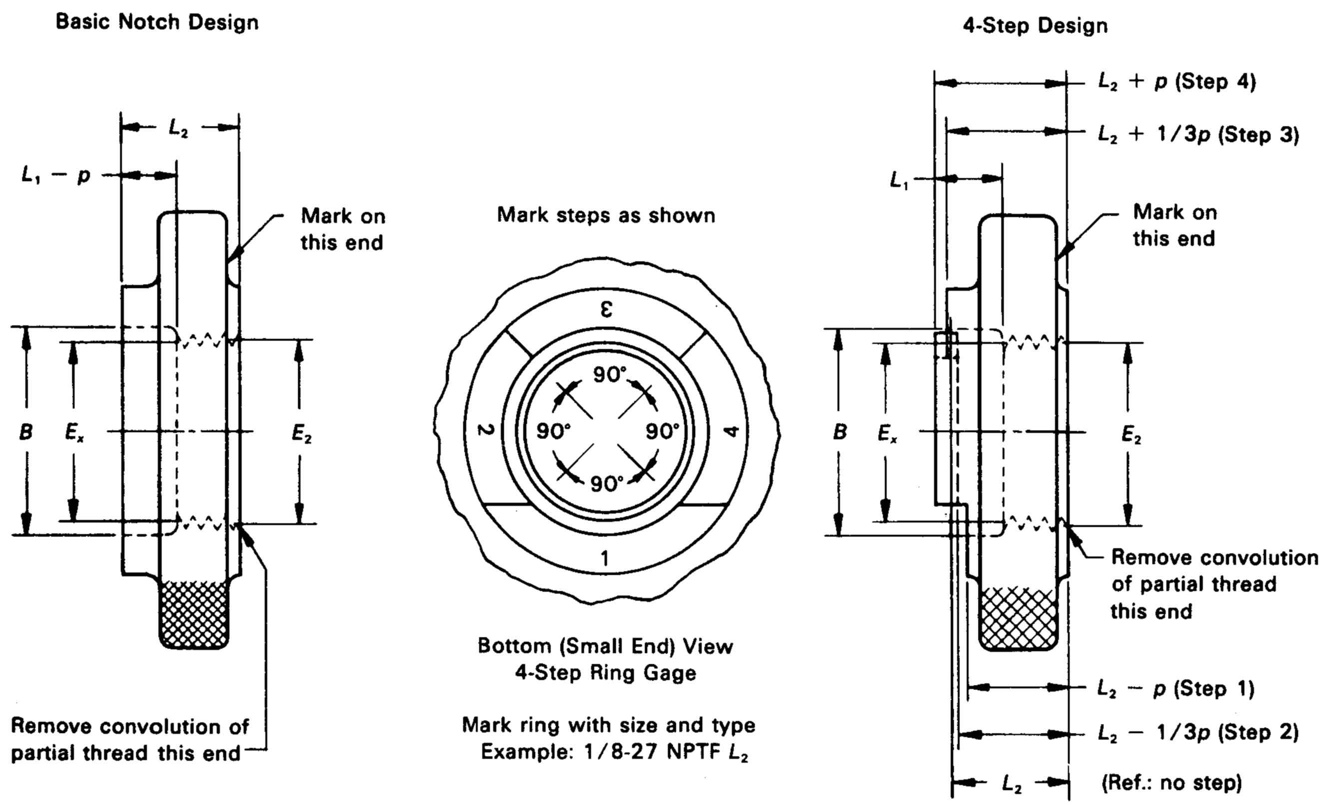
Nominal Size	L_1 short	Max. Gaging Step (L_1 short − ½p)	Min. Gaging Step (L_1 short + p)	Large End Pitch Diam., E_1	Large End Minor Diam. [Note (1)]	Small End Pitch Diam., E_0	Small End Minor Diam. [Note (1)]
1/16-27	0.12296	0.10444	0.16000	0.28118	0.25947	0.27118	0.24947
1/8 -27	0.12446	0.10594	0.16150	0.37360	0.35189	0.36351	0.34180
1/4 -18	0.17224	0.14446	0.22780	0.49163	0.45563	0.47739	0.44139
3/8 -18	0.18444	0.15666	0.24000	0.62701	0.59101	0.61201	0.57601
1/2 -14	0.24857	0.21286	0.32000	0.77843	0.72871	0.75843	0.70871
3/4 -14	0.26757	0.23186	0.33900	0.98887	0.93915	0.96768	0.91796
1 -11 1/2	0.31304	0.26956	0.40000	1.23863	1.17897	1.21363	1.15397
1 1/4 -11 1/2	0.33304	0.28956	0.42000	1.58338	1.52372	1.55713	1.49747
1 1/2 -11 1/2	0.33304	0.28956	0.42000	1.82234	1.76268	1.79609	1.73643
2 -11 1/2	0.34904	0.30556	0.43600	2.29627	2.23661	2.26902	2.20936
2 1/2 - 8	0.55700	0.49450	0.68200	2.76216	2.67291	2.71953	2.63028
3 - 8	0.64100	0.57850	0.76600	3.38850	3.29925	3.34062	3.25137

GENERAL NOTE:
(a) Gage blanks shall conform to dimensions given in ANSI B47.1 except for extra width of 3-step design.
(b) Master gage same as NPTF shown in Table 22.

NOTE:
(1) Minor diameter is based on crest minimum truncation equal to maximum root truncation of product thread (see ANSI B1.20.3).

Table 9 begins on next page.

TABLE 9



GENERAL NOTE: The L_2 ring gage must seat on product thread in relation to the L_1 ring gage within $\pm 1/2$ turn.

TABLE 9 BASIC DIMENSIONS FOR L_2 RING GAGES

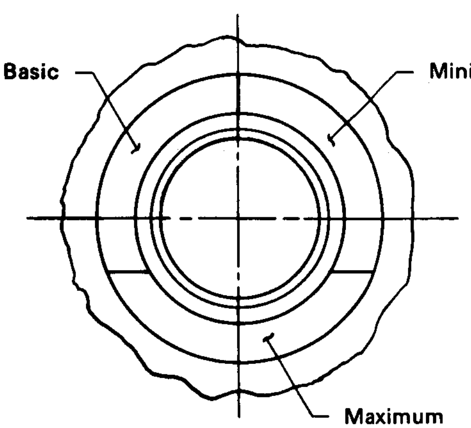
Nominal Size	Basic Length, L_2	Large End: Pitch Diam., E_2	Large End: Minor Diam. [Note (1)]	Maximum Range: Max. Step 1 $(L_2 - p)$	Maximum Range: Min. Step 2 $(L_2 - \frac{1}{3}p)$	Basic Range: Max. Step 2 $(L_2 - \frac{1}{3}p)$	Basic Range: Min. Step 3 $(L_2 + \frac{1}{3}p)$	Minimum Range: Max. Step 3 $(L_2 + \frac{1}{3}p)$	Minimum Range: Min. Step 4 $(L_2 + p)$	Small End: Pitch Diam., E_x	Small End: Minor Diam. [Note (1)]	L_1	Counterbore Diam. to L_1 Plane, B
1/16-27	0.26113	0.28750	0.27024	0.22409	0.24879	0.24879	0.27347	0.27347	0.29817	0.27886	0.26160	0.1600	0.38
1/8 -27	0.26385	0.38000	0.36274	0.22681	0.25151	0.25151	0.27619	0.27619	0.30089	0.37129	0.35403	0.1615	0.47
1/4 -18	0.40178	0.50250	0.47661	0.34622	0.38326	0.38326	0.42030	0.42030	0.45734	0.48816	0.46227	0.2278	0.59
3/8 -18	0.40778	0.63750	0.61161	0.35222	0.38926	0.38926	0.42630	0.42630	0.46334	0.62354	0.59765	0.2400	0.72
1/2 -14	0.53371	0.79179	0.75850	0.46228	0.50990	0.50990	0.55752	0.55752	0.60514	0.77396	0.74067	0.3200	0.88
3/4 -14	0.54571	1.00179	0.96850	0.47428	0.52190	0.52190	0.56952	0.56952	0.61714	0.98440	0.95111	0.3390	1.09
1 -11 1/2	0.68278	1.25630	1.21577	0.59582	0.65379	0.65379	0.71176	0.71176	0.76974	1.23320	1.19267	0.4000	1.34
1 1/4 -11 1/2	0.70678	1.60130	1.56077	0.61982	0.67780	0.67780	0.73576	0.73576	0.79374	1.57794	1.53741	0.4200	1.69
1 1/2 -11 1/2	0.72348	1.84130	1.80077	0.63652	0.69450	0.69450	0.75246	0.75246	0.81044	1.81690	1.77537	0.4200	1.94
2 -11 1/2	0.75652	2.31630	2.27577	0.66956	0.72754	0.72754	0.78550	0.78550	0.84348	2.29084	2.25031	0.4360	2.50
2 1/2 - 8	1.13750	2.79062	2.73237	1.01250	1.09584	1.09584	1.17916	1.17916	1.26250	2.75434	2.69609	0.6820	2.94
3 - 8	1.20000	3.41562	3.35737	1.07500	1.15834	1.15834	1.24166	1.24166	1.32500	3.38068	3.32243	0.7660	3.56

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1 except for extra width of 4-step design.

NOTE:
(1) Minor diameter is based on crest minimum truncation of $0.20p$.

TABLE 10

3-Step Design



Bottom (Small End)
View of Ring Gage

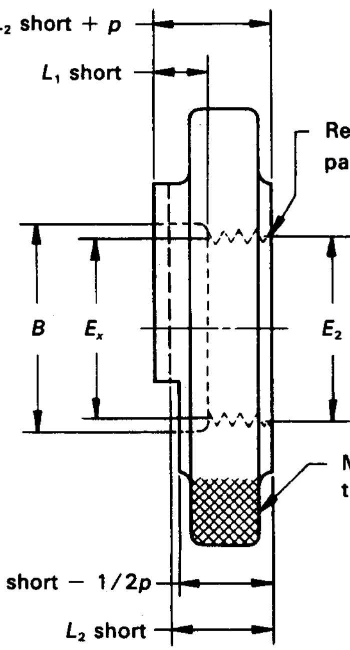
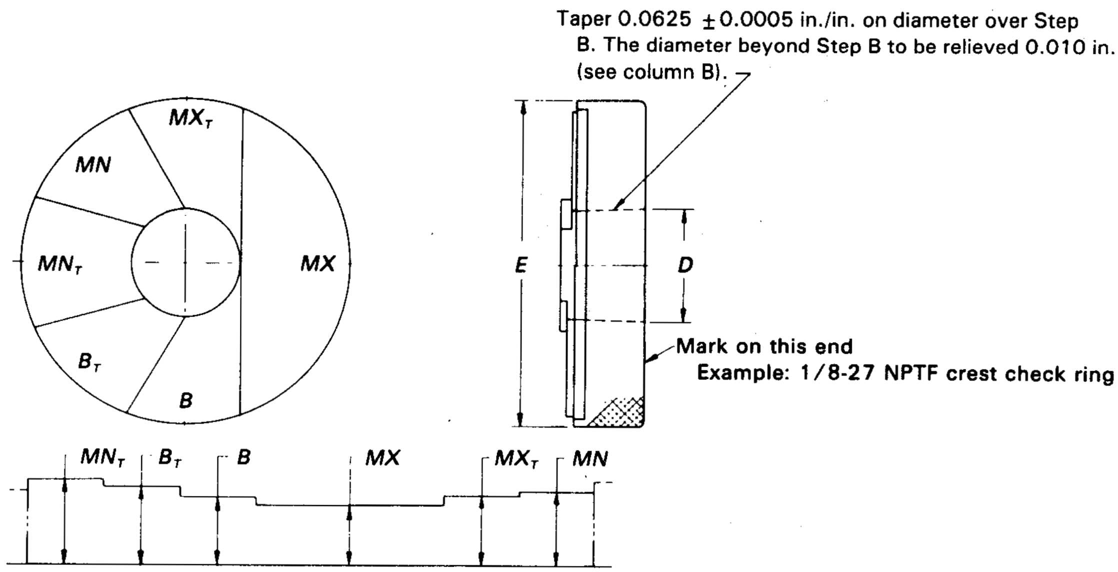


TABLE 10 BASIC DIMENSIONS FOR L_2 SHORT RING GAGES

Nominal Size	(L_1 short)	Max. Gaging Step (L_2 short − ½p)	Min. Gaging Step (L_2 short + p)	Large End		Small End		(L_1 short)	Counterbore Diam., B
				Pitch Diam., E_2	Minor Diam. [Note (1)]	Pitch Diam., E_x	Minor Diam. [Note (1)]		
1/16−27	0.2241	0.20557	0.26113	0.28750	0.27024	0.27886	0.26160	0.12296	0.38
1/8 −27	0.2268	0.20829	0.26385	0.38000	0.36274	0.37129	0.35403	0.12446	0.47
1/4 −18	0.3462	0.31845	0.40178	0.50250	0.47661	0.48816	0.46227	0.17224	0.59
3/8 −18	0.3522	0.32445	0.40778	0.63750	0.61161	0.62354	0.59765	0.18444	0.72
1/2 −14	0.4623	0.42657	0.53371	0.79179	0.75850	0.77396	0.74067	0.24857	0.88
3/4 −14	0.4743	0.43857	0.54571	1.00179	0.96850	0.98440	0.95111	0.26757	1.09
1 −11 1/2	0.5958	0.55235	0.68278	1.25630	1.21577	1.23320	1.19267	0.31304	1.34
1 1/4 −11 1/2	0.6198	0.57635	0.70678	1.60130	1.56077	1.57794	1.53741	0.33304	1.69
1 1/2 −11 1/2	0.6365	0.59305	0.72348	1.84130	1.80077	1.81690	1.77637	0.33304	1.94
2 −11 1/2	0.6695	0.62609	0.75652	2.31630	2.27577	1.29084	2.25031	0.34904	2.50
2 1/2 − 8	1.0125	0.95000	1.13750	2.79062	2.73237	2.75434	2.69609	0.55700	2.94
3 − 8	1.0750	1.01250	1.20000	3.41562	3.35737	3.38068	3.32243	0.64100	3.56

GENERAL NOTES:
(a) Gage blanks shall conform to dimensions given in ANSI B47.1 except for extra width of 3-step design.
(b) Master gage same as NPTF shown in Table 22.

NOTE:
(1) Minor diameter is based on crest minimum truncation of 0.20p.



Development — counterclockwise

TABLE 11 BASIC DIMENSIONS FOR CREST CHECK RING GAGES

Nominal Size	Major Diam. at L_2 Basic Thread With Max., Truncation D	Basic Pipe Thread: Min. Truncation, B	Basic Pipe Thread: Max. Truncation, B_T	Minimum Thread [Note (1)]: Min. Truncation, MN	Minimum Thread [Note (1)]: Max. Truncation, MN_T	Maximum Thread [Note (1)]: Min. Truncation, MX	Maximum Thread [Note (1)]: Max. Truncation, MX_T	Ring Diam., E
	−0.00015 +0.0000	±0.001	+0.000 −0.002	±0.001	+0.000 −0.002	±0.001	+0.000 −0.002	±0.03
1/16−27	0.3126	0.2054	0.2611	0.2301	0.2858	0.1807	0.2364	1.25
1/8 −27	0.4051	0.2082	0.2639	0.2329	0.2886	0.1835	0.2392	1.25
1/4 −18	0.5419	0.3467	0.4018	0.3837	0.4388	0.3097	0.3648	1.50
3/8 −18	0.6769	0.3527	0.4078	0.3897	0.4448	0.3157	0.3708	1.75
1/2 −14	0.8451	0.4788	0.5337	0.5264	0.5813	0.4312	0.4861	2.00
3/4 −14	1.0551	0.4908	0.5457	0.5384	0.5933	0.4432	0.4981	2.25
1 −11 1/2	1.3212	0.6272	0.6828	0.6852	0.7408	0.5692	0.6248	2.62
1 1/4 −11 1/2	1.6662	0.6512	0.7068	0.7092	0.7648	0.5932	0.6488	3.12
1 1/2 −11 1/2	1.9062	0.6678	0.7235	0.7258	0.7815	0.6098	0.6655	3.38
2 −11 1/2	2.3812	0.7008	0.7565	0.7588	0.8145	0.6428	0.6985	4.00
2 1/2 − 8	2.8851	1.0855	1.1375	1.1688	1.2208	1.0022	1.0542	4.75
3 − 8	3.5101	1.1480	1.2000	1.2313	1.2833	1.0647	1.1167	5.50

GENERAL NOTE:
On sizes 1/16 and 1/8, the MX_T and MN dimensions are shown out of relationship on the illustration of step development.

NOTE:
(1) The dimensions given for steps at minimum thread and maximum thread are based on 2/3 turn (0.6667p) from basic thread. Actual truncation of the product thread may be slightly less than or slightly more than the tabulated truncation limit (ANSI B1.20.3) depending upon the variance from mean size in any given range (minimum range — basic range — maximum range). Formulas are shown in Appendix C.

Table 12 begins on next page.

TABLE 12

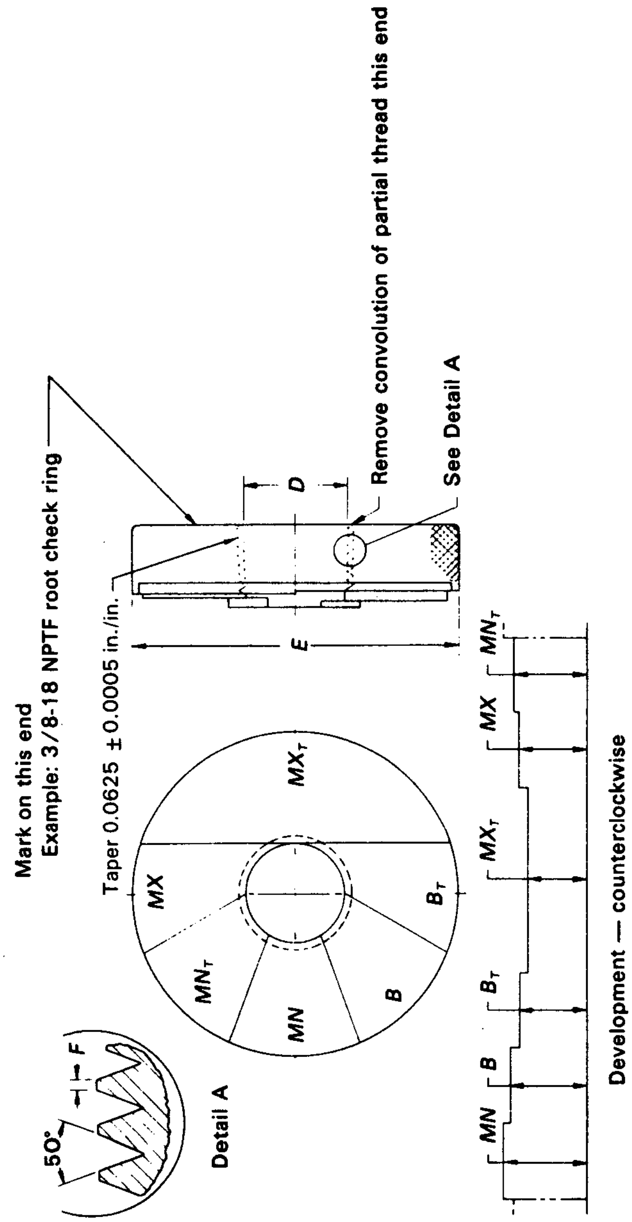

50°
F
Detail A
Mark on this end
Example: 3/8-18 NPTF root check ring
Taper 0.0625 ±0.0005 in./in.
D
E
Remove convolution of partial thread this end
See Detail A
MX
MX_T
MN_T
MN
B
B_T
MN
B
B_T
MX_T
MX
MN_T
Development — counterclockwise

TABLE 12 BASIC DIMENSIONS FOR ROOT CHECK RING GAGES

Nominal Size	Minor Diam. at L_2 Length From End of Pipe. Basic Thread With Min. Truncation, *D*	Max. Width of Crest at Minor Diam., *F*	Basic Pipe Thread		Min. Thread [Note (1)]		Max. Thread [Note (1)]		Ring Diam., *E*
			Min. Truncation, *B*	Max. Truncation, B_T	Min. Truncation, *MN*	Max. Truncation, MN_T	Min. Truncation, *MX*	Max. Truncation, MX_T	
	+0.0002 −0.0000		±0.001	+0.002 −0.000	±0.001	+0.002 −0.000	±0.001	+0.002 −0.000	±0.03
1/16-27	0.2624	0.003	0.2611	0.2066	0.2858	0.2313	0.2364	0.1819	1.25
1/8 -27	0.3549	0.003	0.2639	0.2094	0.2886	0.2341	0.2392	0.1847	1.25
1/4 -18	0.4631	0.004	0.4018	0.3467	0.4388	0.3837	0.3648	0.3097	1.50
3/8 -18	0.5981	0.004	0.4078	0.3527	0.4448	0.3897	0.3708	0.3157	1.75
1/2 -14	0.7385	0.004	0.5337	0.4766	0.5813	0.5242	0.4861	0.4290	2.00
3/4 -14	0.9485	0.004	0.5457	0.4886	0.5933	0.5362	0.4981	0.4410	2.25
1 -11 1/2	1.1914	0.005	0.6828	0.5993	0.7408	0.6573	0.6248	0.5413	2.62
1 1/4 -11 1/2	1.5364	0.005	0.7068	0.6233	0.7648	0.6813	0.6488	0.5653	3.12
1 1/2 -11 1/2	1.7764	0.005	0.7235	0.6400	0.7815	0.6980	0.6655	0.5820	3.38
2 -11 1/2	2.2514	0.005	0.7565	0.6730	0.8145	0.7310	0.6985	0.6150	4.00
2 1/2 - 8	2.6961	0.007	1.1375	1.0535	1.2208	1.1368	1.0542	0.9702	4.75
3 - 8	3.3211	0.007	1.2000	1.1160	1.2833	1.1993	1.1167	1.0327	5.50

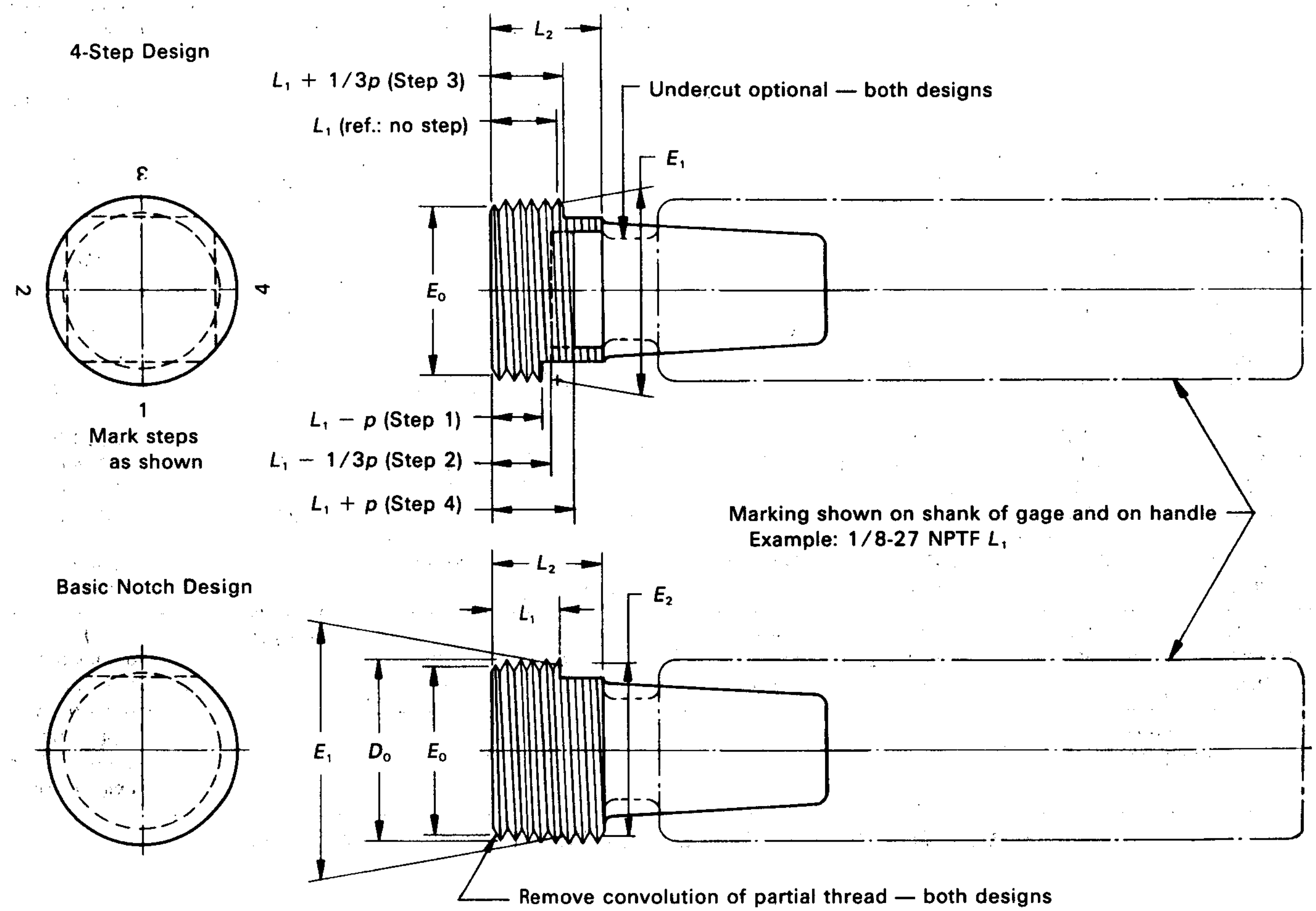
GENERAL NOTE:
On sizes 1/16 and 1/8, the *MX* and MN_T dimensions are shown out of relationship on the illustration of step development.

NOTE:
(1) The dimension given for steps at minimum thread and maximum thread are based on 2/3 turn (0.6667*p*) from basic thread. Actual truncation of the product thread may be slightly less than or slightly more than the tabulated truncation limit (ANSI B1.20.3) depending upon the variance from mean size in any given range (minimum range – basic range – maximum range). Formulas are shown in Appendix C.

TABLE 13

Range qualification by steps:
Between Step 1 and Step 2 — minimum range
Between Step 2 and Step 3 — basic range
Between Step 3 and Step 4 — maximum range

To facilitate use of 6-step crest and root check gages, qualification of the product thread into one of these ranges is necessary and is best determined with the 4-step L_1 plug gage.



GENERAL NOTE: The 3-step design is included in Appendix A for reference.

TABLE 13 BASIC DIMENSIONS FOR L_1 PLUG GAGES, NPTF

Nominal Size [Note (1)]	Basic Length, L_1	L_2	Small End		Basic Dimensions at L_1 Plane		Min. Range		Basic Range		Max. Range		Large End	
			Pitch Diam., E_0	Major Diam., D_0 [Note (2)]	Pitch Diam., E_1	Major Diam. [Note (2)]	Min. Step 1 $(L_1 - p)$	Max. Step 2 $(L_1 - \frac{1}{3}p)$	Min. Step 2 $(L_1 - \frac{1}{3}p)$	Max. Step 3 $(L_1 + \frac{1}{3}p)$	Min. Step 3 $(L_1 + \frac{1}{3}p)$	Max. Step 4 $(L_1 + p)$	Pitch Diam., E_2	Major Diam. [Note (2)]
1/16-27	0.1600	0.26113	0.27118	0.29289	0.28118	0.30289	0.12296	0.14766	0.14766	0.17234	0.17234	0.19704	0.28750	0.30921
1/8-27	0.1615	0.26385	0.36351	0.38522	0.37360	0.39531	0.12446	0.14916	0.14916	0.17384	0.17384	0.19854	0.38000	0.40171
1/4-18	0.2278	0.40178	0.47739	0.51339	0.49163	0.52763	0.17224	0.20928	0.20928	0.24632	0.24632	0.28336	0.50250	0.53850
3/8-18	0.2400	0.40778	0.61201	0.64801	0.62701	0.66301	0.18444	0.22148	0.22148	0.25852	0.25852	0.29556	0.63750	0.67350
1/2-14	0.3200	0.53371	0.75843	0.80815	0.77843	0.82815	0.24857	0.29619	0.29619	0.34381	0.34381	0.39143	0.79179	0.84151
3/4-14	0.3390	0.54571	0.96768	1.01740	0.98887	1.03859	0.26757	0.31519	0.31519	0.36281	0.36281	0.41043	1.00179	1.05151
1-11 1/2	0.4000	0.68278	1.21363	1.27329	1.23863	1.29829	0.31304	0.37102	0.37102	0.42898	0.42898	0.48696	1.25630	1.31596
1 1/4-11 1/2	0.4200	0.70678	1.55713	1.61679	1.58338	1.64304	0.33304	0.39102	0.39102	0.44898	0.44898	0.50696	1.60130	1.66096
1 1/2-11 1/2	0.4200	0.72348	1.79609	1.85575	1.82234	1.88200	0.33304	0.39102	0.39102	0.44898	0.44898	0.50696	1.84130	1.90096
2-11 1/2	0.4360	0.75652	2.26902	2.32868	2.29627	2.35593	0.34904	0.40702	0.40702	0.46498	0.46498	0.52296	2.31630	2.37596
2 1/2-8	0.6820	1.13750	2.71953	2.80878	2.76216	2.85141	0.55700	0.64034	0.64034	0.72366	0.72366	0.80700	2.79062	2.87987
3-8	0.7660	1.20000	3.34062	3.42987	3.38850	3.47775	0.64100	0.72434	0.72434	0.80766	0.80766	0.89100	3.41562	3.50487

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1.

NOTES:
(1) Notch formulas on drawing apply to all sizes.
(2) Major diameter is based on crest minimum truncation equal to maximum root truncation of product thread. (See B1.20.3)

TABLE 14

3-Step Design

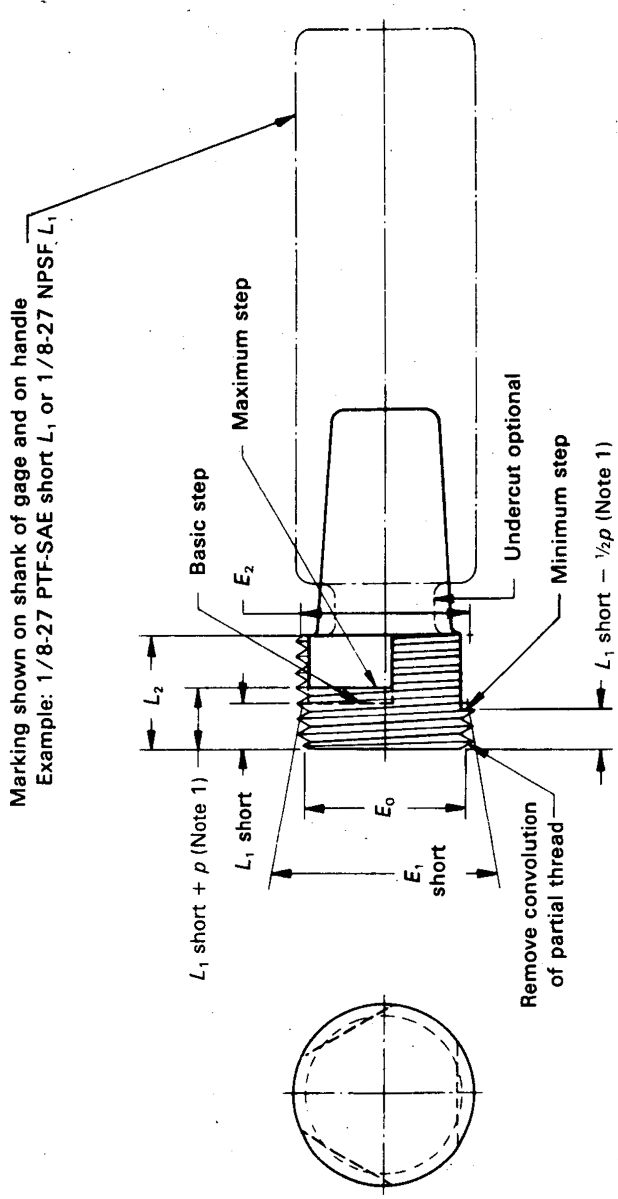


TABLE 14 BASIC DIMENSIONS FOR L_1 SHORT PLUG GAGES

Nominal Size	L_1 Short	L_2	Small End		Min. Pitch Diam. Gaging Step		Max. Pitch Diam. Gaging Step		Basic Step		Large End	
			Pitch Diam., E_0	Major Diam. (2)	(L_1 Short $- \frac{1}{2}p$)	Pitch Diam.	(L_1 Short $+ p$)	Pitch Diam.	Pitch Diam., E_1 Short	Major Diam. (2)	Pitch Diam., E_2	Major Diam. (2)
1/16-27	0.12296	0.26113	0.27118	0.29289	0.10444	0.27771	0.16000	0.28118	0.27886	0.30057	0.28750	0.30921
1/8 -27	0.12446	0.26385	0.36351	0.38522	0.10594	0.37013	0.16150	0.37360	0.37128	0.39299	0.38000	0.40171
1/4 -18	0.17224	0.40178	0.47739	0.51339	0.14446	0.48642	0.22780	0.49163	0.48816	0.52416	0.50250	0.53850
3/8 -18	0.18444	0.40778	0.61201	0.64801	0.15666	0.62180	0.24000	0.62701	0.62354	0.65954	0.63750	0.67350
1/2 -14	0.24857	0.53371	0.75843	0.80815	0.21286	0.77174	0.32000	0.77843	0.77397	0.82369	0.79179	0.84151
3/4 -14	0.26757	0.54571	0.96768	1.01740	0.23186	0.98218	0.33900	0.98887	0.98441	1.03413	1.00179	1.05151
1 -11 1/2	0.31304	0.68278	1.21363	1.27329	0.26956	1.23048	0.40000	1.23863	1.23320	1.29286	1.25630	1.31596
1 1/4 -11 1/2 (3)	0.33304	0.70678	1.55713	1.61679	0.28956	1.57523	0.42000	1.58338	1.57794	1.63760	1.60130	1.66096
1 1/2 -11 1/2 (3)	0.33304	0.72348	1.79609	1.85575	0.28956	1.81419	0.42000	1.82234	1.81690	1.87656	1.84130	1.90096
2 -11 1/2 (3)	0.34904	0.75652	2.26902	2.32868	0.30556	2.28812	0.43600	2.29627	2.29084	2.35050	2.31630	2.37596
2 1/2 - 8 (3)	0.55700	1.13750	2.71953	2.80878	0.49450	2.75044	0.68200	2.76216	2.75435	2.84360	2.79062	2.87987
3 - 8 (3)	0.64100	1.20000	3.34062	3.42987	0.57850	3.37678	0.76600	3.38850	3.38069	3.46994	3.41562	3.50487

GENERAL NOTES:
(a) Gage blanks shall conform to dimensions given in ANSI B47.1.
(b) Master gage same as NPTF shown in Table 21.

NOTES:
(1) Maximum and minimum pitch diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.
(2) Major diameter is based on crest minimum truncation equal to maximum root truncation of product thread. (See ANSI B1.20.3)
(3) For reference only above 1-11 1/2 NPSF.

TABLE 15

3-Step Design

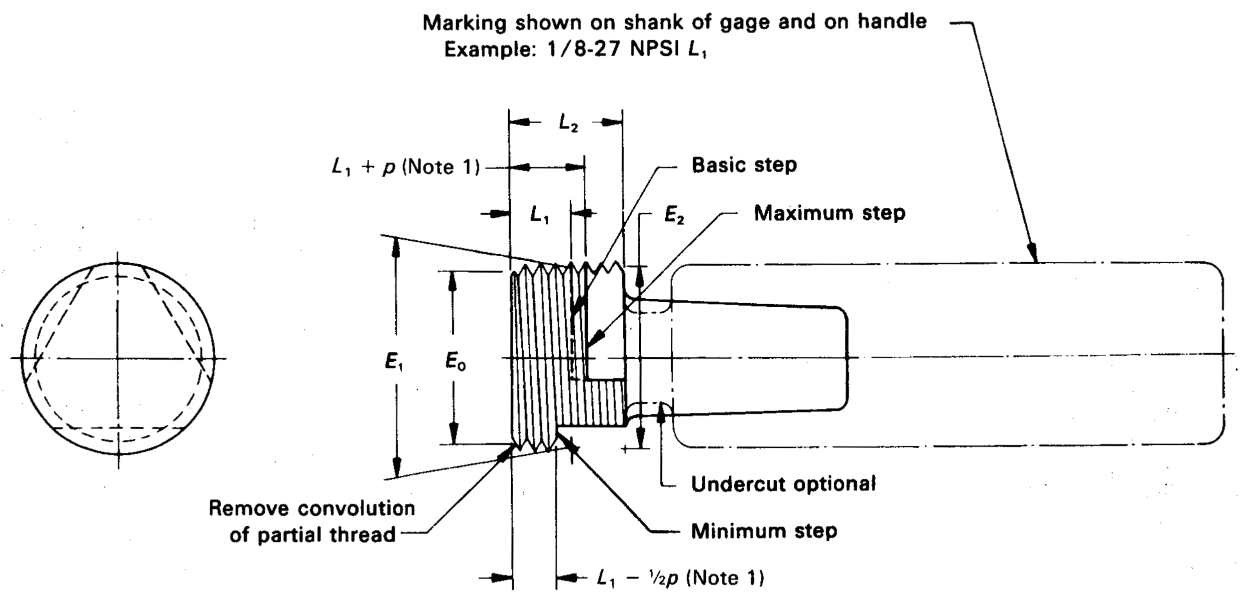


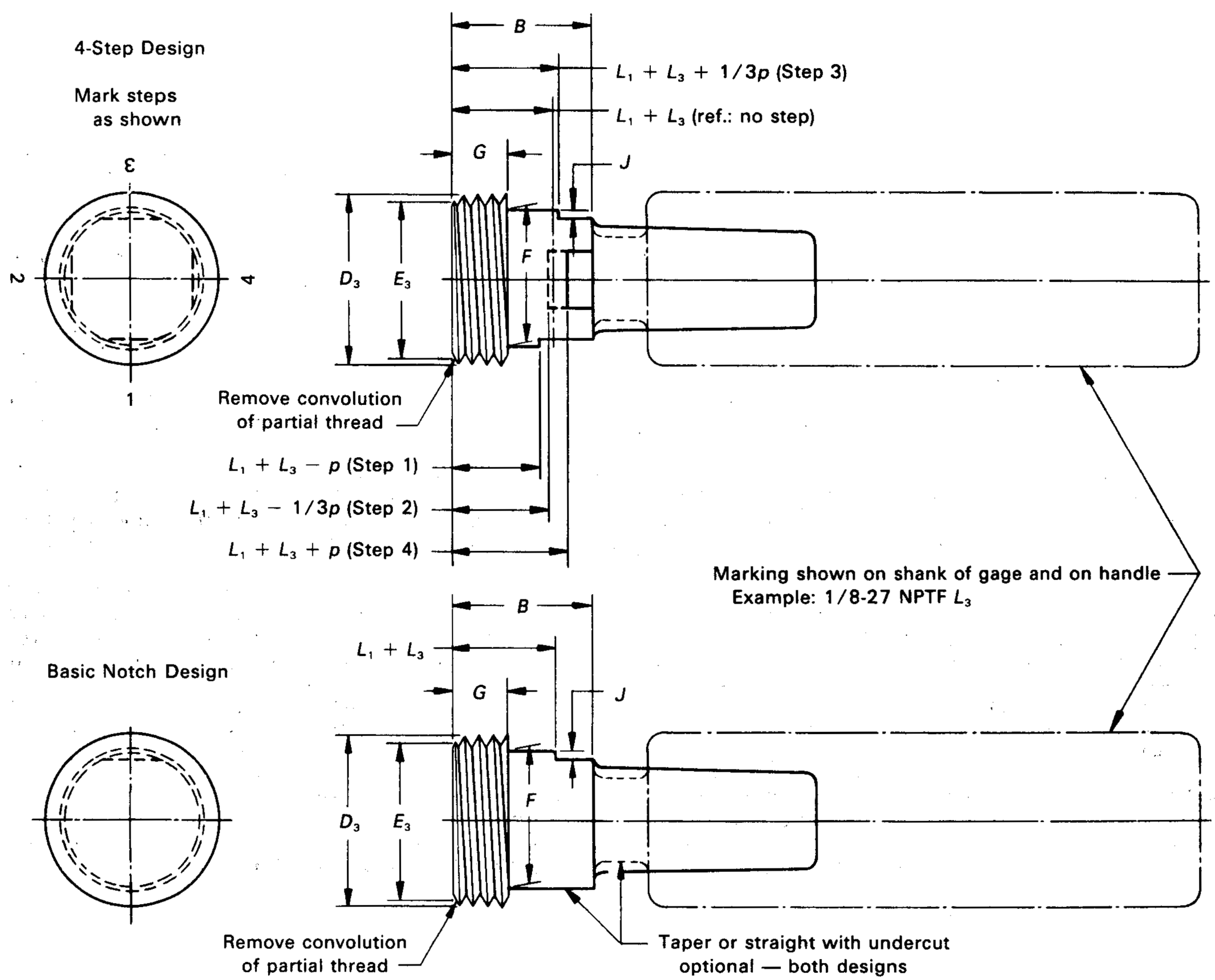
TABLE 15 BASIC DIMENSIONS FOR L_1 PLUG GAGES, NPSI

Nominal Size	L_1	L_2	Small End		Min. Pitch Diam. Gaging Step		Max. Pitch Diam. Gaging Step		Basic Step		Large End	
			Pitch Diam., E_0	Major Diam. (2)	$(L_1 - \frac{1}{2}p)$	Pitch Diam.	$(L_1 + p)$	Pitch Diam.	Pitch Diam., E_1	Major Diam. (2)	Pitch Diam., E_2	Major Diam. (2)
1/16-27	0.1600	0.26113	0.27118	0.29289	0.14148	0.28002	0.19704	0.28350	0.28118	0.30289	0.28750	0.30921
1/8 -27	0.1615	0.26385	0.36351	0.38522	0.14298	0.37245	0.19854	0.37592	0.37360	0.39531	0.38000	0.40171
1/4 -18	0.2278	0.40178	0.47739	0.51339	0.20002	0.48989	0.28336	0.49510	0.49163	0.52763	0.50250	0.53850
3/8 -18	0.2400	0.40778	0.61201	0.64801	0.21222	0.62527	0.29556	0.63048	0.62701	0.66301	0.63750	0.67350
1/2 -14	0.3200	0.53371	0.75843	0.80815	0.28428	0.77620	0.39143	0.78289	0.77843	0.82815	0.79179	0.84151
3/4 -14	0.3390	0.54571	0.96768	1.01740	0.30328	0.98664	0.41043	0.99333	0.98887	1.03859	1.00179	1.05151
1 -11 1/2	0.4000	0.68278	1.21363	1.27329	0.35652	1.23592	0.48696	1.24406	1.23863	1.29829	1.25630	1.31596
1 1/4 -11 1/2 (3)	0.4200	0.70678	1.55713	1.61679	0.37652	1.58066	0.50696	1.58882	1.58338	1.64304	1.60130	1.66096
1 1/2 -11 1/2 (3)	0.4200	0.72348	1.79609	1.85575	0.37652	1.81962	0.50696	1.82778	1.82234	1.88200	1.84130	1.90096
2 -11 1/2 (3)	0.4360	0.75652	2.26902	2.32868	0.39252	2.29355	0.52296	2.30170	1.29627	1.35593	2.31630	2.37596
2 1/2 - 8 (3)	0.6820	1.13750	2.71953	2.80878	0.61950	2.75825	0.80700	2.76997	2.76216	2.85141	2.79062	2.87987
3 - 8 (3)	0.7660	1.20000	3.34062	3.42987	0.70350	3.38459	0.89100	3.39631	3.38850	3.47775	3.41562	3.50487

GENERAL NOTES:
(a) Gage blanks shall conform to dimensions given in ANSI B47.1.
(b) Master gage same as NPTF shown in Table 21.

NOTES:
(1) Maximum and minimum pitch diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.
(2) Major diameter is based on crest minimum truncation equal to maximum root truncation of product thread. (See ANSI B1.20.3)
(3) For reference only above 1-11 1/2 NPSI.

TABLE 16



GENERAL NOTES:
(a) The 3-step design is included in Appendix A for reference.
(b) The L_3 plug gage must seat on product thread in relation to L_1 plug gage within ±1/2 turn.

TABLE 16 BASIC DIMENSIONS FOR L_3 PLUG GAGES

Nominal Size	Basic Length $(L_1 + L_3)$	Small End: Pitch Diam., E_3	Small End: Major Diam. [Note (1)] D_3	Relief Diam. [Note (2)] F +0.005 −0.000	Four Threads $(L_3 + p)$, G	Min. Range: Min. Step 1 $(L_1 + L_3 - p)$	Min. Range: Max. Step 2 $(L_1 + L_3 - \frac{1}{3}p)$	Basic Range: Min. Step 2 $(L_1 + L_3 - \frac{1}{3}p)$	Basic Range: Max. Step 3 $(L_1 + L_3 + \frac{1}{3}p)$	Max. Range: Min. Step 3 $(L_1 + L_3 + \frac{1}{3}p)$	Max. Range: Max. Step 4 $(L_1 + L_3 + p)$	Blank Length, B	Notch Depth [Note (3)], J +0.005 −0.000
1/16–27	0.2711	0.2642	0.2815	0.216	0.1482	0.23406	0.25876	0.25876	0.28344	0.28344	0.30814	0.42	0.030
1/8–27	0.2726	0.3566	0.3738	0.309	0.1482	0.23556	0.26026	0.26026	0.28494	0.28494	0.30964	0.46	0.030
1/4–18	0.3945	0.4670	0.4928	0.409	0.2222	0.33894	0.37598	0.37598	0.41302	0.41302	0.45006	0.55	0.030
3/8–18	0.4067	0.6016	0.6275	0.542	0.2222	0.35114	0.38818	0.38818	0.42522	0.42522	0.46226	0.62	0.030
1/2–14	0.5343	0.7451	0.7783	0.676	0.2857	0.46287	0.51049	0.51049	0.55811	0.55811	0.60573	0.74	0.040
3/4–14	0.5533	0.9543	0.9876	0.886	0.2857	0.48187	0.52949	0.52949	0.57711	0.57711	0.62473	0.78	0.040
1 –11 1/2	0.6609	1.1973	1.2379	1.118	0.3478	0.57394	0.63192	0.63192	0.68988	0.68988	0.74786	0.94	0.050
1 1/4–11 1/2	0.6809	1.5408	1.5814	1.462	0.3478	0.59394	0.65192	0.65192	0.70988	0.70988	0.76786	0.94	0.050
1 1/2–11 1/2	0.6809	1.7798	1.8203	1.701	0.3478	0.59394	0.65192	0.65192	0.70988	0.70988	0.76786	0.94	0.050
2 –11 1/2	0.6969	2.2527	2.2932	2.174	0.3478	0.60994	0.66792	0.66792	0.72588	0.72588	0.78386	0.94	0.050
2 1/2 – 8	1.0570	2.6961	2.7543	2.590	0.5000	0.93200	1.01534	1.01534	1.09866	1.09866	1.18200	1.58	0.050
3 – 8	1.1410	3.3172	3.3754	3.214	0.5000	1.01600	1.09934	1.09934	1.18266	1.18266	1.26600	1.58	0.050

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1.

NOTES:
(1) Major diameter is based on crest minimum truncation of 0.20p.
(2) $F = [E_3 + (0.0625 \times 4p)$ − sharp V thread height − 0.020 to 0.025 below sharp root]
(3) Notch formulas on drawing apply to all sizes.

3-Step Design

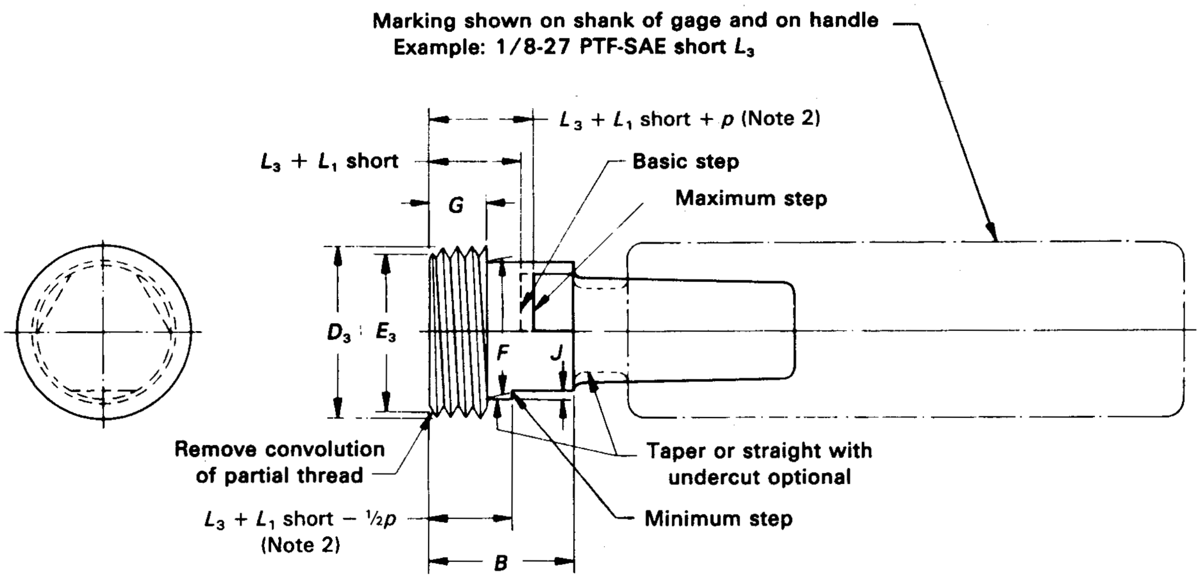


TABLE 17 BASIC DIMENSIONS FOR L_3 SHORT PLUG GAGES

Nominal Size	Small End: Pitch Diam., E_3	Small End: Major Diam. [Note (1)], D_3	Relief Diam. [Note (3)], F +0.005 −0.000	Four Threads, (L_3 + p), G	Min. Pitch Diam. Gaging Step + 3 Threads (L_3 + L_1 Short − ½p)	Max. Pitch Diam. Gaging Step + 3 Threads (L_3 + L_1 Short + p)	Blank Length, B	Notch Depth, J +0.005 −0.000
1/16−27	0.2642	0.2815	0.216	0.1482	0.2156	0.2711	0.42	0.030
1/8 −27	0.3566	0.3738	0.309	0.1482	0.2171	0.2726	0.46	0.030
1/4 −18	0.4670	0.4928	0.409	0.2222	0.3111	0.3945	0.55	0.030
3/8 −18	0.6016	0.6275	0.542	0.2222	0.3233	0.4067	0.62	0.030
1/2 −14	0.7451	0.7783	0.676	0.2857	0.4271	0.5343	0.74	0.040
3/4 −14	0.9543	0.9876	0.886	0.2857	0.4462	0.5533	0.78	0.040
1 −11 1/2	1.1973	1.2379	1.118	0.3478	0.5304	0.6609	0.94	0.050
1 1/4 −11 1/2	1.5408	1.5814	1.462	0.3478	0.5504	0.6809	0.94	0.050
1 1/2 −11 1/2	1.7798	1.8203	1.701	0.3478	0.5504	0.6809	0.94	0.050
2 −11 1/2	2.2527	2.2932	2.174	0.3478	0.5664	0.6969	0.94	0.050
2 1/2 − 8	2.6961	2.7543	2.590	0.5000	0.8695	1.0570	1.58	0.050
3 − 8	3.3172	3.3754	3.214	0.5000	0.9535	1.1410	1.58	0.050

GENERAL NOTE:
(a) Gage blanks shall conform to dimensions given in ANSI B47.1.
(b) Master gage same as NPTF shown in Table 21.

NOTES:
(1) Major diameter is based on crest minimum truncation of 0.20p.
(2) Maximum and minimum pitch diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.
(3) F = [E_3 + (0.0625 × 4p) − sharp V thread height − 0.020 to 0.025 below sharp root].

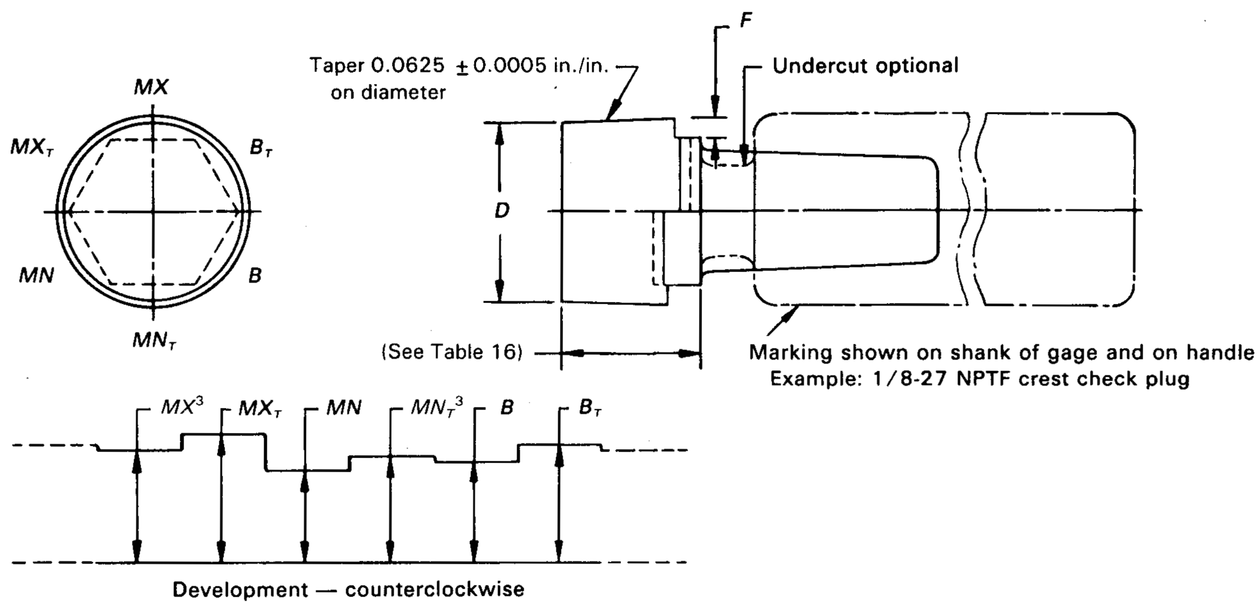
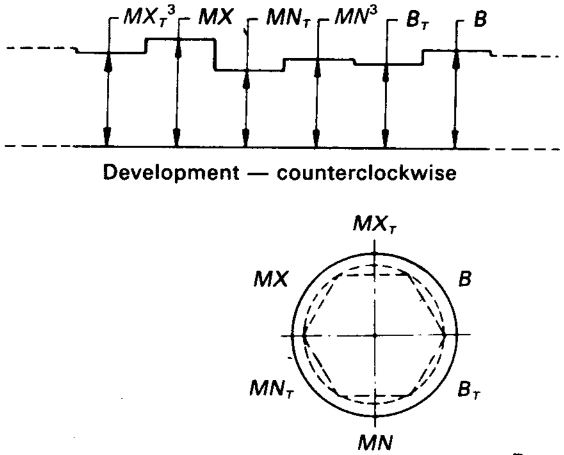


TABLE 18 BASIC DIMENSIONS FOR CREST CHECK PLUG GAGES

Nominal Size	Max. Diam. at L_3 Basic Thread With Max. Truncation, D	Basic Pipe Thread		Min. Thread (1)		Max. Thread (1)		Depth of Notch, F
		Min. Truncation, B	Max. Truncation, B_T	Min. Truncation, MN	Max. Truncation, MN_T	Min. Truncation, MX	Max. Truncation, MX_T	
	+0.00015 −0.00000	±0.001	+0.000 −0.002	±0.001	+0.000 −0.002	±0.001	+0.000 −0.002	
1/16−27	0.2391	0.2154	0.2711	0.1907	0.2464	0.2401	0.2958	0.037
1/8 −27	0.3315	0.2169	0.2726	0.1922	0.2479	0.2416	0.2973	0.055
1/4 −18	0.4276	0.3394	0.3945	0.3024	0.3575	0.3764	0.4315	0.055
3/8 −18	0.5622	0.3516	0.4067	0.3146	0.3697	0.3886	0.4437	0.085
1/2 −14	0.6918	0.4794	0.5343	0.4318	0.4867	0.5270	0.5819	0.085
3/4 −14	0.9010	0.4984	0.5533	0.4508	0.5057	0.5460	0.6009	0.120
1 −11 1/2	1.1324	0.6052	0.6609	0.5472	0.6029	0.6632	0.7189	0.120
1 1/4 −11 1/2	1.4759	0.6252	0.6809	0.5672	0.6229	0.6832	0.7389	0.120
1 1/2 −11 1/2	1.7149	0.6252	0.6809	0.5672	0.6229	0.6832	0.7389	0.120
2 −11 1/2	2.1878	0.6412	0.6969	0.5832	0.6389	0.6992	0.7549	0.120
2 1/2 − 8 (3)	2.6016	1.0050	1.0570	0.9217	0.9737	1.0883	1.1403	0.120
3 − 8 (3)	3.2227	1.0890	1.1410	1.0057	1.0577	1.1723	1.2243	0.120

NOTES:
(1) On sizes 1/16 and 1/8, the MX and MN_T dimensions are shown out of relationship on the illustration of step development.
(2) The dimensions given for steps at minimum thread and maximum thread are based on 2/3 turn (0.6667p) from basic thread. Actual truncation of the product thread may be slightly less than or slightly more than the tabulated truncation limit (B1.20.3) depending upon the variance from mean size in any given range (minimum range — basic range — maximum range). Formulas are shown in Appendix C.
(3) Gages are sizes 2 1/2 and 3 to fit standard trilock handle.



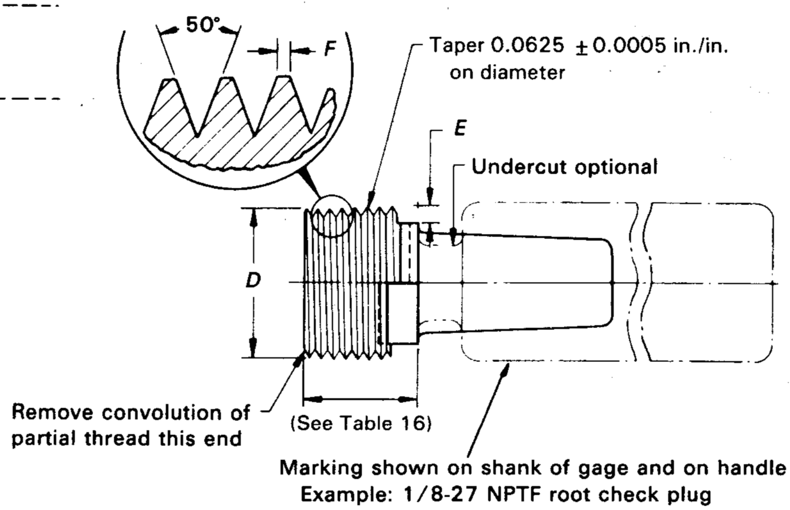


TABLE 19 BASIC DIMENSIONS FOR ROOT CHECK PLUG GAGES

Nominal Size	Max. Diam. at $L_1 + L_3$ Length From End of Fitting. Basic Thread With Min. Truncation, D +0.0002 −0.0000	Max. Width of Crest at Major Diam., F	Basic Pipe Thread Min. Truncation, B ±0.001	Basic Pipe Thread Max. Truncation, B_T +0.002 −0.000	Min. Thread (2) Min. Truncation, MN ±0.001	Min. Thread (2) Max. Truncation, MN_T +0.002 −0.000	Max. Thread (2) Min. Truncation, MX ±0.001	Max. Thread (2) Max. Truncation, MX_T +0.002 −0.000	Depth of Notch, M +0.005 −0.000
1/16-27	0.2893	0.003	0.2711	0.2166	0.2464	0.1919	0.2958	0.2413	0.060
1/8 -27	0.3817	0.003	0.2726	0.2181	0.2479	0.1934	0.2973	0.2428	0.060
1/4 -18	0.5064	0.004	0.3945	0.3394	0.3575	0.3024	0.4315	0.3764	0.080
3/8 -18	0.6410	0.004	0.4067	0.3516	0.3697	0.3146	0.4437	0.3886	0.080
1/2 -14	0.7984	0.004	0.5343	0.4772	0.4867	0.4296	0.5819	0.5248	0.095
3/4 -14	1.0076	0.004	0.5533	0.4962	0.5057	0.4486	0.6009	0.5438	0.095
1 -11 1/2	1.2622	0.005	0.6609	0.5774	0.6029	0.5194	0.7189	0.6354	0.110
1 1/4 -11 1/2	1.6057	0.005	0.6809	0.5974	0.6229	0.5394	0.7389	0.6554	0.110
1 1/2 -11 1/2	1.8447	0.005	0.6809	0.5974	0.6229	0.5394	0.7389	0.6554	0.110
2 -11 1/2	2.3176	0.005	0.6969	0.6134	0.6389	0.5554	0.7549	0.6714	0.110
2 1/2 - 8 (3)	2.7096	0.007	1.0570	0.9730	0.9737	0.8897	1.1403	1.0563	0.140
3 - 8 (3)	3.4117	0.007	1.1410	1.0570	1.0577	0.9737	1.2243	1.1403	0.140

NOTES:
(1) On sizes 1/16 and 1/8, the MX_T and MN dimensions are shown out of relationship on the illustration of step development.
(2) The dimensions given for steps at minimum thread and maximum thread are based on 2/3 turn (0.6667p) from basic thread. Actual truncation of the product thread may be slightly less than or slightly more than the tabulated truncation limit (ANSI B1.20.3) depending upon the variance from mean size in any given range (minimum range — basic range — maximum range). Formulas are shown in Appendix C.
(3) Gages are sizes 2 1/2 and 3 to fit standard trilock handle.

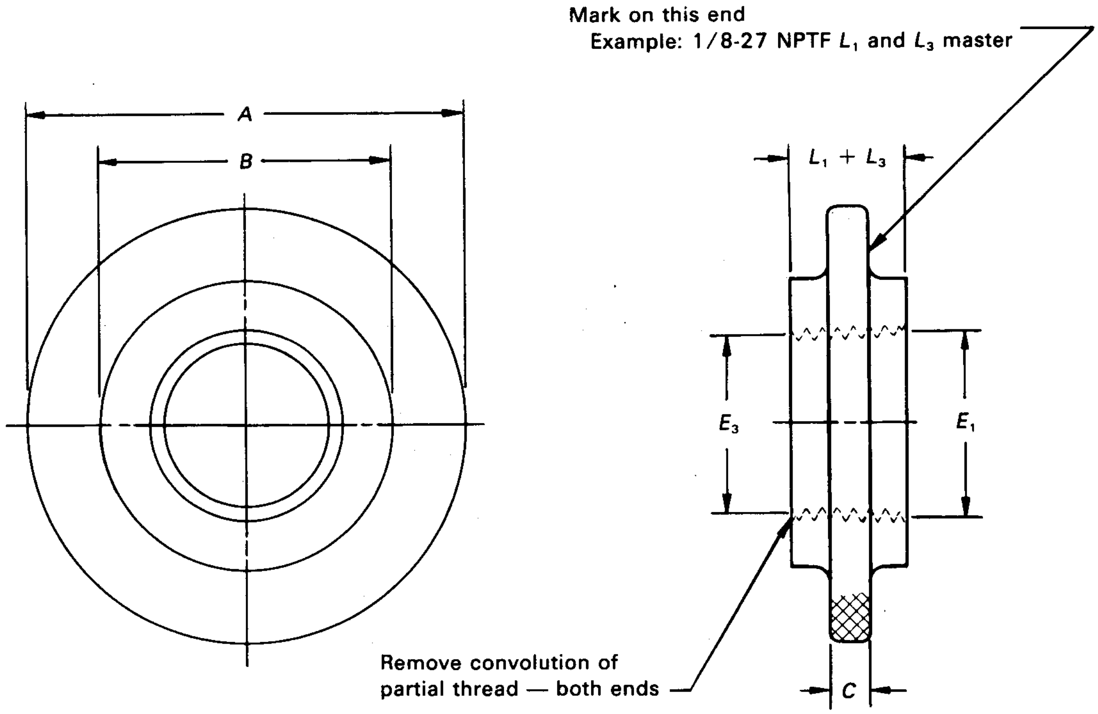


TABLE 20 BASIC DIMENSIONS OF MASTER RING GAGES FOR L_1 AND L_3 TAPER PLUG GAGES

Nominal Size	Basic Length, ($L_1 + L_3$)	Large End Pitch Diam., E_1	Large End Minor Diam. [Note (1)]	Small End Pitch Diam., E_3	Small End Minor Diam. [Note (1)]	A ±0.03	B ±0.03	C ±0.03
1/16–27	0.2711	0.28118	0.25651	0.26420	0.23953	1.00	0.62	0.11
1/8 –27	0.2726	0.37360	0.34893	0.35660	0.33193	1.12	0.69	0.12
1/4 –18	0.3945	0.49163	0.45463	0.46700	0.43000	1.31	0.84	0.14
3/8 –18	0.4067	0.62701	0.59001	0.60160	0.56460	1.50	1.00	0.14
1/2 –14	0.5343	0.77843	0.73086	0.74510	0.69753	1.69	1.19	0.19
3/4 –14	0.5533	0.98887	0.94129	0.95430	0.90672	1.94	1.44	0.20
1 –11 1/2	0.6609	1.23863	1.18072	1.19730	1.13939	2.31	1.69	0.27
1 1/4 –11 1/2	0.6809	1.58338	1.52547	1.54080	1.48289	2.75	2.06	0.28
1 1/2 –11 1/2	0.6809	1.82234	1.76442	1.77980	1.72188	3.06	2.25	0.28
2 –11 1/2	0.6969	2.29627	2.23836	2.25270	2.19479	3.62	2.75	0.30
2 1/2 – 8	1.0570	2.76216	2.67891	2.69610	2.61285	4.25	3.38	0.50
3 – 8	1.1410	3.38850	3.30525	3.31720	3.23395	5.00	4.00	0.56

NOTE:
(1) Minor diameter of master ring gages based on truncation of $0.1p$ to clear maximum crest truncation of product thread (flank wear plane on working plug gage).

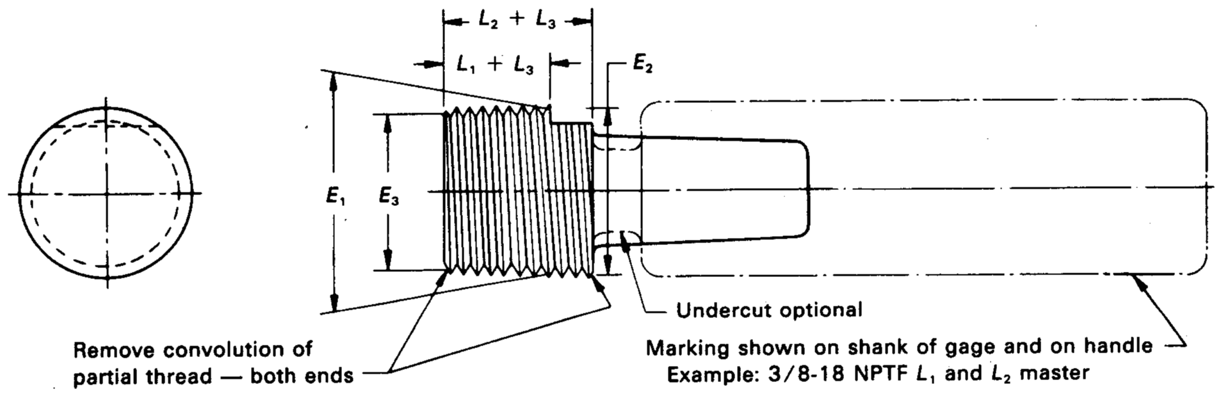


TABLE 21 BASIC DIMENSIONS OF MASTER PLUG GAGES FOR L_1 AND L_2 TAPER RING GAGES

Nominal Size	$(L_1 + L_3)$	$(L_2 + L_3)$	Small End		Gaging Notch		Large End	
			Pitch Diam., E_3	Major Diam. [Note (1)]	Pitch Diam., E_1	Major Diam. [Note (1)]	Pitch Diam., E_2	Major Diam.
1/16-27	0.2711	0.37225	0.2642	0.28887	0.28118	0.30585	0.28750	0.31217
1/8 -27	0.2726	0.37497	0.3566	0.38127	0.37360	0.39827	0.38000	0.40467
1/4 -18	0.3945	0.56846	0.4670	0.50400	0.49163	0.52863	0.50250	0.53950
3/8 -18	0.4067	0.57446	0.6016	0.63860	0.62701	0.66402	0.63750	0.67450
1/2 -14	0.5343	0.74800	0.7451	0.79267	0.77843	0.82600	0.79179	0.83936
3/4 -14	0.5533	0.76000	0.9543	1.00187	0.98887	1.03644	1.00179	1.04936
1 -11 1/2	0.6609	0.94366	1.1973	1.25521	1.23863	1.29654	1.25630	1.31422
1 1/4 -11 1/2	0.6809	0.96766	1.5408	1.59871	1.58338	1.64129	1.60130	1.65922
1 1/2 -11 1/2	0.6809	0.98436	1.7798	1.83771	1.82234	1.88025	1.84130	1.89922
2 -11 1/2	0.6969	1.01740	2.2527	2.31061	2.29627	2.35418	2.31630	2.37422
2 1/2 - 8	1.0570	1.51250	2.6961	2.77935	2.76216	2.84541	2.79062	2.87388
3 - 8	1.1410	1.57500	3.3172	3.40045	3.38850	3.47175	3.41562	3.49888

NOTE:
(1) Major diameter of master plug gages based on truncation of 0.1p to clear maximum crest truncation of product thread (flank wear plane on working ring gages).

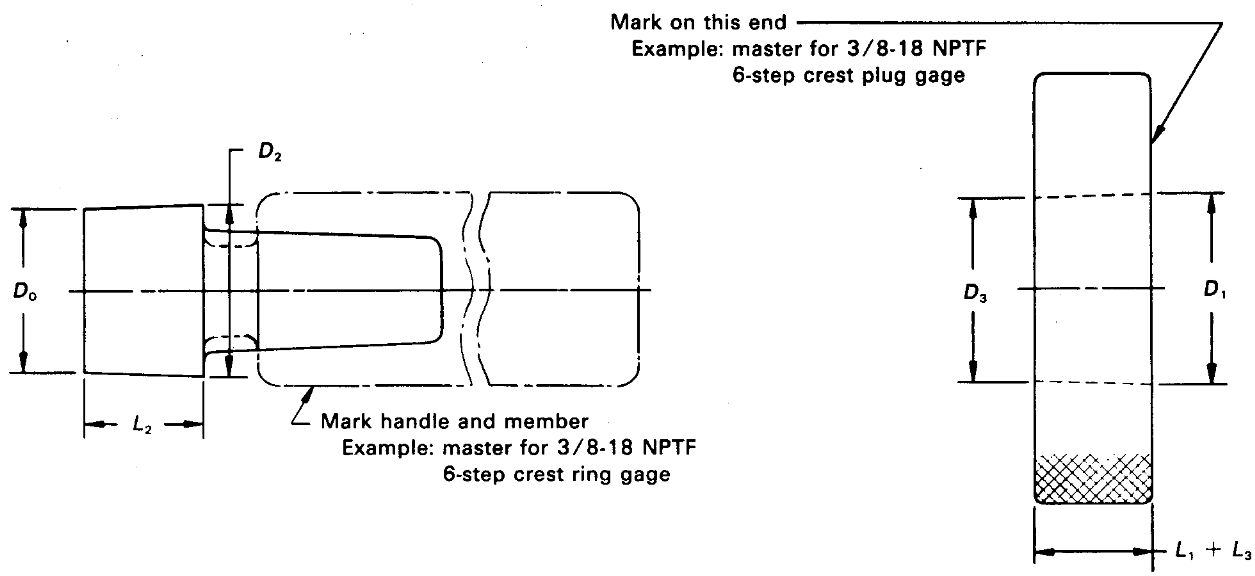


TABLE 22 BASIC DIMENSIONS OF MASTER GAGES FOR 6-STEP CREST RING AND 6-STEP CREST PLUG GAGES

Master Plug Gages for 6-Step Crest Ring Gages				Master Ring Gages for 6-Step Crest Plug Gages			
Nominal Size	Length L_2	Major Diam. at L_2, Basic Thread With Max. Truncation, D_2	Diam. at Small End of Plug Gage, D_0	Nominal Size	Length $(L_1 + L_3)$	Minor Diam. at L_3, Basic Thread With Max. Truncation, D_3	Diam. at Large End of Ring Gage, D_1
	±0.001	±0.00005	Ref.		±0.001	±0.00005	Ref.
1/16–27	0.2611	0.3126	0.2963	1/16–27	0.2711	0.2391	0.2560
1/8 –27	0.2639	0.4051	0.3886	1/8 –27	0.2726	0.3315	0.3485
1/4 –18	0.4018	0.5419	0.5168	1/4 –18	0.3945	0.4276	0.4523
3/8 –18	0.4078	0.6769	0.6514	3/8 –18	0.4067	0.5622	0.5876
1/2 –14	0.5337	0.8451	0.8117	1/2 –14	0.5343	0.6918	0.7252
3/4 –14	0.5457	1.0551	1.0210	3/4 –14	0.5533	0.9010	0.9356
1 –11 1/2	0.6828	1.3212	1.2785	1 –11 1/2	0.6609	1.1324	1.1737
1 1/4 –11 1/2	0.7068	1.6662	1.6220	1 1/4 –11 1/2	0.6809	1.4759	1.5185
1 1/2 –11 1/2	0.7235	1.9062	1.8610	1 1/2 –11 1/2	0.6809	1.7149	1.7575
2 –11 1/2	0.7565	2.3812	2.3339	2 –11 1/2	0.6969	2.1878	2.2314
2 1/2 – 8	1.1375	2.8851	2.8140	2 1/2 – 8	1.0570	2.6016	2.6677
3 – 8	1.2000	3.5101	3.4351	3 – 8	1.1410	3.2227	3.2940

GENERAL NOTES:
(a) Tolerance on taper on master plug gages over basic length (L_2) is minus 0.00015 and tolerance on taper on master ring gages over basic length ($L_1 + L_3$) is plus 0.00015.
(b) Master plugs and master rings on this tabulation do not mate one to the other and each must be calibrated and certified separately by gage manufacturer or qualified metrology laboratory.
(c) Standoff of master plug gage to working 6-step crest ring gage will be flush to +0.004 at the B_T step.
(d) Standoff of master ring gage to working 6-step crest plug gage will be flush to −0.004 at the B_T step.

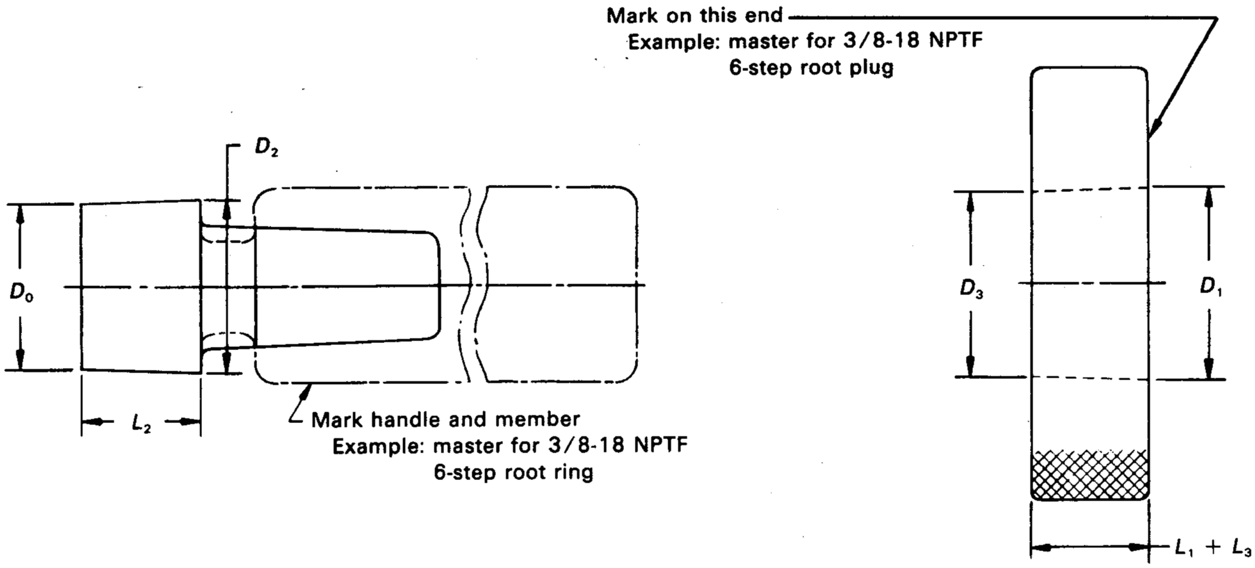


TABLE 23 BASIC DIMENSIONS OF MASTER GAGES FOR 6-STEP ROOT RING GAGES AND 6-STEP ROOT PLUG GAGES

Master Plug Gages for 6-Step Root Ring Gages				Master Ring Gages for 6-Step Root Plug Gages			
Nominal Size	Length L_2	Minor Diam. at L_2 Plane, External. Basic Thread With Min. Truncation, D_2	Diam. at Small End of Plug Gage, D_0	Nominal Size	Length $(L_1 + L_3)$	Major Diam. at $L_1 + L_3$ Plane, Internal. Basic Thread With Min. Truncation, D_3	Diam. at Large End of Ring Gage, D_1
	±0.001	±0.00005	Ref.		±0.001	±0.00005	Ref.
1/16-27	0.2611	0.2624	0.2461	1/16-27	0.2711	0.2893	0.3062
1/8 -27	0.2639	0.3549	0.3384	1/8 -27	0.2726	0.3817	0.3987
1/4 -18	0.4018	0.4631	0.4380	1/4 -18	0.3945	0.5064	0.5311
3/8 -18	0.4078	0.5981	0.5726	3/8 -18	0.4067	0.6410	0.6664
1/2 -14	0.5337	0.7385	0.7051	1/2 -14	0.5343	0.7984	0.8318
3/4 -14	0.5457	0.9485	0.9144	3/4 -14	0.5533	1.0076	1.0422
1 -11 1/2	0.6828	1.1914	1.1487	1 -11 1/2	0.6609	1.2622	1.3035
1 1/4 -11 1/2	0.7068	1.5364	1.4922	1 1/4 -11 1/2	0.6809	1.6057	1.6483
1 1/2 -11 1/2	0.7235	1.7764	1.7312	1 1/2 -11 1/2	0.6809	1.8447	1.8873
2 -11 1/2	0.7565	2.2514	2.2041	2 -11 1/2	0.6969	2.3176	2.3612
2 1/2 - 8	1.1375	2.6961	2.6250	2 1/2 - 8	1.0570	2.7096	2.7757
3 - 8	1.2000	3.3211	3.2461	3 - 8	1.1410	3.4117	3.4830

GENERAL NOTES:
(a) Tolerance on taper on master plug gages over basic length (L_2) is minus 0.00015 and tolerance on taper on master ring gages over basic length ($L_1 + L_3$) is plus 0.00015.
(b) Master plugs and master rings on this tabulation do not mate one to the other and each must be calibrated and certified separately by gage manufacturer or qualified metrology laboratory.
(c) Standoff of master plug gage to working 6-step root ring gage will be flush to −0.004 at the B step.
(d) Standoff of master ring gage to working 6-step root plug gage will be flush to +0.004 at the B step.

APPENDIX A
3-STEP GAGES FOR CHECKING NPTF THREADS

(This Appendix is not part of ASME B1.20.5-1991 and is included for information purposes only.)

A1 WORKING GAGE DIMENSIONS

The basic dimensions given for reference in Tables A1 through A4 pertain to working gages. Three-step designs are covered for L_1 and L_2 ring gages and L_1 and L_3 plug gages.

A1.1 L_1 Ring Gage

See Table A1.

A1.2 L_2 Ring Gage

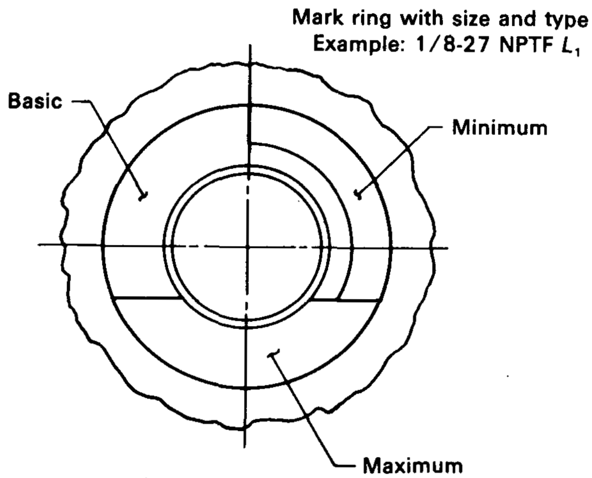
See Table A2.

A1.3 L_1 Plug Gage

See Table A3.

A1.4 L_3 Plug Gage

See Table A4.



Bottom (Small End)
View of Gage

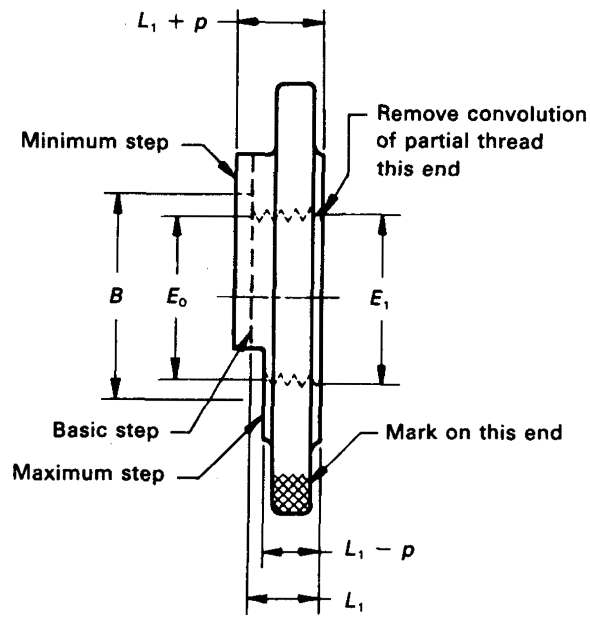


TABLE A1 BASIC DIMENSIONS FOR L_1 3-STEP RING GAGES

Nominal Size	Basic Gaging Step, L_1	Max. Gaging Step $(L_1 - p)$	Min. Gaging Step $(L_1 + p)$	Large End Pitch Diam., E_1	Large End Minor Diam. [Note (1)]	Small End Pitch Diam., E_0	Small End Minor Diam. [Note (1)]	Counterbore Diam. to L_1 Plane, B
1/16-27	0.1600	0.12296	0.19704	0.28118	0.25947	0.27118	0.24947	0.38
1/8 -27	0.1615	0.12446	0.19854	0.37360	0.35189	0.36351	0.34180	0.47
1/4 -18	0.2278	0.17224	0.28336	0.49163	0.45563	0.47739	0.44139	0.59
3/8 -18	0.2400	0.18444	0.29556	0.62701	0.59101	0.61201	0.57601	0.72
1/2 -14	0.3200	0.24857	0.39143	0.77843	0.72871	0.75843	0.70871	0.88
3/4 -14	0.3390	0.26757	0.41043	0.98887	0.93915	0.96768	0.91796	1.09
1 -11 1/2	0.4000	0.31304	0.48696	1.23863	1.17897	1.21363	1.15397	1.34
1 1/4 -11 1/2	0.4200	0.33304	0.50696	1.58338	1.52372	1.55713	1.49747	1.69
1 1/2 -11 1/2	0.4200	0.33304	0.50696	1.82234	1.76268	1.79609	1.73643	1.94
2 -11 1/2	0.4360	0.34904	0.52296	2.29627	2.23661	2.26902	2.20936	2.50
2 1/2 - 8	0.6820	0.55700	0.80700	2.76216	2.67291	2.71953	2.63028	2.94
3 - 8	0.7660	0.64100	0.89100	3.38850	3.29925	3.34062	3.25137	3.56

GENERAL NOTES:
(a) Gage blanks shall conform to dimensions given in ANSI B47.1 except for extra width of 3-step design.
(b) Use of gages having minor diameters based on crest truncations equal to $0.20p$ to $0.25p$ is not prohibited, but such gages should be replaced by gages having specified minor diameters as soon as practicable.

NOTE:
(1) Minor diameter is based on crest minimum truncation equal to maximum root truncation of product thread. (See ANSI B1.20.3)

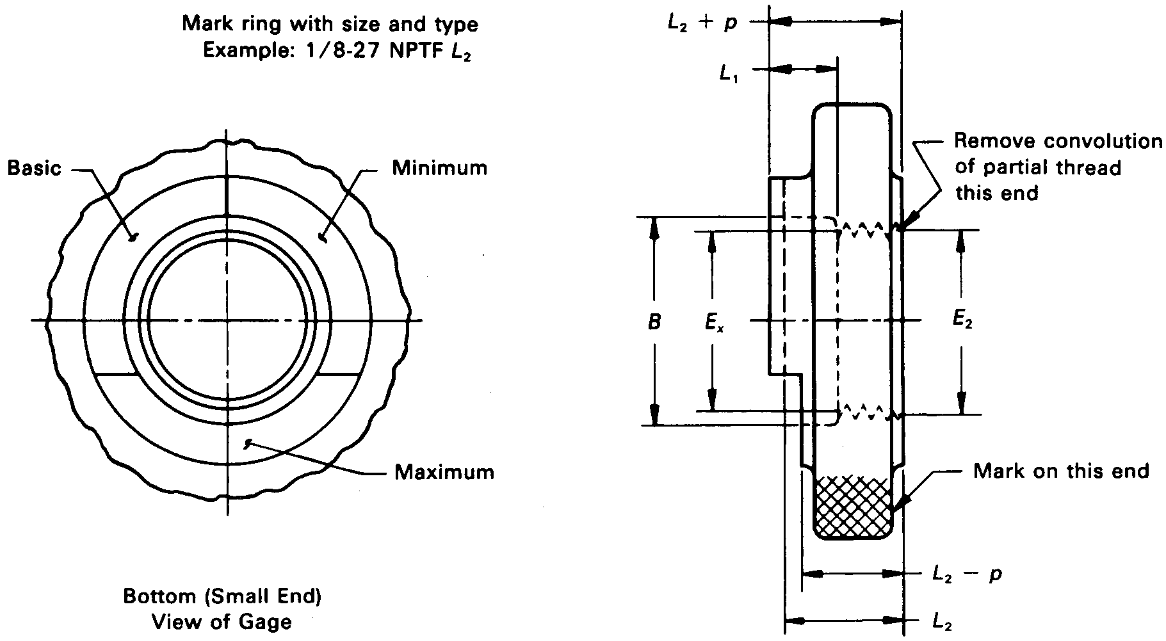


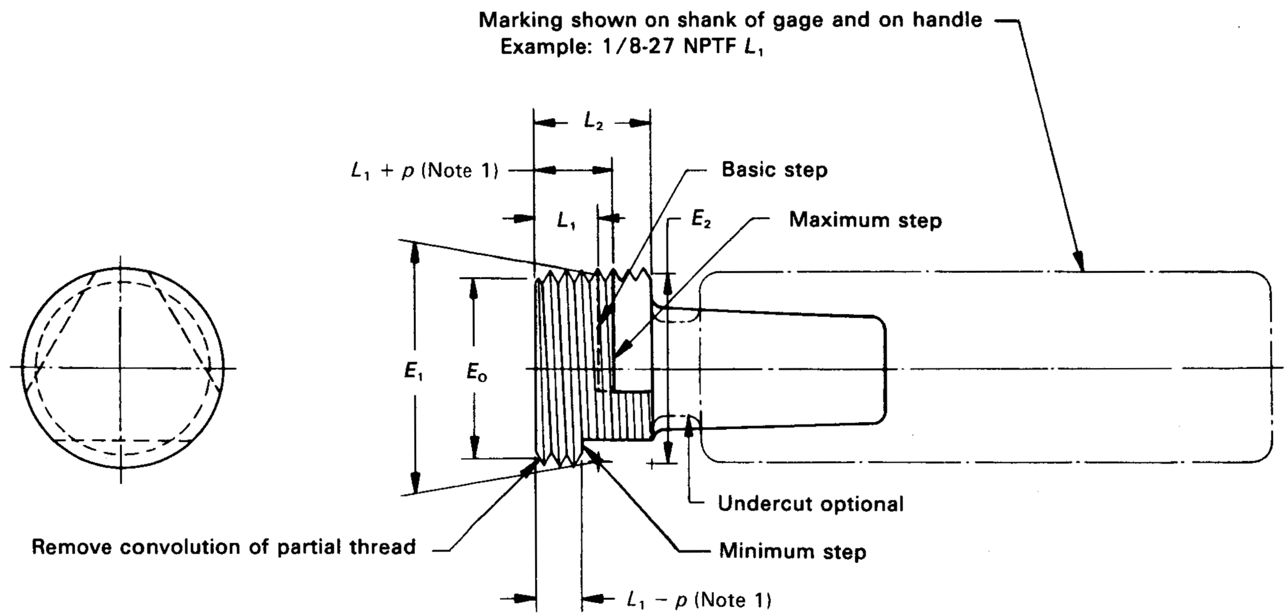
TABLE A2 BASIC DIMENSIONS FOR L_2 3-STEP RING GAGES

Nominal Size	Basic Gaging Step, L_2	Max. Gaging Step $(L_2 - p)$	Min. Gaging Step $(L_2 + p)$	Large End Pitch Diam., E_2	Large End Minor Diam. [Note (1)]	Small End Pitch Diam., E_x	Small End Minor Diam. [Note (1)]	(L_1)	Counterbore Diam., B
1/16-27	0.26113	0.22409	0.29817	0.28750	0.27024	0.27886	0.26160	0.1600	0.38
1/8 -27	0.26385	0.22681	0.30089	0.38000	0.36274	0.37129	0.35403	0.1615	0.47
1/4 -18	0.40178	0.34622	0.45734	0.50250	0.47661	0.48816	0.46227	0.2278	0.59
3/8 -18	0.40778	0.35222	0.46334	0.63750	0.61161	0.62354	0.59765	0.2400	0.72
1/2 -14	0.53371	0.46228	0.60514	0.79179	0.75850	0.77396	0.74067	0.3200	0.88
3/4 -14	0.54571	0.47428	0.61714	1.00179	0.96850	0.98440	0.95111	0.3390	1.09
1 -11 1/2	0.68278	0.59582	0.76974	1.25630	1.21577	1.23320	1.19267	0.4000	1.34
1 1/4 -11 1/2	0.70678	0.61982	0.79374	1.60130	1.56077	1.57794	1.53741	0.4200	1.69
1 1/2 -11 1/2	0.72348	0.63652	0.81044	1.84130	1.80077	1.81690	1.77637	0.4200	1.94
2 -11 1/2	0.75652	0.66956	0.84348	2.31630	2.27577	2.29084	2.25031	0.4360	2.50
2 1/2 - 8	1.13750	1.01250	1.26250	2.79062	2.73237	2.75434	2.89609	0.6820	2.94
3 - 8	1.20000	1.07500	1.32500	3.41562	3.35737	3.38068	3.32243	0.7660	3.56

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1 except for extra width of 3-step design.

NOTE:
(1) Minor diameter is based on crest minimum truncation of 0.20p.

TABLE A3



Marking shown on shank of gage and on handle
Example: 1/8-27 NPTF L_1
L_2
$L_1 + p$ (Note 1)
L_1
Basic step
E_2
Maximum step
E_1
E_o
Remove convolution of partial thread
Undercut optional
Minimum step
$L_1 - p$ (Note 1)

TABLE A3 BASIC DIMENSIONS FOR L_1 3-STEP PLUG GAGES, NPTF

Nominal Size	L_1	L_2	Small End		Min. Pitch Diam. Gaging Step		Max. Pitch Diam. Gaging Step		Basic Step		Large End	
			Pitch Diam., E_0	Major Diam. [Note (2)]	$(L_1 - p)$	Pitch Diam.	$(L_1 + p)$	Pitch Diam.	Pitch Diam., E_1	Major Diam. [Note (2)]	Pitch Diam. E_2	Major Diam. [Note (2)]
1/16–27	0.1600	0.26113	0.27118	0.29289	0.12296	0.27886	0.19704	0.28350	0.28118	0.30289	0.28750	0.30921
1/8 –27	0.1615	0.26385	0.36351	0.38522	0.12446	0.37129	0.19854	0.37592	0.37360	0.39531	0.38000	0.40171
1/4 –18	0.2278	0.40178	0.47739	0.51339	0.17224	0.48816	0.28336	0.49510	0.49163	0.52763	0.50250	0.53850
3/8 –18	0.2400	0.40778	0.61201	0.64801	0.18444	0.62354	0.29556	0.63048	0.62701	0.66301	0.63750	0.67350
1/2 –14	0.3200	0.53371	0.75843	0.80815	0.24857	0.77397	0.39143	0.78289	0.77843	0.82815	0.79179	0.84151
3/4 –14	0.3390	0.54571	0.96768	1.01740	0.26757	0.98441	0.41043	0.99333	0.98887	1.03859	1.00179	1.05151
1 –11 1/2	0.4000	0.68278	1.21363	1.27329	0.31304	1.23320	0.48696	1.24406	1.23863	1.29829	1.25630	1.31596
1 1/4 –11 1/2	0.4200	0.70678	1.55713	1.61679	0.33304	1.57795	0.50696	1.58882	1.58338	1.64304	1.60130	1.66096
1 1/2 –11 1/2	0.4200	0.72348	1.79609	1.85575	0.33304	1.81691	0.50696	1.82778	1.82234	1.88200	1.84130	1.90096
2 –11 1/2	0.4360	0.75652	2.26902	2.32868	0.34904	2.29084	0.52296	2.30170	1.29627	1.35593	2.31630	2.37596
2 1/2 – 8	0.6820	1.13750	2.71953	2.80878	0.55700	2.75435	0.80700	2.76997	2.76216	2.85141	2.79062	2.87987
3 – 8	0.7660	1.20000	3.34062	3.42987	0.64100	3.38069	0.89100	3.39631	3.38850	3.47775	3.41562	3.50487

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1.

NOTES:
(1) Maximum and minimum pitch diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.
(2) Major diameter is based on crest minimum truncation equal to maximum root truncation of product thread. (See ANSI B1.20.3)

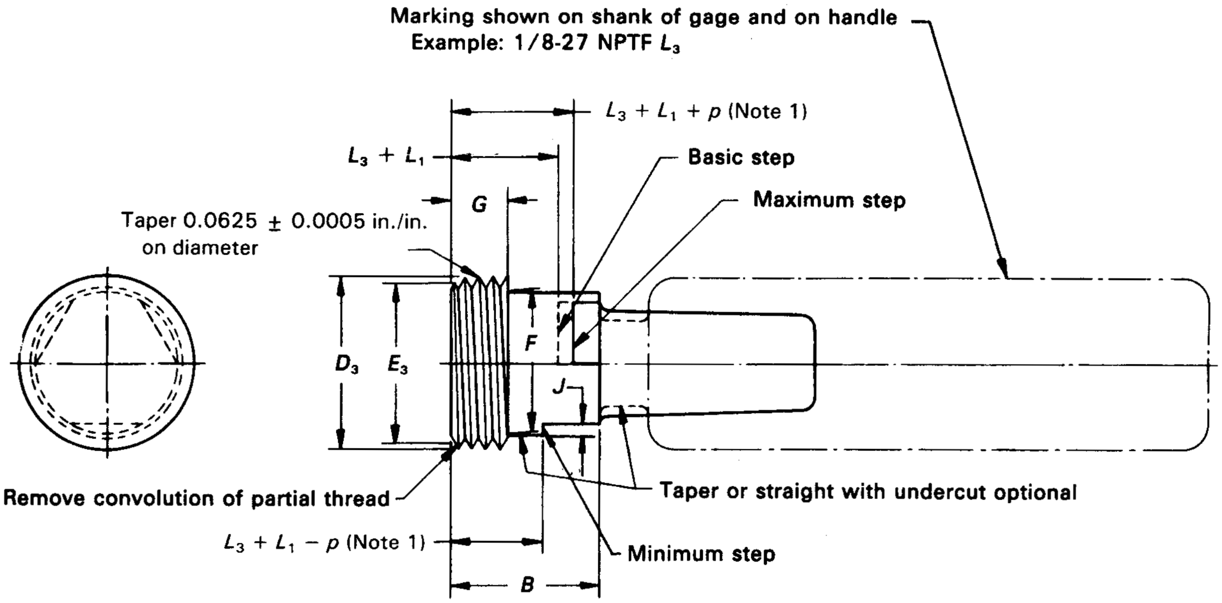


TABLE A4 BASIC DIMENSIONS FOR L_3 3-STEP PLUG GAGES

Nominal Size	Small End Pitch Diam., E_3	Small End Major Diam., D_3 [Note (3)]	Relief Diam., F [Note (2)] +0.005 −0.000	Four Threads ($L_3 + p$), G	Min. Pitch Diam. Gaging Step + 3 Threads ($L_3 + L_1 - p$)	Min. Pitch Diam. Gaging Step + 3 Threads ($L_3 + L_1 + p$)	Blank Length, B	Notch Depth, J +0.005 −0.000
1/16–27	0.2642	0.2815	0.216	0.1482	0.2341	0.3082	0.42	0.030
1/8 –27	0.3566	0.3738	0.309	0.1482	0.2356	0.3097	0.46	0.030
1/4 –18	0.4670	0.4928	0.409	0.2222	0.3389	0.4500	0.55	0.030
3/8 –18	0.6016	0.6275	0.542	0.2222	0.3511	0.4622	0.62	0.030
1/2 –14	0.7451	0.7783	0.676	0.2857	0.4628	0.6057	0.74	0.040
3/4 –14	0.9543	0.9876	0.886	0.2857	0.4818	0.6247	0.78	0.040
1 –11 1/2	1.1973	1.2379	1.118	0.3478	0.5739	0.7478	0.94	0.050
1 1/4 –11 1/2	1.5408	1.5814	1.462	0.3478	0.5939	0.7678	0.94	0.050
1 1/2 –11 1/2	1.7798	1.8203	1.701	0.3478	0.5939	0.7678	0.94	0.050
2 –11 1/2	2.2527	2.2932	2.174	0.3478	0.6099	0.7838	0.94	0.050
2 1/2 – 8	2.6961	2.7543	2.590	0.5000	0.9320	1.1820	1.58	0.050
3 – 8	3.3172	3.3754	3.214	0.5000	1.0160	1.2660	1.58	0.050

GENERAL NOTE:
Gage blanks shall conform to dimensions given in ANSI B47.1.

NOTES:
(1) Maximum and minimum pitch diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.
(2) $F = [E_3 + (0.0625 \times 4p) -$ sharp V thread height $-$ 0.020 to 0.025 below sharp root]
(3) Major diameter is based on crest minimum truncation of $0.20p$.

APPENDIX B

MEASUREMENT OF PITCH DIAMETER OF TAPER THREADS HAVING AN INCLUDED TAPER OF 0.0625 INCH PER INCH

(This Appendix is not part of ASME B1.20.5-1991 and is included for information purposes only.)

B1 MEASUREMENT OF PITCH DIAMETER OF TAPER THREAD PLUG GAGE

B1.1 Measuring Position

The pitch diameter of a taper thread plug gage is measured in much the same manner as that of a straight thread gage, except that a definite position at which the measurement is to be made must be located. A point at a known distance, L, from the reference end of the gage is located by means of a combination of precision gage blocks and the cone point furnished as an accessory with these blocks, as shown in the inset in Fig. B1. The gage is set vertically on a surface plate, the cone point is placed with its axis horizontal at the desired height, and the plug is turned until the point fits accurately into the thread. The position of this point is marked carefully with a pencil or a bit of Prussian blue.

B1.2 Two-Wire Method

Assuming that the measurement is to be made with a horizontal comparator, the gage is set in the comparator with its axis vertical; that is, the line of measurement and the thread axis are perpendicular to each other. The measurement is made with two wires, as shown in Fig. B1, one of which is placed in the thread to make contact at the same axial section of the thread as was touched by the cone point. This wire is designated the fixed wire. The second wire is placed in the thread groove, on the opposite side of the gage, which is next above the fixed wire, and the measurement over the wires is made. The second wire is then placed in the thread groove next below the fixed wire, and a second measurement is made. The average of these two measurements is M_w, the measurement over the wires at the position of the fixed wire.

The general formula for a taper thread is

$$E = M_w + \frac{p(\cot\alpha - \tan^2\beta\tan\alpha)}{2} - w\,(1 + \operatorname{cosec}\alpha) + \frac{\tan^2\lambda\cos\alpha\cot\alpha}{2} \qquad (1)$$

where

E = pitch diameter
M_w = measurement over wires
β = half angle of taper of thread
p = pitch of thread
α = half angle of thread
w = mean diameter of wires
λ = lead angle

The term

$$\frac{p(\cot\alpha - \tan^2\beta\tan\alpha)}{2}$$

is the exact value of the depth of the fundamental triangle of a taper thread, which is less than that of the same pitch thread cut on a cylinder. For steep tapered thread gages, having an included taper larger than 0.0625 in./in. this more accurate term should be applied. For such a thread, which has a small lead angle, formula (1) takes the form

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

Otherwise, as for American National Standard taper pipe threads having an included taper of 0.0625 in./in. the simplified formula

$$E = M_w + 0.86603p - 3w \qquad (3)$$

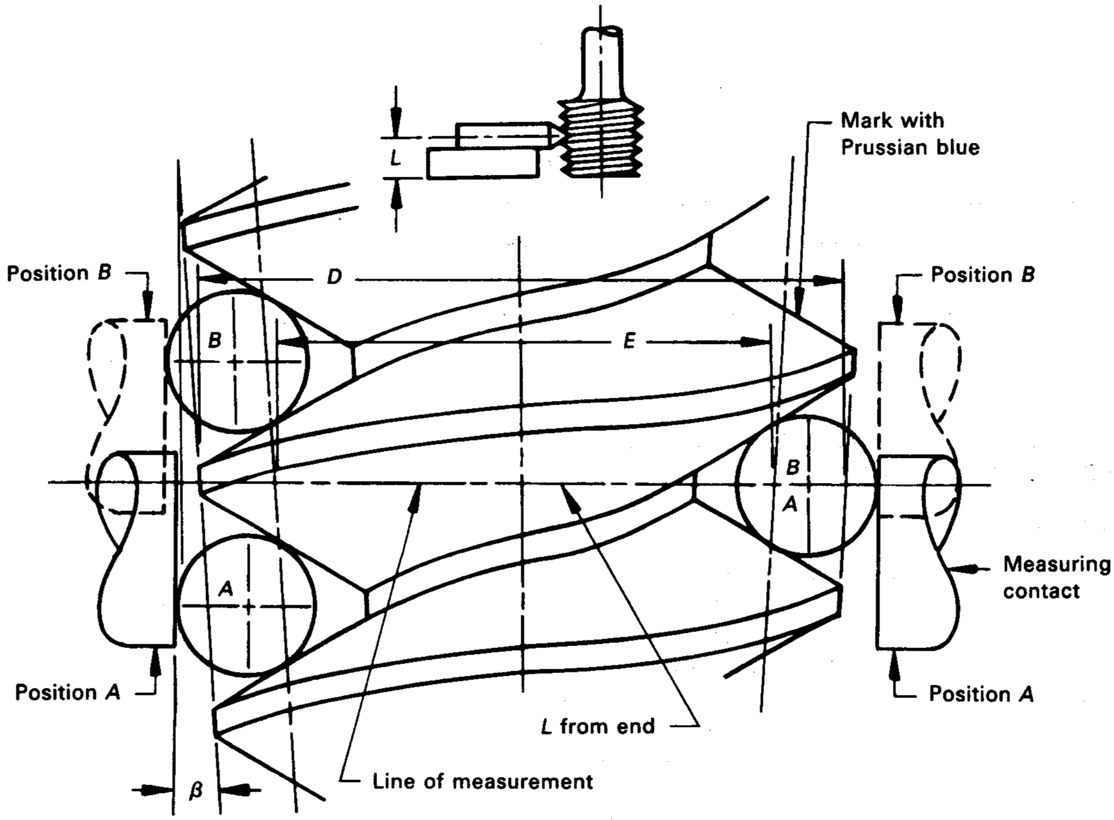


FIG. B1 MEASUREMENT OF PITCH DIAMETER OF TAPER THREAD GAGES BY THE 2-WIRE METHOD

for 60 deg. threads may be used. This simplified formula (3) gives a value of E that is 0.00005 in. larger than that given by the above general formula (1) for the 2 ½-8 American National Standard taper pipe thread, the worst case in this thread series.

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

B1.3 Three-Wire Methods

B1.3.1 Horizontal Measurement. It is sometimes convenient to use three wires when the plane at the small end of the gage is perpendicular to the thread axis. In such cases pitch diameter measurement is made in the usual horizontal manner, but care must be taken that the measuring contacts touch all three wires, as the line of measurement is not perpendicular to the axis of the screw when there is proper contact. Figure B2 shows the horizontal measuring method using a sine block to tilt the taper plug gage.

On account of this inclination, the measured distance between the axes of the wires must be multiplied by the secant of the half angle of the taper of the thread. The formula for the pitch diameter at the marked gage point of any taper thread plug gage, the threads of which are symmetrical with respect to a line perpendicular to the axis, then has the form:

$$E = (M_w - w) \sec \beta + \frac{p(\cot \alpha)}{2} - w \operatorname{cosec} \alpha \qquad (4)$$

in which β = half angle of taper of thread. Thus the pitch diameter of an American National Standard pipe

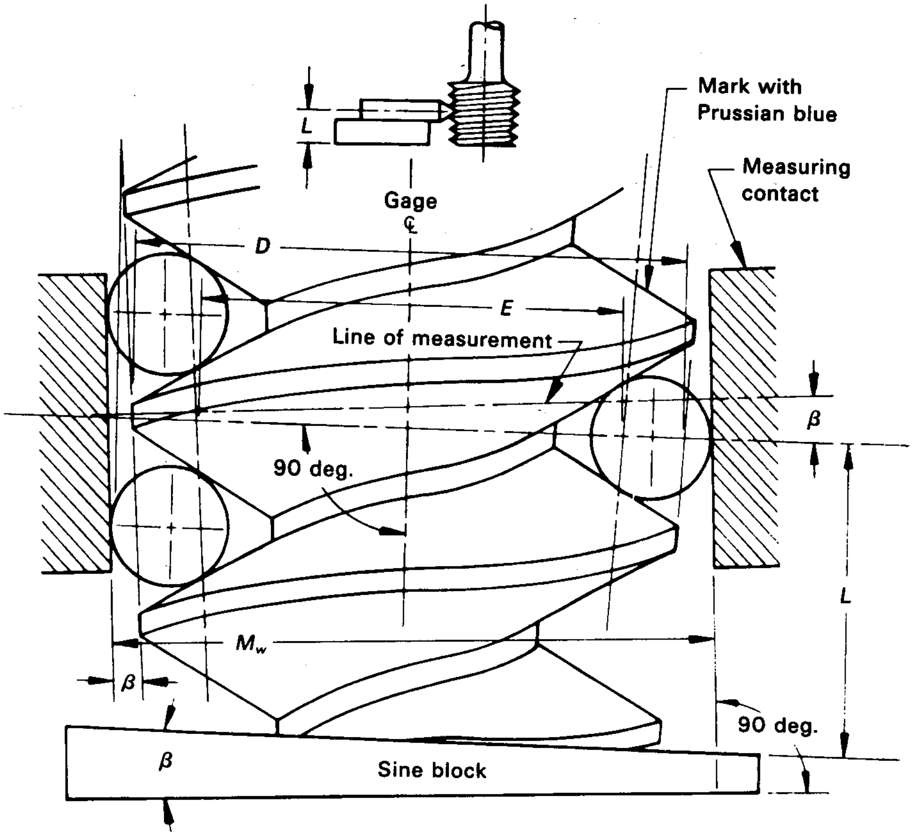


FIG. B2 HORIZONTAL MEASUREMENT OF PITCH DIAMETER OF TAPER THREAD GAGES BY THE 3-WIRE METHOD USING SINE BLOCK

taper thread gage having correct angle (60 deg.) and taper (0.0625 in./in.) is then given by the formula

$$E = 1.00049\,(M_w - w) + 0.86603\,p - 2w \qquad (5)$$

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

B1.3.2 Vertical Measurement. An adaptation of the three-wire method is frequently used to reduce the time required when the pitch diameter of a number of gages of the same size is to be measured. Gages as large as 3 in. nominal size can be measured by this method, see Fig. B3. The gage is supported on two wires placed several threads apart, which are in turn supported on a taper thread testing fixture. The third wire is placed in the threads at the top of the gage and measurement is made from the top of this wire to the bottom of the fixture with a vertical comparator having a flat anvil, using a gage block combination as the standard. The fixture consists of a block, the upper surface of which is at an angle to the base plane equal to the nominal angle of taper of the thread, 2β. Thus the element of the cone at the top of the thread gage is made parallel to the base of the instrument. The direction of measurement is not perpendicular to the axis of the gage but at an angle, β, from perpendicularity. A stop is provided at the thick

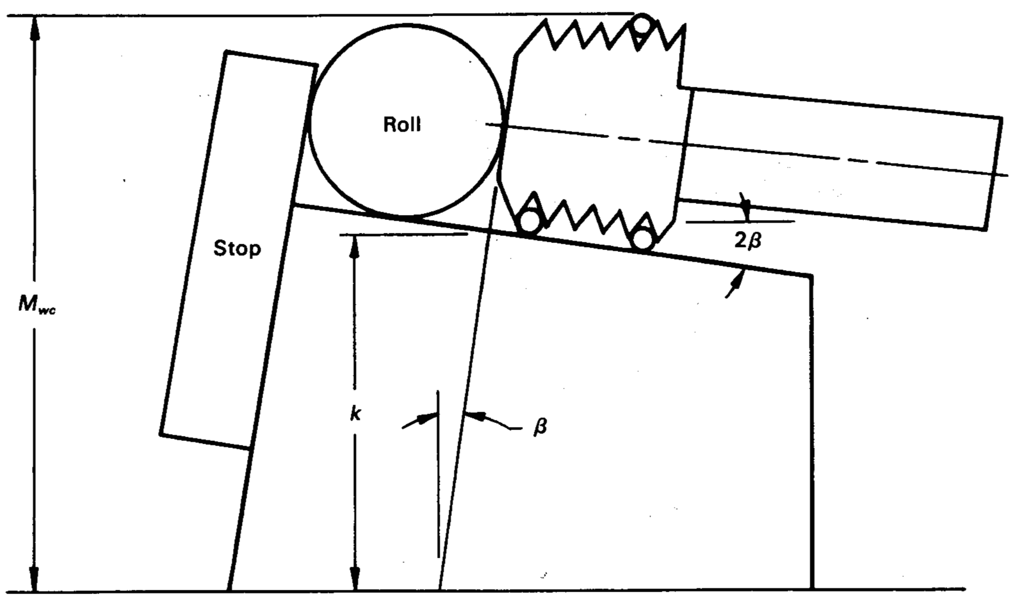


FIG. B3 VERTICAL MEASUREMENT OF PITCH DIAMETER OF TAPER GAGES BY THE 3-WIRE METHOD USING A SINE FIXTURE

end of the block with respect to which the gage is positioned on the fixture. As the plane of the end of the gage may not be perpendicular to the axis, a roll approximately equal to the diameter of the gage should be inserted between the stop and the gage to assure contact at the axis of the gage. For a given fixture and roll, a constant, k, is computed which, when subtracted from the measured distance M_{wc} from the top of the upper wire to the base plane gives M_w corresponding to the pitch diameter, E_o, at the small end of the gage.

$$M_w = M_{wc} - k$$

E_o is then determined by applying formula (4) or (5).

B1.4 Four-Wire Methods

B1.4.1 Measurement E_o at Small End of Gage. A four-wire method of measurement that yields measurements of the pitch diameter, E_o, at the small end of the gage, and the halfangle of taper, β is also sometimes used. This method is illustrated in Fig. B4 and requires four thread wires of equal diameter, a pair of gage blocks of equal thickness, and two pairs of rolls of different diameters, the rolls of each pair being equal in diameter. Two measurements, M_1 and M_2, are made over the rolls and formulas are applied as follows:

$$\cot \frac{90 \text{ deg.} - \beta}{2} = \frac{M_2 - M_1 + d_1 - d_2}{d_2 - d_1} \tag{6}$$

$$M_w = M_2 - d_2 \left(1 + \cot \frac{90 \text{ deg.} - \beta}{2}\right) - 2g \sec \beta \tag{7}$$

where

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

To determine E_o the pitch diameter at the small end of the gage, M_w, as determined from formula (7), is substituted in formula (1) or (2) or (3).

The errors of measurement by this method may be slightly, but not significantly, larger than by the other

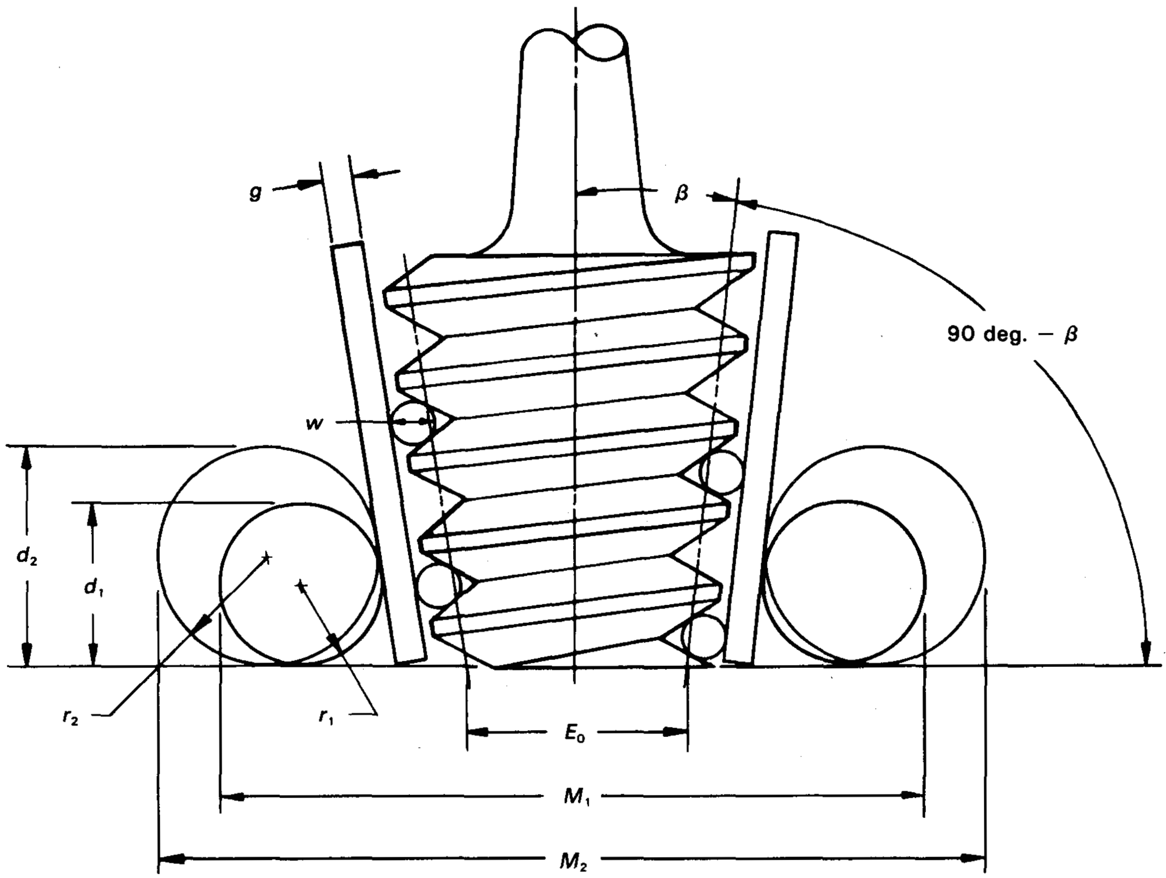


FIG. B4 MEASUREMENT OF PITCH DIAMETER E_o OF TAPER THREAD GAGES BY THE 4-WIRE METHOD

methods described, on account of elastic deformations of the rolls and gage blocks under the measuring force, and differing conditions of loading of the thread wires.

B1.4.2 Measurement *E* at the Marked Gage Point. A four-wire method of measurement that gives pitch diameter at the gage point is illustrated in Fig. B5. A pair of gage blocks are chosen to support the two rolls d_3 so that L is equal to the sum of the gage block stack and the radius of the roll. For a taper of 0.0625 in./in. the simple pitch diameter equation (3) becomes

$$E = M_3 + 0.86603p - 3w - d_3 - \frac{d_3}{\cos \beta} - 2g \sec \beta \quad (8)$$

when M_3 = measurement over rolls d_3.

B2 MEASUREMENT OF PITCH DIAMETER OF TAPER THREAD RING GAGE

B2.1 Common Method

The usual practice is to fit the ring gage to a threaded setting plug rather than measure the pitch diameter. When the thread ring gage is of correct lead, angle, and thread form, within close limits, this method is satisfactory. It is the only method available for small sizes of threads. For the larger sizes, a direct method of measurement of pitch diameter is made on an XYZ coordinate measuring machine.

B2.2 Ball Probe Method

The pitch diameter of taper thread ring gage may be determined by comparison with an external standard 60 deg. zero lead groove ground into a plain cylinder as

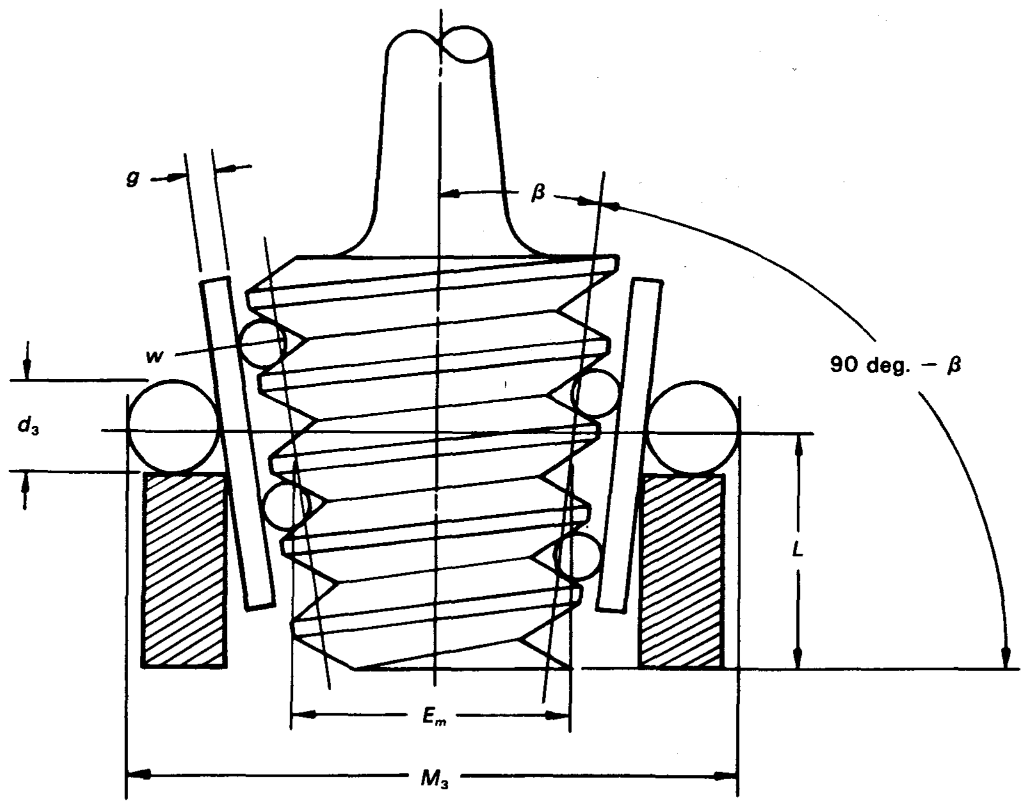


FIG. B5 MEASUREMENT OF PITCH DIAMETER E_m OF TAPER THREAD GAGES BY THE 4-WIRE METHOD

shown in Fig. B6. The groove standard is calibrated for a pitch diameter with the "best-size" pair of wires for the required pitch by the method used for external straight threads. A double-ended stylus with the ends radiused to match the "best-size" wire is used with a null indicator to obtain two readings (R_1 and R_3) on the standard and three readings (R_2, R_4', and R_4'') on the internal taper thread (See Fig. B6). The standard and the ring gage are mounted separately on the table on an XYZ coordinate measuring machine. From the five position readings the internal pitch diameter, E_m, is calculated:

$$E_m = X_1 + X_2 - E_{Std}\,. \qquad (9)$$

Where X_1 is the measured distance between left side of the 60 deg. groove standard and the right side of the thread, X_2 is the measured distance between the right side of the groove standard, and the average value of the left side of the corresponding internal threads and E_{Std} is the calibrated pitch diameter of the 60 deg. groove standard.

The pitch diameter at any other point along the thread is obtained by multiplying the distance parallel to the axis of the thread, between this point and the point at which the measurement was taken, by the taper per inch, then applying the product to E_m.

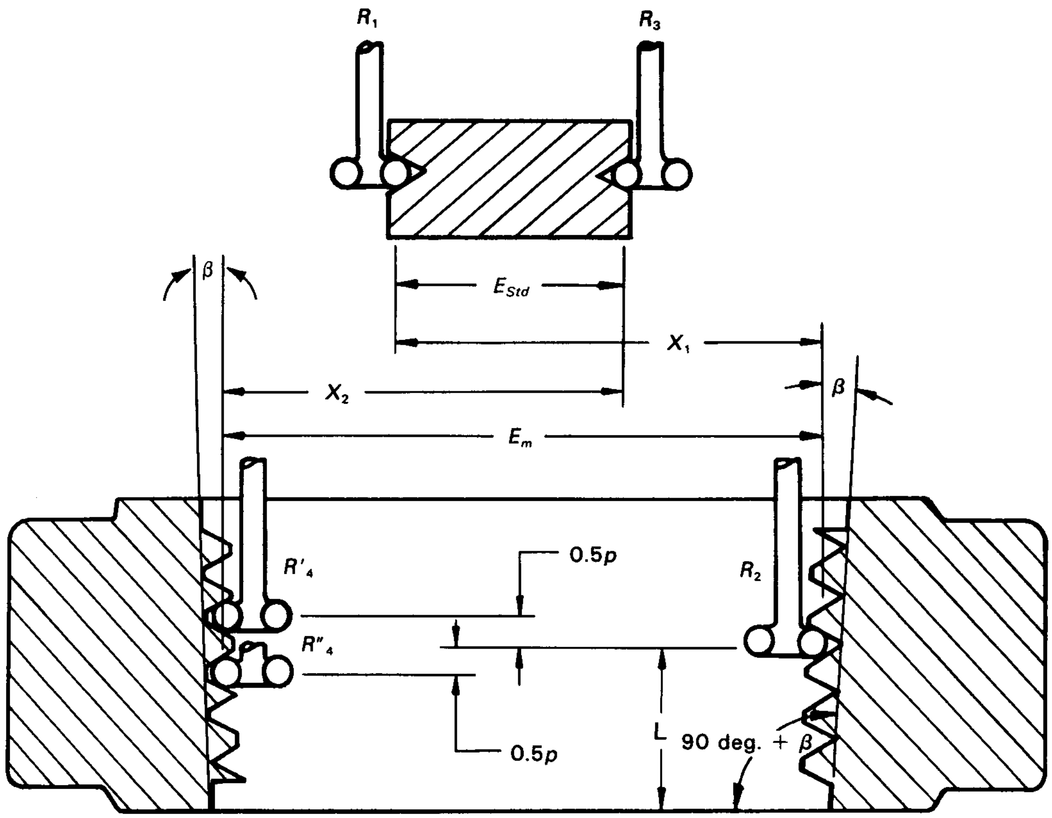


FIG. B6 MEASUREMENT OF PITCH DIAMETER OF TAPER THREAD RING GAGE ON COORDINATE MEASURING MACHINE WITH BALL PROBE

This page intentionally left blank.

APPENDIX C
FORMULAS FOR CALCULATING 6-STEP TAPER PLUG AND RING GAGE DIMENSIONS

(This Appendix is not part of ASME B1.20.5-1991 and is included for information purposes only.)

Dimension	Crest Check Ring Gage (Table 12)	Root Check Ring Gage (Table 13)	Crest Check Plug Gage (Table 20)	Root Check Plug Gage (Table 21)
D	$E_2 + H - 2T_{mx}$	$E_2 - H + 2T_{mn}$	$E_3 - H + 2T_{mx}$	$E_3 + H - 2T_{mn}$
B	$L_2 - 32T_{mc}$	L_2	$(L_1 + L_3) - 32T_{mc}$	$L_1 + L_3$
B_T	L_2	$L_2 - 32T_{mr}$	$L_1 + L_3$	$(L_1 + L_3) - 32T_{mr}$
MN	$L_2 - 32T_{mc} + 0.6667p$	$L_2 + 0.6667p$	$(L_1 + L_3) - 32T_{mc} - 0.6667p$	$(L_1 + L_3) - 0.6667p$
MN_T	$L_2 + 0.6667p$	$L_2 - 32T_{mr} + 0.6667p$	$(L_1 + L_3) - 0.6667p$	$(L_1 + L_3) - 32T_{mr} - 0.6667p$
MX	$L_2 - 32T_{mc} - 0.6667p$	$L_2 - 0.6667p$	$(L_1 - L_3) - 32T_{mc} + 0.6667p$	$(L_1 + L_3) + 0.6667p$
MX_T	$L_2 - 0.6667p$	$L_2 - 32T_{mr} - 0.6667p$	$(L_1 - L_3) + 0.6667p$	$(L_1 + L_3) - 32T_{mr} + 0.6667p$

H = height of sharp V thread
T_{mx} = maximum crest truncation
T_{mn} = minimum root truncation
T_{mc} = difference between maximum and minimum crest truncations
T_{mr} = difference between maximum and minimum root truncations.

Other symbols are as defined for NPTF threads in ANSI B1.20.3.

EXAMPLE: Calculate MN for ½-14 nominal size for Table 19 using values shown in ANSI B1.20.3.

$$L_1 + L_3 = 0.5341$$

$$p = 0.07143$$

$$T_{mc} = 0.060p - 0.036p = 0.024p = 0.00171432$$

$$32T_{mc} = 0.05486$$

$$0.6667p = 0.0476$$

$$MN = 0.5343 - 0.05486 - 0.0476 = 0.43184$$

This page intentionally left blank.

APPENDIX D
THE TURNS ENGAGEMENT METHOD OF GAGING PRODUCT THREADS

(This Appendix is not part of ASME B1.20.5-1991 and is included for information purposes only.)

D1 GAGES

The turns engagement method can be used with either 4 step, 3 step, or basic step design gages. L_1 and L_1-short length gages can be used interchangeably, since the pitch diameter size at the small end of the gage is the same in both cases and the step location is not used.

D2 METHOD OF GAGING

For the turns engagement method of gaging, the turns to remove the L_1 gage from the product thread are counted and must be within the maximum and minimum limits obtained using Table 1 and Table D1 for the specific type and size of thread to be gaged. The difference between the turns engagement of the L_1 versus L_2 ring or L_1 versus L_3 plug gage shall not exceed the difference per Table D1 by more than one-half turn.

TABLE D1 BASIC TURNS ENGAGEMENT

Nominal Size	L_1 or L_1 Short Ring	L_2 or L_2 Short Ring	L_1 or L_1 Short Plug	L_3 or L_3 Short Plug
1/16-27	3.32	5.80	3.82	6.57
1/8 -27	3.36	5.87	3.86	6.61
1/4 -18	3.10	5.98	3.60	6.35
3/8 -18	3.32	6.09	3.82	6.57
1/2 -14	3.48	6.22	3.98	6.73
3/4 -14	3.75	6.39	4.25	7.00
1 -11 1/2	3.60	6.60	4.10	6.85
1 1/4 -11 1/2	3.83	6.88	4.33	7.08
1 1/2 -11 1/2	3.83	7.07	4.33	7.08
2 -11 1/2	4.01	7.45	4.51	7.26
2 1/2 - 8	4.46	7.85	4.96	7.71
3 - 8	5.13	8.35	5.63	8.38

GENERAL NOTE:
The turns engagement shown are theoretical. In practical application the nearest 1/4 turn is usually used.

ISBN #0-7918-2084-X

N09290